FINAL

Work Plan
Remedial Investigation IR Sites 34b and 34d
Naval Weapons Station Seal Beach Detachment Fallbrook
Fallbrook, California

May 2015

Prepared for:

Naval Facilities Engineering Command Southwest

1220 Pacific Highway
San Diego, CA 92132-5190

Prepared by:

CB&I Federal Services

Prepared under:

Contract Number: N62473-10-D-4009
Task Order Number: 0096
DCN: CBI-4009-0096-2146

In Coordination with:

Trevet
9888 Carroll Centre Road, Suite 228
San Diego, California 92126

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Acronyms and Abbreviations

AOC	area of concern
AUF	area use factor
BERA	baseline ecological risk assessment
bgs	below ground surface
CAGC	Coastal California gnatcatcher
CFS	CB&I Federal Services
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSEM	conceptual site exposure model
Det.	Detachment
DDS 2	Dunnage Disposal Site 2
DDS 4	Dunnage Disposal Site 4
DON	Department of the Navy
DOT	Department of Transportation
DTSC	California Department of Toxic Substances Control
EPC	exposure point concentration
ESL	ecological screening level
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IAS	initial assessment study
IDW	investigation-derived waste
IR	Installation Restoration Program
LANL	Los Alamos National Laboratory
LBV	Least Bell's vireo
LOAEL	Lowest Observed Adverse Effect Level
LOEC	Lowest Observed Adverse Effect Concentration
MC	munitions constituents
MCB	Marine Corps Base
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram

msl	mean sea level
NAD	Naval Ammunition Depot
NAVFAC SW	Naval Facilities Engineering Command Southwest
NAVWPNSTA	Naval Weapons Station
NEESA	Naval Energy and Environmental Support Activity
NOAEL	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
PA	Preliminary Assessment
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RWQCB	California Regional Water Quality Control Board, San Diego Region
SAP	sampling and analysis plan
SI	Site Inspection
SKR	Stephens kangaroo rat
SLERA	screening-level ecological risk assessment
SSHP	Site-specific Safety and Health Plan
SVOC	semivolatile organic compound
SWFC	Southwestern willow flycatcher
TCDD	tetrachloro-dibenzo-p-dioxin
TES	threatened or endangered species
TOC	total organic carbon
UCL	upper confidence limit
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

Section 1 Introduction

Trevet prepared this work plan to conduct a Remedial Investigation (RI) at Installation Restoration Program (IR) Site 34b and IR Site 34d, located at Naval Weapons Station (NAVWPNSTA) Seal Beach Detachment (Det.) Fallbrook, California (Figure 1). This work plan details the field, laboratory, risk analysis, and reporting efforts associated with the RI and includes a sampling and analysis plan (SAP) as Appendix A. A Biological Avoidance and Minimization Plan has been developed for the proposed RI fieldwork at IR Sites 34b and 34d and is included as Appendix B. The Human Health Risk Assessment (HHRA) Work Plan presented in Appendix C. The Screening Level Ecological Risk Assessment (SLERA) Work Plan is presented in Appendix D.

This work plan has been prepared on behalf of the United States Department of the Navy (DON), under Naval Facilities Engineering Command Southwest (NAVFAC SW) Contract Number N62473-10-D-4009, Task Order 0096. Trevet prepared this work plan under subcontract to CB&I Federal Services (CFS). The RI will be performed in accordance with the National Oil and Hazardous Substances Contingency Plan; Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA); U.S. Environmental Protection Agency (U.S. EPA) guidance; and Navy policy. Regulatory agencies, including the California Department of Toxic Substances Control (DTSC) and California Regional Water Quality Control Board, San Diego Region (RWQCB), will also provide oversight for the RI activities. CFS and Trevet will work together to perform the RI fieldwork and prepare the RI report.

1.1 Purpose

The purpose of this RI is to characterize the nature and extent of soil contamination at IR Sites 34b and 34d. Potential sediment and surface water contamination will also be characterized at IR Site 34d. These sites have been grouped together because of the sites' similar contaminants, histories, and position in the CERCLA response process. Soil impacts at these sites are thought to be associated with the deposition of dunnage and other debris on the ground surface or in shallow trenches. Dunnage includes generally low-value packing materials used for shipping products, presumably munitions at NAVWPNSTA Seal Beach Det. Fallbrook. The RI will characterize impacted soil (and sediment and surface water at IR Site 34d) to evaluate the extent of chemicals of potential concern (COPC) to human health and/or chemicals of potential ecological concern (COPEC) in the environment. The RI field investigation for IR Site 34d includes an offsite area adjacent east of IR Site 34d where debris was observed during the Site Inspection (SI) (ChaduxTt 2010). Based on the findings of the RI field investigation, the RI report will recommend either further action, such as additional characterization or a remedial response, or no further action.

1.2 IR Sites 34b and 34d Summary

IR Sites 34b and 34d were established to investigate soil impacts from disposal activities at Dunnage Disposal Site 2 (DDS 2) and Dunnage Disposal Site 4 (DDS 4), respectively, from 1942 until 1978. The Preliminary Assessment (PA) (Malcolm Pirnie 2006) evaluated the potential for munitions-related impacts to these two sites. Based on installation record reviews, visual surveys, and interviews, sites DDS 2 and DDS 4 were not used as munitions burial sites; therefore, the COPCs have been limited to chemical impacts from buried debris. The PA recommended no further action (NFA) for both sites under the munitions response program. (Malcolm Pirnie 2006). The following sections further summarize IR Sites 34b and 34d.

1.2.1 IR Site 34b – Dunnage Disposal Site 2

IR Site 34b is located in the north-central portion of NAVWPNSTA Seal Beach Det. Fallbrook (Figures 1 and 2), east of Walleye Road. It encompasses approximately 9 acres of northwest-facing hillside covered with native vegetation. Historical information documented in the PA (Malcolm Pirnie 2006) indicated that IR Site 34b was reportedly used as a disposal or burial area for dunnage and other debris from 1942 to 1978. The site is not developed and has no current land use other than open space. No manmade structures or evidence of previously existing structures were observed at the site during the SI (ChaduxTt 2010).

The SI report identified a shallow waste disposal trench in the central portion of the site as the primary area of concern (AOC) for IR Site 34b. This trench will be referred to as the "known disposal trench" in this work plan. The known disposal trench extended 480 feet in a northwesterly direction down slope from a nearby access road (Figure 2). The known disposal trench was estimated to be 3.5 feet wide and contained debris from the surface to a depth of 4 feet below the surface. The known disposal trench was partially filled with undocumented fill soil or slough from the trench walls, along with metal, wood, and glass debris. The debris consisted of weathered and deteriorated 2- to 5-gallon metal containers, metal banding, empty 55-gallon drums, glass bottles, cans, and other miscellaneous solid waste, some of which indicated that it had been burned. The known disposal trench was identified in a 1953 photograph along with two less conspicuous linear features identified located farther west, which were similar in appearance to the known disposal trench (Figure 2). The two additional linear surface disturbances were suspected to also be disposal trenches and were therefore included as AOCs for IR Site 34b (ChaduxTt 2010). A fourth potential disposal area east of the known disposal trench was also included as an AOC for IR Site 34b (Figure 2).

During a site visit after the May 2014 wildfires that burned IR Sites 34b and 34d, visual indications of disposal at the three potential disposal trenches were not observed. The fire cleared much of the vegetation at IR Site 34b and little dunnage and/or debris was visible outside of the known disposal trench. However, the three potential disposal trenches were included in

the geophysical investigation. Based on the results of the geophysical survey, as well visual assessment and a review of aerial photographs conducted in response to agency comments (Appendix E) the Navy and its Agency partners agreed that intrusive investigation at IR Site 34b may be focused on the single known disposal trench, and that the other locations evaluated do not require further investigation.

1.2.2 IR Site 34d – Dunnage Disposal Site 4

IR Site 34d is located in the central portion of NAVWPNSTA Seal Beach Det. Fallbrook, north of Ammunition Road and along the south side of Fallbrook Creek (Figures 1 and 3). The site encompasses 1.8 acres. Old asphalt paving associated with Maverick Road and improvements related to the former crossing over Fallbrook Creek are located in the northern portion of the site. Fallbrook Creek flows westward through the northern portion of the site (Figures 3 and 4). The site is vacant and has no current land use other than open space.

IR Site 34d was reportedly used as a disposal and possibly a burial area for dunnage and other debris. In addition to the possible disposal of dunnage, at least three former structures were known to have existed at the site: Buildings 341, 430, and 325 (Figure 3). In addition one former building (Building 338) was located adjacent to the site to the Southeast. The SI identified these former buildings as a former restroom, a former boiler house, and a former wooden ammunition magazine, respectively. Subsequent evaluation of historical maps for the area indicates that Building 325 was a testing facility for wet munitions, shown on a 1944 map as “Mark 8 Depth Charge Testing Bldg”. A review of aerial photographs (Appendix E) indicated that this building was completely removed sometime between 1953 and 1964. Building 338 has been identified as office space related to weapons testing (ChaduxTt 2010). Only the remnants of the concrete slab from Building 341 and the adjacent below grade three-stage concrete sump (Building 430) with an adjoining drainpipe currently remain on site. The drainpipe appears to discharge to a small dry ravine that leads to Fallbrook Creek. These building remnants are located within the western portion of IR Site 34d (Figure 3). No remnants of Building 325 are evident at the site.

During the SI field investigation, surficial and buried debris was observed near the slab remnants of former Building 341. Detector-aided visual surveys performed during the SI indicated metal debris, construction debris, and other debris within and adjacent (uphill to the east) to IR Site 34d. Debris observed at the site and adjacent to Fallbrook Creek included metal piping, asphalt, wood pallets, boards and burnt wood remains, plastic piping, aluminum canisters, and glass. Three magnetic anomalies were detected with a hand-held magnetic gradiometer along the location of the former access road that cuts through the site. Along with observed debris, several weathered small arms ammunition canisters and spent small caliber blank casings were observed on the south side of the creek. The canisters and casings are considered isolated debris and were not taken to indicate the presence of munitions and explosives of concern (MEC) or munitions constituents (MC) at the site (ChaduxTt 2010).

The SI identified the following areas that will be investigated further as AOCs in this RI for IR Site 34d:

- areas near the slab of former Building 341 and three-stage concrete sump (Building 430) and drainpipe to investigate the soil impacts from historical operations
- the areas near the wood debris and burnt wood located near borings IRP34D-SB01, IRP34D-SB04, and IRP34D-SB05 (Figure 3)
- several on site areas and the offsite area east of IR Site 34d and Fallbrook Creek to investigate potential buried debris.

1.3 Objectives

The objectives of the RI for IR Site 34b are to delineate the nature and extent of impacts from the known disposal trench identified during the SI (Figure 2). Soil impacts from buried debris will be characterized to evaluate if volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, PCBs, and/or dioxins/furans are present in soil at concentrations that may pose a risk to human health and/or the environment.

The objectives of the RI for IR Site 34d are to evaluate potential soil impacts near former Buildings 341 and 430, evaluate the extent of previously reported PAHs near SI boring IRP34D-SB01, and evaluate areas of potential dunnage debris disposal (Figure 3). Because no areas of dunnage or waste disposal were identified during the geophysical evaluation, the planned exploratory test pits and potholes at IR Site 34d will be used to evaluate parts of the sites where buried waste might exist, which were not detected by the geophysical survey. The characterization activities will evaluate whether dunnage debris or other buried waste is present, and whether VOCs, SVOCs, and metals are present in soil at concentrations that pose a risk to human health and/or the environment. A test pit will be placed near where burnt wood debris was previously reported during the SI near borings IRP34D-SB04 and IRP34D-SB05 to confirm the presence of a wooden retaining wall visually observed during the geophysical investigation field activities that is the likely source of the wood debris. Sediment and surface water samples will also be collected from Fallbrook Creek adjacent to the site to determine if VOCs, SVOCs, metals, and/or dioxins/furans are present at concentrations that may pose a risk to human health and/or the environment.

1.4 Scope of Work

The technical approach for this investigation is designed to collect soil samples to address the nature and extent of subsurface impacts identified during the SI for both IR Sites 34b and 34d. Additionally, the investigation at IR Site 34d includes sediment and surface water samples from Fallbrook Creek to address the nature and extent of potential impacts to this ephemeral stream, which have not been characterized previously. The data obtained during this RI will be collected

using methods and procedures that produce a level of quality appropriate for risk assessment and future site management decisions.

Preliminary field activities for the RI scope of work at IR Sites 34b and 34d include visual surveys to assess the potential for threatened or endangered species (TES) to occur, implementing avoidance measures during further field activities if TES are observed, clearance of brush and vegetation as necessary, and geophysical clearance of subsurface utilities. Other field support activities will include surveying and characterizing and managing investigation-derived waste (IDW).

Following these preliminary activities, six test pit excavations will be dug at IR Site 34b in areas containing possible dunnage/debris material. Soil samples will be collected from the test pits for laboratory analysis of VOCs, SVOCs, and metals, pesticides, PCBs, and dioxins/furans.

The field investigation at IR Site 34d will include several sampling activities. The existing concrete building slab and three-stage concrete sump associated with former Buildings 341 and 430 will be removed to allow soil sampling under these structures. Soil samples will be collected from underneath the concrete building slab, three-stage concrete sump, and drainpipe and will be submitted for laboratory analysis of VOCs, SVOCs, and metals. Borings will be advanced to laterally and vertically delineate VOCs, SVOCs, metals, and dioxins/furans in soil near the slab and near previous SI boring IRP34D-SB01, a boring that had reported elevated PAHs. A total of 22 exploratory test pits are planned to investigate potential dunnage burial areas at IR Site 34d and in the area east of IR Site 34d. Soil samples will be collected from the test pits for laboratory analysis of VOCs, SVOCs, metals, and dioxins/furans. Finally, sediment and surface water samples will be collected from Fallbrook Creek to evaluate potential impacts from site contaminants to the stream system. The samples will be analyzed for VOCs, SVOCs, and metals. Sediment samples will also be analyzed for dioxins/furans.

The work performed under this work plan will be overseen by a California-licensed professional geologist or engineer. Field work will begin following approval of the work plan by the DON and regulatory agencies and receipt of an authorization to proceed.

Following receipt of validated analytical data, an RI report will be prepared. The RI report will document the field work and will include an evaluation of the data collected during the RI and previous investigations. The risk discussion in the RI report will include the results of an HHRA and SLERA. The RI report will include conclusions based on the findings and risk analysis and will present recommendations for additional investigation, a Feasibility Study to evaluate remedial alternatives, or no further action, as appropriate.

1.5 Work Plan Organization

This work plan includes discussions of the site background, notification requirements, soil investigation procedures, waste management, reporting, and project management activities conducted for the project. The SAP is included as Appendix A. The work plan is organized as follows:

- Section 1.0 Introduction
- Section 2.0 Site Description
- Section 3.0 Field Sampling Plan
- Section 4.0 Risk Assessment Approach
- Section 5.0 Project Management Plan
- Section 6.0 References

Section 2 Site Description

Naval Ammunition Depot (NAD) Fallbrook was commissioned in February 1942. The depot's mission was to receive, store, and guard large quantities of explosives and ammunition and to distribute and deliver them as needed to other installations. NAD Fallbrook was put on caretaker status in 1947 but was reactivated in 1950 with the onset of the Korean War. In 1958, NAD Fallbrook was designated an annex of the Naval Ammunition and Net Depot, Seal Beach. In the 1960s, the primary duty of the Fallbrook annex was to support the Pacific Marine Forces. It also stored, tested, and maintained several types of missiles. As of October 1, 1997, the installation reported to the present NAVWPNSTA Seal Beach and it was designated as Det. Fallbrook. Functions at the installation currently include inspecting, maintaining, and recertifying air-launched missiles such as the Phoenix, Sidewinder, Maverick, and high-speed anti-radiation missiles. The installation has 190 magazines that store pyrotechnics, high explosives, fuses, detonators, and small arms. However, no active firing ranges are located within the installation (Malcolm Pirnie 2006).

The following subsections provide descriptions for IR Sites 34b and 34d at NAVWPNSTA Seal Beach Det. Fallbrook, present a summary of the geologic and hydrogeologic conditions, and summarize background and previous investigations at these sites.

2.1 Location

NAVWPNSTA Seal Beach Det. Fallbrook is approximately 53 miles north of San Diego, California, in northern San Diego County. It is approximately 9 miles inland from the Pacific Ocean and adjoins a portion of the eastern border of Marine Corps Base (MCB) Camp Pendleton. Elevations within the central part of the installation range from 300 to 840 feet above mean sea level (msl) and the topography is characterized by low hills and shallow west-flowing drainages. The exception is the deeply incised Santa Margarita River channel located along the northern boundary of the installation that has a base elevation between 160 and 300 feet msl. The installation occupies 8,852 acres and is secured by a chain-link fence. The location of the installation and IR Sites 34b and 34d are shown on Figure 1.

2.2 Geology and Hydrogeology

The following sections describe the regional and site-specific geologic and hydrogeologic conditions found at NAVWPNSTA Seal Beach Det. Fallbrook (ChaduxTt 2010).

2.2.1 Site Geology

NAVWPNSTA Seal Beach Det. Fallbrook is located in the western portion of the Peninsular Ranges geomorphic province. The province is dominated by igneous, volcanic, and metamorphic rocks. Granitic, volcanic, and metasedimentary bedrock underlie the coastal

portions of the province, which include NAVWPNSTA Seal Beach Det. Fallbrook. Weakly to strongly metamorphosed volcanic rocks are found locally within the central and, to a lesser extent, near the coastal areas of the province such as the San Onofre Mountains of MCB Camp Pendleton (ChaduxTt 2010). Figure 4 shows the surface geology near IR Sites 34b and 34d at NAVWPNSTA Seal Beach Det. Fallbrook.

2.2.1.1 IR Site 34b Geology

IR Site 34b is underlain by granitic bedrock mapped as primarily of tonalite composition. Tonalite is a crystalline rock dominated by calcium-sodium plagioclase feldspar, quartz, and mafic (iron-magnesium-bearing) minerals. As observed at other locations within the installation, slightly weathered to unweathered tonalite was generally medium to light gray in color. During previous investigations at Site 34b, there were essentially no outcrops and the moderately weathered bedrock could be excavated using a hand auger to a depth of 2 feet with relative ease. Undocumented or debris fill was observed within the known disposal trench. The fill was logged to a maximum depth of 4 feet and consisted of a medium to light brown fine to medium grained silty sand with metal and wood debris. Alluvial soils were not encountered within the site during the SI but were mapped to the north, adjacent to the natural drainage. Metavolcanic rocks have also been mapped in the drainage north of the site (Figure 2).

2.2.1.2 IR Site 34d Geology

The site is underlain by granitic bedrock mapped as primarily of tonalite composition. Bedrock is exposed at several locations within the Fallbrook Creek drainage channel. The bedrock consisted of a medium gray, massive medium crystalline tonalite that contained a moderate amount of hornblende-rich xenoliths, ranging in size from 1 to 10 inches in diameter. The long axis of the xenoliths was typically oriented in a near-vertical direction (ChaduxTt 2010).

The incised creek channel affords excellent exposure of the alluvial soils in the channel slopes. The alluvium was measured to depths ranging from 10 to 15 feet. The alluvium consisted of a brown silty medium to coarse grained sand that was loose in consistency and dry.

Also observed overlying the alluvium in the channel banks were relatively thin layers of debris fill that ranged in thickness from 1 to 2 feet. Debris fill was primarily medium brown silty sand that was dry and loose in consistency. The fill included wood, metal, and concrete debris with some evidence of burning. Debris fill encountered in boring IRP34D-SB04 (between former Buildings 325, 341, and 430) contained glass fragments and burn ash. It is likely that other areas of debris fill are present; however, detailed mapping of the slope area in the southern portion of the site and the stream banks was not feasible because of the heavy vegetation in this area during the SI.

Artificial fill associated with construction of Maverick Road and the former crossing over Fallbrook Creek was mapped within the site (Figure 3). It appears that at one time Maverick Road, or an extension of it, also extended to the southeast to allow access to the parking area along Ammunition Road where Building 338 was formerly located. Artificial fill associated with the road and development of the parking area is also shown on Figure 3.

2.2.2 Site Hydrogeology

The general hydrologic setting for the northern portion of the installation is dominated by the Santa Margarita River channel that defines the northern boundary of NAVWPNSTA Seal Beach Det. Fallbrook. Surface runoff from the northern portion of the installation flows into the Santa Margarita River, which is considered part of the Santa Margarita–Upper Ysidora Watershed. The central portion of the installation, where IR Sites 34b and 34d are located, is characterized by first-and second-order ephemeral drainages associated with Fallbrook Creek and other tributaries to the Santa Margarita River. Fallbrook Creek traverses the community of Fallbrook and enters the installation near the east gate at Ammunition Road. The creek flows west through the installation and exits NAVWPNSTA Seal Beach Det. Fallbrook along the middle of the west boundary, entering MCB Camp Pendleton. The southern portion of the installation drains southward via first- and second-order ephemeral drainages that include Pilgrim Creek. Pilgrim Creek exits the installation along the southern boundary and continues southward, where it eventually joins the San Luis Rey River Channel. Fallbrook Creek traverses the northern portion of IR Site 34d. IR Site 34b is drained by an unnamed tributary to the Santa Margarita River feeding most directly to Depot Lake (Figure 4).

Although groundwater within the installation is considered beneficial use by the RWQCB, NAVWPNSTA Seal Beach Det. Fallbrook receives all of its potable water from the San Diego County Water Authority (ChaduxTt 2010). Depths to water in three monitoring wells located on Ammunition Road, 1.2 to 1.3 miles east of IR Sites 34b and 34d, were measured between 50 and 60 feet below ground surface (bgs) in 2003 (Malcolm Pirnie 2006). These wells are adjacent to IR Site 30 and relatively close to IR Sites 31 and 32. Based on the data from these wells, direction of groundwater flow was toward the southwest, consistent with the direction of surface water flow. The wells are located within the Fallbrook Creek drainage basin, 700 feet north of Fallbrook Creek.

No site-specific groundwater depth data were available for IR Sites 34b and 34d. No groundwater was encountered during the SI in borings completed to a maximum depth of 6 feet within IR Site 34b. It is anticipated that groundwater may be present in the alluvial soils along the bedrock-to-alluvium contact, adjacent to Fallbrook Creek at IR Site 34d. Groundwater is not anticipated to be contacted during the field investigations at IR Sites 34b and 34d due to the shallow depths of the proposed soil borings.

2.3 Ecological and Environmental Setting

More than 80 percent of NAVWPNSTA Seal Beach Det. Fallbrook lands exist as natural open space because of the low-intensity land use of the military installation. Seven different habitat types occur at the installation: coastal sage scrub, mixed chaparral, chamise chaparral, valley foothill riparian, annual grassland, fresh emergent wetlands, and eucalyptus. Fauna common to the installation include many mammals (kangaroo rats, voles, deer, mice, bats, ground squirrels, opossum, rabbits, and coyotes), reptiles (orange-throated whiptails, rattlesnakes, and horned lizards), and birds (owls, kites, quails, sparrows, kingbirds, and hawks).

Many federally threatened or endangered species have been documented or have the potential to occur at the installation, including the following (Tierra Data Inc. 2006):

- Coastal California gnatcatcher (CAGC) (*Polioptila californica californica*); threatened
- Least Bell's vireo (LBV) (*Vireo bellii pusillus*); endangered
- Southwestern willow flycatcher (SWFC) (*Empidonax trailli extimus*); endangered
- Stephens kangaroo rat (SKR) (*Dipodomys stephensi*); endangered
- Arroyo toad (*Bufo californicus*); endangered
- California red-legged frog (*Rana aurora draytonii*), threatened

CAGC is a non-migratory species that nests in coastal sage scrub and adjacent chaparral. The LBV usually arrives in southern California in mid-March through August or September and nests in riparian as well as coastal sage vegetation with patches of Mexican elderberry (*Sambucus mexicanus*). The SWFC also nests in riparian areas and occurs in southern California between mid-May through September or October. The SKR burrows in areas with low-lying perennial cover and bare ground, including coastal sage scrub, grassland, and chaparral. The arroyo toad uses wetland and upland areas during various parts of its life cycle; they are known to occur along the Santa Margarita River and may occur in suitable habitat at NAVWPNSTA Det. Fallbrook. The California red-legged frog inhabits freshwater marshes, ponds, streams, lakes, and other quiet water bodies.

The SIs at IR Sites 34b and 34d included a survey of federally protected species listed as threatened or endangered. Suitable habitat for one or more protected species was found at each site during a field visit in 2007 (ChaduxTt 2010). The results are summarized below.

- IR Site 34b — Vegetation in the area is considered mostly coastal sage scrub and provides suitable habitat for the CAGC and SKR, with some burrows observed at the site; therefore, both species could occur at the site. Wildfires that occurred in May

2014 removed much of the dense brush at the site, possibly degrading wildlife habitat for the 2015 breeding season.

- IR Site 34d — Vegetation in the area is a mix of oak woodland, riparian woodland, and coastal sage scrub. The site provides suitable habitat for the CAGC, SKR, LBV, and SWFC; therefore, these species could occur at the site. Wildfires that occurred in May 2014 removed much of the dense brush at the site, possibly degrading wildlife habitat for the 2015 breeding season.

2.4 Previous Investigations and Background

The DON has been investigating IR Sites 34b and 34d at NAVWPNSTA Seal Beach Det. Fallbrook since 1985. An initial assessment study (IAS) for NAVWPNSTA Seal Beach, California was completed by Naval Energy and Environmental Support Activity (NEESA) in 1985 (NEESA 1985). This document included investigations at NAVWPNSTA Seal Beach and NAVWPNSTA Seal Beach Det. Fallbrook. The IAS was revised and updated in 1990 (NEESA 1990). Nine separate spill or disposal sites were investigated at NAVWPNSTA Seal Beach Det. Fallbrook during the IAS, including IR Sites 34b and 34d – previously referred to as DDS 2 and DDS 4, respectively. The IAS did not recommend an SI at the Dunnage Disposal Sites.

A PA for the munitions response program was completed in 2006 that included IR Sites 34b and 34d (Malcolm Pirnie 2006). Based on the results of the PA, NFA for MEC and MC was recommended for Sites 34b, 34d, and 34e; therefore, those sites remained within the IR program and were not addressed as Munitions Response Program sites. An SI was completed in 2010 for IR Sites 32, 34b, 34d, and 34e as well as Munitions Response Program Sites UX01, UX02, UX03, UX04, UX06, and UX07 (ChaduxTt 2010). Tables summarizing the laboratory data collected during the SI for both IR Site 34b and IR Site 34d have been included in this Work Plan as Appendix F. The following subsections summarize the background and SI results for IR Sites 34b and 34d.

2.4.1 Previous Investigations at IR Site 34b

Historical information obtained during preparation of the PA (Malcolm Pirnie 2006) indicated that IR Site 34b was reportedly used as a disposal or burial area for dunnage from 1942 until 1978. A detailed review of historical installation records, reconnaissance surveys, and follow-up interviews was conducted for the PA and no evidence was found of munitions being disposed at the site.

A supplemental review of historical photographs from 1953 to 1978 indicated that the southeastern portion of the site and south adjoining area was used as a borrow pit for sand and gravel. The borrow area appeared to be in heavy use before and during the 1950s. By the late 1970s, activity in this area appears to have been curtailed or eliminated (ChaduxTt 2010).

During the SI, a shallow trench was identified in the central portion of the site containing dunnage and other debris. The known disposal trench extended 480 feet down slope in a northwesterly direction and was estimated to be 3.5 feet wide. Fill or debris was encountered to a maximum depth of approximately 4 feet below adjacent grade. The known disposal trench was partially filled with undocumented fill soil or slough from the trench walls, along with metal, wood, and glass debris. Metal debris found within the disposal trench included canisters, banding, cable, a 1950s-vintage fire extinguisher, empty 55-gallon drums, and other miscellaneous scrap metal. The encountered metal items appeared to be relatively old, as they were weathered and highly deteriorated. Other debris observed included wood, wood pallets, a tire, and glass (bottles and fragments). Some evidence of melted glass was also observed in the soil borings, suggesting the debris was burned as part of the disposal practice. The known disposal trench was also identified in the 1953 photograph along with two less conspicuous linear features farther west (Figure 2). These additional linear surface disturbances are considered secondary AOCs for IR Site 34b (ChaduxTt 2010).

The results of the biased and unbiased soil sampling at IR Site 34b indicated that no SVOCs were reported and the VOCs reported, mainly fuel-related hydrocarbons, were below human health screening criteria. Lead results indicated four samples exceeded the industrial screening criterion, which in many cases was the highest of the human health and ecological screening levels, with the highest concentration at 18,100 milligrams per kilogram (mg/kg). All 26 analytical results for arsenic exceeded the industrial screening criterion, with the highest concentration at 11.9 mg/kg. Although at relatively low concentrations, other metals such as antimony, cadmium, and iron were reported above the corresponding residential screening criteria. Fourteen metal analytes also exceeded ecological screening levels. Some metals concentrations that exceed the screening levels may have been within the normal background range for soil in the area. Burned debris indicated the possibility of dioxins and/or furans, although these compounds were not part of the SI's analytical suite. These results led the SI to recommend conducting an RI for soil impacts from buried debris at IR Site 34b.

2.4.2 Previous Investigations at IR Site 34d

Historical information obtained during preparation of the PA (Malcolm Pirnie 2006) indicated that IR Site 34d was reportedly used as a disposal or burial area for dunnage from 1942 until 1978. A detailed review of historical installation records, reconnaissance surveys, and follow-up interviews was conducted for the PA and no evidence was found of munitions being disposed at the site.

In addition to the possible disposal of dunnage, at least three structures were known to have existed at the site, Buildings 341, 430 and 325, which were potentially identified as a former restroom, a former boiler house, and a former wooden ammunition magazine, respectively (Figure 3). The SI identified these structures from interviews with facility personnel and a

review of historical utility maps for the installation. Currently, manmade features at IR Site 34d consist of the remnants of a building slab (Building 341) and a below-grade, three-stage concrete sump (Building 430). A clay drainpipe extends west from the sump toward a small tributary that drains to Fallbrook Creek. The slab of former Building 341 was inspected and appeared to be the remnant of a restroom (ChaduxTt 2010). A historical Fresh Water Distribution Utility Map (Department of Navy 1954) indicated that the three-stage concrete sump was referred to as the Boiler House and was identified as Building 430. The utility maps indicated that a 6-inch water line ran to Building 341 and connected to a fire hydrant located along Maverick Road, just south of Fallbrook Creek. An additional building was identified in historical site photographs within the site that was designated as Building 325. The use of Building 325 was not known at that time; however, it was believed at that time that the building may have been a wooden magazine (Wade 2009). The structure was observed in a 1953 photograph and also is shown on a historical topographic map.

Following the publication of the SI Report, subsequent evaluation of historical maps for the area indicates that Building 325 was a testing facility for wet munitions, shown on a 1944 map as "Mark 8 Depth Charge Testing Bldg". A review of aerial photographs (Appendix E) indicated that this building was constructed between 1938 and 1946, and was completely removed sometime between 1953 and 1964. Building 338 has been identified as office space related to weapons testing (ChaduxTt 2010).

Along with the construction-related debris, several highly weathered metal small arms ammunition canisters were observed on the south side of the creek during the SI. Other munitions related material observed beyond the site boundary included several casings from blank 5.56-mm rounds. The shells were observed adjacent to the parking area located off of Ammunition Road, southeast of the site. Two tripwires were also located nearby, suggesting that security forces or special operations training may have occurred in the area. These items were considered isolated artifacts and did not indicate that munitions were used or disposed of at IR Site 34d (ChaduxTt 2010).

A total of 20 soil samples were collected at IR Site 34d during the SI. VOCs were not detected at concentrations above the laboratory reporting limits in any of the soil samples. Five SVOCs - benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene - were detected at concentrations above the laboratory reporting limit in one soil sample (IRP34D-SB01) adjacent to Fallbrook Creek (Figure 3). Arsenic was the only metal analyte that exceeded either the residential or industrial screening criteria at the site, with the highest concentration at 1.9 mg/kg. This was flagged by the laboratory as an estimated (J-flagged) value. Nine metal analytes also exceeded ecological screening levels. Metals concentrations that exceed the screening levels may have been within the normal background range for soil in the area. Burned debris indicated the possibility of dioxins and/or furans, although these compounds were not part of the SI's

analytical suite. Also, detector-aided visual surveys indicated evidence for additional debris on the slope southeast of the site. The SI recommended that an RI should be performed for the identified AOCs and for soil impacts from buried debris at IR Site 34d.

2.5 Current Site Conditions

In May 2014, three separate wildfires (known as the Tomahawk Fire, San Mateo Fire, and Las Pulgas Fire) burned approximately 21,900 acres of MCB Camp Pendleton and NAVWPNSTA Seal Beach Det. Fallbrook (MCB Camp Pendleton 2014). The Tomahawk Fire burned approximately 5,400 acres at NAVWPNSTA Seal Beach Det. Fallbrook. The fire burned intensely and cleared nearly all vegetation at IR Site 34b. During a site walk on May 27, 2014, dunnage and other metal debris were visible in the known disposal trench (see Photograph 2-1 below). Other metallic debris outside the known disposal trench was noted around the fire-cleared site but only in isolated, single-item spots. The results of the fire at IR Site 34d were similar with the clearance of much of the leaf litter, grass, and brush. Larger trees still remained in the riparian area near the stream and in the area east of IR Site 34d (see Photograph 2-2 below). The burning of vegetation will likely impact the ecological habitat and nesting season in 2014 and 2015 at both sites. Areas that were once inaccessible due to thick vegetation are now clear and accessible for sampling in the near term.

Photograph 2-1: View looking northwest at IR Site 34b on May 27, 2014. Photo shows fire-cleared site and dunnage and other debris in known waste disposal trench.

Photograph 2-2: View looking west at IR Site 34d on May 27, 2014. Photo shows fire-cleared site with scorched riparian zone on the right.

2.6 Background Metals Study

NAVFAC SW contracted with SES-TECH to perform a base-wide study of metals concentrations in natural soil at NAVWPNSTA Seal Beach Det. Fallbrook (SES-TECH 2012). This investigation consisted of reviewing the geology of the installation and collecting samples of residual soil at 28 locations around NAVWPNSTA Seal Beach Det. Fallbrook, representing the installation's four dominant parent rock types (gabbro, tonalite, granodiorite, and metavolcanics). None of the samples were collected on or within 1,000 feet of IR Sites 34b and 34d. The soil samples were analyzed using EPA Methods 6020 and 7471. Background metals concentrations were established at the 95% upper tolerance limits and are applicable to saprolitic soil derived from the weathering of the underlying bedrock. Table 1 shows the background metals concentrations for the grouping of the three dominant granitic rock types (gabbro, granodiorite, and tonalite) which underlie IR Sites 34b and 34d. These background metals concentrations may be used to compare to metals concentrations from samples collected at IR Sites 34b and 34d. The background values may not be applicable to alluvial or fill material that is not native to the sites.

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Section 3 Field Sampling Plan

This section describes the methodology for conducting the RI at IR Sites 34b and 34d NAVWPNSTA Seal Beach Det. Fallbrook, including the methods and procedures for implementation during field operations.

3.1 Health and Safety

The fieldwork will be conducted in accordance with the Accident Prevention Plan (CFS 2014) prepared for this project. The Accident Prevention Plan describes the safety requirements for investigation activities at the subject sites and includes a Site-specific Safety and Health Plan (SSHP) and activity hazard analyses. As required, each field worker on this project will have undergone Occupational Safety and Health Administration 40-hour Hazardous Waste Operation and Emergency Response training. A copy of the plan will be available on site during work activities. Prior to initiating fieldwork, all field personnel will be required to read the Accident Prevention Plan, SSHP, and activity hazard analyses. Health and safety meetings will be conducted with all on-site personnel each day of field activities. All field personnel will attend a NAVWPNSTA Seal Beach Det. Fallbrook hazard control brief pursuant to base explosive safety requirements.

3.2 Pre-Field Coordination

All field activities will be coordinated with the following:

- Ms. Margaret Wallerstein, NAVWPNSTA Seal Beach, (562) 626-7838 margaret.wallerstein.ctr@navy.mil

Under CERCLA-regulated cleanups, no federal, state, or local permits are required for on-site investigations. Additionally, due to the anticipated depth to water at the site (greater than 50 feet) and the shallow proposed total depth of the hand auger borings and test pits (maximum depth of approximately 8 feet bgs), soil boring information will not be provided to the County of San Diego Department of Environmental Health and a soil boring permit will not be obtained.

3.3 Biological Monitoring and Vegetation Clearance

Prior to the start of vegetation removal activities (if clearing is necessary), biological monitoring will be performed in accordance with the Biological Avoidance and Minimization Plan included as Appendix B. In short, a field biologist will conduct a visual survey of IR Sites 34b and 34d to assess the potential for TES to occur. The field biologist will survey and demarcate any kangaroo rat burrows and nests, including both the protected SKR and the unprotected Dulzura kangaroo rat, which are difficult to differentiate based on burrow morphology. The purpose of marking the burrows and nests is to ensure that field activities will avoid and not disturb

endangered species. Avoidance of the burrows will be the primary protection strategy for SKR. If sampling is necessary near kangaroo rat burrows or nests and/or at the recommendation of the base biologist, the field biologist may conduct up to 5 nights of trapping at IR Site 34b following United States Fish and Wildlife Service protocol. If burrows can be marked and avoided, trapping may not be necessary. It is not expected that SKR trapping will be required for IR Site 34d. Following the completion of the initial biological monitoring, brush and vegetation will be cleared and the site will be prepared for intrusive activities as necessary in coordination with the biologist's recommendations.

3.4 Utility Survey and Clearance

Underground utility clearing will be completed before intrusive fieldwork at IR Sites 34b and 34d. Prior to conducting any utility clearance, each test pit and boring location will be demarcated with stakes and/or flagging. Prior to subsurface utility clearance, a subsurface operations permit will be submitted through the Navy Public Works Center. Dig Alert will be notified at least 48 hours prior to subsurface work to allow proper utility clearance by public utilities. Additionally, a private subsurface utility locator will conduct a geophysical survey to locate utilities at the proposed location of test pits and soil borings at each of the IR Sites.

The utility surveyor will approve each test pit and boring location by confirming no utilities are identified within a 5-foot radius around each of the proposed locations. If a utility is identified within 5 feet of the proposed location, the proposed location will be moved and the clearance procedures will be repeated.

3.5 Geophysical Investigation

In October 2014 a geophysical investigation was conducted at IR Sites 34b and 34d, to evaluate potential dunnage disposal areas at the sites. A technical memorandum containing proposed test pit locations, and presenting the results of the geophysical investigation was submitted to the regulatory agencies as an attachment to the response to comments (RTCs) prepared for agency comments received on the Draft Work Plan. The RTCs including the attached Tech Memo and Geophysical Report are included as Appendix E to this RI Work Plan.

In summary, the geophysical evaluation did not indicate any significant areas of buried waste other than the known disposal trench at IR Site 34b. The planned investigative program at the two sites is discussed in Section 3.7 below.

3.6 Site Preparation for Intrusive Investigation

Based on the results of the geophysical investigation, the proposed locations for the test pits were selected to include geophysical anomalies that are most likely to represent buried dunnage or other debris. Proposed test pit and hand auger boring locations will be identified using Global

Positioning System equipment and staked or marked on the ground with the test pit or proposed boring number. To allow access for sampling directly beneath the concrete slab (Building 341) and three-stage concrete sump (Building 430), these structures will be crushed, removed, and stockpiled onsite.

An IDW staging area will be selected prior to initiating fieldwork. The staging area will be used to store IDW generated during field efforts. IDW wastes will be stored in 55-gallon Department of Transportation (DOT) approved drums in a secondary containment area. The IDW staging area will likely be established at IR Site 34d.

3.7 Test Pit Excavations and Potholing

Test pits and potholes will be excavated at IR Sites 34b and 34d (Figures 5 and 6) using a backhoe excavator. Test pits are anticipated to be at least the width of the excavator bucket, and typically at least 5 feet in length. Tests pits will generally be excavated to approximately 5 feet bgs. In the event that buried waste is encountered that extends to a greater depth than expected, then the depth of the excavation will be increased as feasible based on the limitations of the excavation equipment or refusal. Following the logging of the test pits and the collection of the soil samples, the test pits will be backfilled with the excavated soil.

Three types of proposed excavations are planned. Waste Test Pits are planned where known or expected waste is believed to be buried, and five samples are planned for each waste test pit. Exploratory Test Pits are planned to evaluate potential areas where waste might be buried, and two samples are planned for each exploratory test pit. Exploratory Potholes are planned to evaluate subsurface objects identified during the geophysical survey that should be assessed; however sample collection is not planned for exploratory potholes. The sampling program planned for each of the test pits and potholes is presented in the subsections below.

In addition, the Proposed Test Pit Locations technical memorandum is included as Attachment F to this Work Plan. One significant deviation in this work plan from the Tech Memo is the number of test pits at IR Site 34b. The Tech Memo recommended 8 test pits at IR Site 34b, however following a site walk conducted January 16, 2015, and subsequent discussion with the Navy's Agency partners, it was agreed that the two Exploratory Test Pits proposed in linear features identified from aerial photographs during the SI are not needed. These test pits have therefore not been included in this Work Plan, and the number of test pits shown for IR Site 34b is 6.

Test pit excavation and soil sampling will follow the procedures outlined in the SAP (Appendix A). The subsections below detail the excavating and sampling plan for each IR site.

3.7.1 IR Site 34b

For IR Site 34b, a total of six test pits will be excavated to investigate visible dunnage or other debris, and geophysical anomalies identified in the geophysical survey as shown on Figure 5. All six of the test pits are located along or adjacent to the known disposal trench identified in the SI report. Four of the six test pits will be placed within the waste disposal area and are designated as Waste Test Pits. Two of the test pits are planned to bound the ends of the disposal trench, and are designated as Exploratory Test Pits as waste or dunnage debris are not anticipated in these test pits. It is expected that test pits at IR Site 34b will be excavated to a depth of 3 to 6 feet bgs, depending on the depth of debris at that location. Up to 32 soil samples are planned from the six test pits and will be analyzed for VOCs, SVOCs, metals, and total organic carbon (TOC). TOC data will be used in risk analysis and is not a COPC or COPEC. Of these samples, up to 10 soil samples may be additionally analyzed for dioxins/furans based on field visual indications of historic burn activities. Four of the samples collected in soil associated with the waste itself will be additionally analyzed for pesticides and PCBs. At the discretion of the field geologist, soil sample locations will be biased towards staining or other visual indications of potential contamination, such as dunnage debris, to determine the extent of soil impacts.

Soil containing ash from the May 2014 wildfires will be avoided for sampling purposes. If sampling must be performed in an area where recent ash is visible, the sampling area will be mechanically scraped to remove the ash and near-surface soil before proceeding with sample collection. Burned vegetation above the ground surface in the sampling area will also be removed before sample collection.

The rationale and sampling program for each test pit planned at IR Site 34b is described below.

Planned Test Pits at IR Site 34b				
Area	Proposed Location ID	Reason for Test Pit Location	Analytical Methods*	Sampling Program
IR Site 34b	Test Pit #1	Known disposal trench. Geophysical anomalies identified. Sampling to bound waste in trench laterally and vertically, and to assess the waste itself.	VOCs, SVOCs, and metals. Four waste samples will be additionally analyzed for pesticides and PCBs.	Waste Test Pits (6 to 7 samples each). Two sidewall samples in visually clean soil to laterally bound the disposal trench. One shallow sample in visually clean material for surface risk. One sidewall sample biased in the waste itself, with one additional shallow waste sample collected if the sidewall sample is not shallow. Two floor samples in visually clean soil, one beneath the other, to vertically bound the contamination in the trench.
	Test Pit #2			
	Test Pit #3			
	Test Pit #4			
	Test Pit #5	Laterally bound the ends of the known disposal trench, outside of the identified geophysical anomalies.	VOCs, SVOCs, and metals.	Exploratory Test Pits (2 samples each). One shallow sidewall sample and one floor sample, unless debris or discoloration is encountered. If debris or discoloration is encountered, the deeper sample will be collected at that location.
	Test Pit #6			

* Up to 10 of the Test Pit samples at each site may be additionally analyzed for dioxins/dibenzofurans, based on visual indications of burned waste.

3.7.2 IR Site 34d

For IR Site 34d, eleven Exploratory Test Pits are planned to evaluate areas where dunnage disposal may have taken place. Test pits were initially planned to evaluate areas of buried debris as identified by the geophysical investigation. However, no such areas were identified. As a result, the purpose of the test pits has been shifted slightly from the evaluation of identified areas of buried waste or debris, to exploration and confirmation of the results of the geophysical investigation (Figure 6). In the event that buried waste is encountered at IR Site 34d that extends to a greater depth than expected, then the depth of the excavation will be increased as feasible based on the limitations of the excavation equipment or refusal. Two soil samples are planned from each of the 11 test pits, for a total of 22 samples. Soil sample locations will be biased towards staining or other visual indications of potential contamination, such as dunnage debris, to evaluate the extent of soil impacts. Soil samples will be submitted for laboratory analysis of

VOCs, SVOCs, metals, and TOC. Of these 22 soil samples, up to 10 samples may be additionally analyzed for dioxins/furans based on field visual indications of historic burn activities.

Soil containing ash from the May 2014 wildfires will be avoided for sampling purposes. If sampling must be performed in an area where recent ash is visible, the sampling area will be mechanically scraped to remove the ash and near-surface soil before proceeding with sample collection. Burned vegetation above the ground surface in the sampling area will also be removed before sample collection.

Proposed Test Pits at IR Site 34d				
Subarea	Proposed Location ID	Reason for Test Pit Location	Analytical Methods*	Sampling Program
IR Site 34d	Test Pit #1	Confirm apparent wooden retaining wall visually identified above former location of Building 325. Near burned wood and glass shards identified in SI near SB04. This test pit will replace the five borings originally planned in this area.	VOCs, SVOCs, and metals. Four of the test pit samples, with the greatest overall detected contaminant concentrations, will be additionally analyzed for pesticides and PCBs.	Exploratory Test Pits. One shallow sidewall sample and one floor sample, unless debris or discoloration is encountered. If debris or discoloration is encountered, the sample will be collected at that location.
	Test Pit #2	Evaluate soil downgradient of partially buried ammo cans that appear to be a small retaining wall structure that was visually identified during site reconnaissance.		
	Test Pit #3	Fill area where Building 325 was formerly located.		
	Test Pit #4	Flat area visually identified during site reconnaissance.		
	Test Pit #5	Flat area visually identified during site reconnaissance.		
	Test Pit #6	Small buried items identified by geophysics.		
	Test Pit #7	Downslope from the nearby former roadway.		
	Test Pit #8	Flat area next to former roadway.		
	Test Pit #9	Toe of slope downslope from Test Pit #8.		
	Test Pit #10	Toe of slope below parking area.		
	Test Pit #11	Slope below parking area.		

* Up to 10 of the Test Pit samples at each site may be additionally analyzed for dioxins/dibenzofurans, based on visual indications of burned waste.

In addition to the Exploratory Test Pits, potholing is proposed to investigate several areas identified during the geophysical survey. Of particular note is a potential underground storage tank (UST) identified near Buildings 341 and 430. Because the nature of the feature is unknown no sampling is planned at this time, and information from the potholing will be used by the Navy to determine what actions, if any, need to be taken regarding the feature.

Proposed Exploratory Potholing at IR Site 34d, No Sampling Planned		
Subarea	Location	Feature Description
IR Site 34d	Pothole #1	Position and geophysical signature suggest the identified subsurface structure might be the footing for former bridge over Fallbrook Creek. That bridge is no longer present.
	Pothole #2	Position and geophysical signature suggest a possible UST near Building 341.
	Pothole #3	Surface metal debris near stream embankment.
	Pothole #4	Surface metal debris and small metallic anomaly on slope near parking area.

3.8 Other Soil Sampling at IR Site 34d

In addition to the test pit excavations, other samples will be collected at IR Site 34d. Soil samples will be collected near both the removed concrete slab (former Building 341) and the three-stage concrete sump (former Building 430). Soil sampling will also be conducted at the terminus of the clay drainpipe west of former Building 430 and adjacent to the slab for former Building 341. Five hand auger borings will be advanced near previous SI boring IRP34D-SB01 to collect soil samples (Figure 6). Sediment and surface water samples will also be collected from the Fallbrook Creek drainage channel. Sampling will follow the procedures outlined in the SAP (Appendix A). The following subsections further outline sampling at these areas.

3.8.1 Sampling Near Former Buildings 341 and 430

After the removal of the concrete slab (Building 341) and three-stage concrete sump (Building 430), 10 grab soil samples will be collected (Figure 6) to assess this area. Five grab soil samples will be collected from below the footprint of the removed concrete slab. An additional five grab soil samples will be collected from below the footprint of the removed concrete sump. As described in the SAP, grab samples will be collected from the excavator bucket using a disposable plastic scoop to transfer soil into a laboratory-supplied container.

In addition to the grab sample planned under the buildings, four soil borings will be advanced in this area. One hand auger boring will be advanced at the terminus of the clay drainpipe, west of the concrete sump, and up to three soil samples will be collected from this boring. The hand auger boring is expected to extend to approximately 6 feet bgs (or refusal), with samples collected near the surface, at 3-4 feet bgs, and at 5-6 feet bgs, as feasible. Three additional hand auger borings will be advanced adjacent to the slab for Building 341, as shown on Figure 6. These three hand auger boring are expected to extend to approximately 6 feet bgs (or refusal), with samples also collected near the surface, at 3-4 feet bgs, and at 5-6 feet bgs, as feasible. As

described in the SAP, hand auger samples will be collected by transferring soil from the target interval directly from the hand auger barrel into a laboratory-supplied container.

These 22 soil samples will be submitted for laboratory analysis for VOCs, SVOCs, metals, and TOC.

3.8.2 Sampling Near Boring IRP34D-SB01

Up to five hand auger borings will be advanced near boring IRP34D-SB01 (Figure 6). The objective of these borings is to laterally and vertically delineate SVOC impacts near IRP34D-SB01. The borings are expected to extend to approximately 6 feet bgs (or refusal), with samples collected near the surface, at 3-4 feet bgs, and at 5-6 feet bgs. Up to 15 samples will be submitted for laboratory analysis of VOCs, SVOCs, PAHs by Selective Ion Monitoring (SIM), metals, and TOC. Up to five of these 15 soil samples may be additionally analyzed for dioxins/furans based on visual indications of historic burn activities. Measures to protect ash from the 2014 wildfires from contaminating the soil samples, such as scraping the ground surface, will be implemented as described in Section 3.7.2.

3.8.3 Sediment and Surface Water Sampling from Fallbrook Creek

Four sediment samples and four surface water samples will be collected from portions of Fallbrook Creek that are adjacent or east of the site (Figure 6). The surface water and sediment samples will be collocated. Surface water samples will only be collected if Fallbrook Creek, an ephemeral stream, is flowing during the fieldwork activities. One of the four sediment/surface water sample locations will be collected from an upgradient portion of Fallbrook Creek for comparison to the three samples collected adjacent to the site.

Sediment and surface water sample locations will be visually scanned for ash from the 2014 wildfires. Areas containing recent visible ash will be avoided. Measures to protect ash from the 2014 wildfires from contaminating the sediment and surface water samples, such as scraping the ground surface, will be implemented as described in Section 3.7.2. However, these measures may be less successful in the topographically low creek bed where wildfire ash would be expected to accumulate. If dioxins/furans are reported in sediment samples, the potential for contamination from wildfire ash will be discussed in the RI report.

The sediment samples will be collected from the middle of the small watercourse following the procedure described in the SAP. The sediment samples, which will be obtained from wet granular material in the stream channel axis, will be collected using disposable plastic scoops to transfer soil into laboratory-supplied containers. The sediment samples will be analyzed for VOCs, SVOCs, metals, and TOC, and may additionally be analyzed for dioxins/furans to evaluate the potential impacts to Fallbrook Creek. The sediment samples collected will only be

analyzed for dioxins/furans if one or more soil samples collected at the site are selected for dioxin/furan analysis.

If Fallbrook Creek contains water during fieldwork activities, surface water samples will be collected following the procedure described in the SAP. Surface water samples will be collected by dipping laboratory-supplied containers directly in the creek without overfilling and washing out preservatives. The surface water samples will be analyzed for VOCs, SVOCs, metals, and hardness (as calcium carbonate). For metals analysis, both filtered and unfiltered surface water samples will be collected. The filtered samples will be transferred through a 0.45 micron filter cartridge using a peristaltic pump.

3.9 Sample Analysis

Soil samples will be collected and analyzed from the soil test pits and hand auger borings at IR Sites 34b and 34d following the methods and procedures outlined in the SAP (Appendix A). Surface water samples will also be collected from Fallbrook Creek (if it is flowing) following the procedures outlined in the SAP. The analytical program is summarized below.

3.9.1 IR Site 34b

Up to 32 samples will be analyzed for the following:

- VOCs by U.S. EPA Method 8260B
- SVOCs by U.S. EPA Method 8270C
- Metals by U.S. EPA Method 6020A and 7471B
- TOC by the Walkley-Black method

Four of these samples will additionally be analyzed for:

- Pesticides/PCBs by U.S. EPA Method 8081A/8082

Up to 10 of these samples may be analyzed for:

- Dioxins/furans by U.S. EPA Method 8290

3.9.2 IR Site 34d

Up to 59 soil samples will be analyzed for the following:

- VOCs by U.S. EPA Method 8260B
- SVOCs by U.S. EPA Method 8270C
- Metals by U.S. EPA Method 6020A and 7471B
- TOC by the Walkley-Black method

Fifteen of these samples will be additionally analyzed for:

- PAHs by SIM using U.S. EPA Method 8270C

Up to 15 of these samples may be analyzed for:

- Dioxins/furans by U.S. EPA Method 8290

Four sediment samples will be analyzed for:

- VOCs by U.S. EPA Method 8260B
- SVOCs by U.S. EPA Method 8270C
- Metals by U.S. EPA Method 6020A and 7471B
- Dioxins/furans by U.S. EPA Method 8290 (if soil samples at site are analyzed for dioxins/furans)
- TOC by the Walkley-Black method

Four surface water samples will be analyzed for:

- VOCs by U.S. EPA Method 8260B
- SVOCs by U.S. EPA Method 8270C
- Metals by U.S. EPA Method 6020A and 7471B
- Hardness as calcium carbonate by Standard Method 2340C

Further information regarding analytical suites, sample methods, containers, preservations, volumes, holding time requirements, and quality assurance/quality control sampling is included in the SAP.

3.10 Equipment Decontamination

Hand augers and all non-consumable equipment that comes into contact with sampling media during the sampling events will be decontaminated between borings using 3-stage decontamination procedures in accordance with the following steps:

1. **Wash with nonphosphate detergent and water solution.** This step will remove all visible contamination from the equipment. A container of suitable size, water diluted with nonphosphate detergent, and a brush will be used for this step. Dilute nonphosphate detergent as directed by the manufacturer.
2. **Rinse with potable water.** This step will rinse the detergent solution away from the equipment. A container of suitable size filled with water and a brush will be used for this step. Periodic changing of this water is required. Perform this rinse twice.
3. **Rinse with deionized/laboratory reagent-grade water.** This step will include double rinsing any detergent solution and potable water residues. Rinsing will include spraying the the equipment being cleaned with a stainless steel Hudson-type sprayer or plastic squeeze bottle while holding the equipment over a container of suitable size.

All decontamination water will be containerized in DOT-approved, 55-gallon drums and stored at the designated IDW staging area.

3.11 Sample Packaging and Shipping

Immediately after sample collection, sample labels will be affixed to each sample container. SAP Worksheets #26 and #27 (Appendix A) describe sample handling and custody requirements in greater detail. The samples will be packed with shock-absorbent materials, such as bubble wrap, to prevent movement or breakage of the sample containers during transport. A cooler will be filled with wet ice that will be double-bagged in resealable bags in order to meet temperature requirements of 4 ± 2 degrees Celsius. A temperature blank will accompany each cooler to be measured by the laboratory upon receipt. Cooler drain spouts (if present) will be taped from the inside and outside of the cooler to prevent leakage.

A chain-of-custody form will be placed in a resealable bag and inserted into the cooler, which will then be sealed with packaging tape. The cooler containing the environmental samples will either be picked up by a laboratory courier or arrangements will be made to have the cooler delivered to the laboratory by an overnight delivery service. If an overnight delivery service is used, the package will be scheduled for priority overnight service to ensure that the temperature preservative requirement is not exceeded. Saturday deliveries will be coordinated with the laboratory.

3.12 Investigation-Derived Waste

All soil cuttings and IDW fluids will be containerized in DOT-approved, 55-gallon drums and place in secondary containment for storage. The drums will be stored on site in a designated IDW storage area. The containerized media may be sampled and analyzed for profiling purposes. Alternatively, analytical results from site samples may be used for profiling. After waste profiling is complete, the IDW will be transported to an approved disposal facility in accordance with 40 CFR 300.440.

The appropriate disposal facility will be determined by the following hazardous classifications:

- Although not anticipated to be present, any soil or water classified as Resource Conservation and Recovery Act (RCRA) hazardous waste will be transported to a licensed treatment, storage, and disposal facility for treatment and disposal.
- Any soil or water classified as non-RCRA hazardous waste will be transported for disposal to a licensed landfill facility in accordance with the CERCLA Off-Site Rule.
- Soil classified as nonhazardous waste, or inert, will be transported for disposal to a licensed landfill or soil treatment facility permitted to accept such waste in accordance with the CERCLA Off-Site Rule.

- Water classified as nonhazardous will be transported for disposal to a licensed treatment facility permitted to accept such waste in accordance with the CERCLA Off-Site Rule.

All waste manifests and profiles, along with analytical data and land disposal restrictions, will be routed through the NAVWPNSTA Seal Beach Det. Fallbrook Environmental Department for signature. Original copies of the manifest packages will be provided to the transporter for shipment. All wastes will be removed from the site within 90 days and will be transported via a licensed transporter.

3.13 Reporting and Data Submission

An RI report will be prepared to document the RI activities and data collected, summarize the results and findings, describe the nature and extent of contamination, and present recommendations for follow-up actions. The RI report will include site maps, site data in tabular format, a summary of variances from this work plan (if necessary), and copies of waste manifests. The RI report will also summarize the results of the HHRA and SLERA. A draft version of the RI report will be submitted to the Navy, DTSC, and RWQCB for review. Comments on the draft version of the document will be addressed and a final completion report will be submitted.

In accordance with Environmental Work Instruction #6 (NAVFAC SW 2005), sample location coordinates, analytical results, and other applicable data collected during the RI will be submitted to the Naval Installation Restoration Information Solution database in the Naval Environmental Data Deliverable format.

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Section 4 Risk Assessment Approach

This section summarizes the HHRA and SLERA approaches recommended to be performed as part of the RI for IR Sites 34b and 34d. Appendix C includes the HHRA Work Plan. Appendix D includes the SLERA Work Plan.

4.1 HHRA Approach

As presented in detail in Appendix C, the objective of the HHRA will be to evaluate potential health risks and hazards for potential current and future receptors exposed to potential site contaminants (i.e., metals, VOCs, SVOCs, and dioxin/furans) at IR Sites 34b and 34d. The HHRA Work Plan describes the data collection and evaluation process, presents the conceptual site exposure model (CSEM), and provides the exposure assumptions that will be used in the HHRA for IR Sites 34b and 34d. The HHRA will be performed in accordance with appropriate risk assessment guidance documents. The HHRA Work Plan in Appendix C includes the followings sections:

- Section 2.0 summarizes the sampling and analysis program.
- Section 3.0 describes the process for selecting COPCs for the risk assessment.
- Section 4.0 presents the preliminary CSEM.
- Sections 5.0 and 6.0 explain the procedures for the exposure assessment and the toxicity assessment.
- Section 7.0 discusses how the HHRA will characterize risk and hazard for IR Sites 34b and 34d
- Section 8.0 provides references.

The HHRA for IR Sites 34b and 34d will be based on the data set that has been compiled under the previous SI, as well as the sample collection planned as part of the RI. Data collected as part of the SI consisted of soil samples and these data will be used in the HHRA. Additional soil data are to be collected for VOCs, SVOCs, metals, and dioxins/furans as part of the RI. The depth interval for surface soils is defined to be from 0 to 0.5 feet, unless site-specific conditions warrant otherwise. Subsurface soil samples are defined as those samples collected from a depth between 0.5 feet and 10 feet bgs. Surface water and sediment samples will be collected from Fallbrook Creek that is adjacent to IR Site 34d, as site contaminants may migrate to the creek as a result of overland flow during precipitation events. Multiple site samples adjacent to the creek are proposed, as well as one upstream sample. The upstream sample will be used to assess whether or not detected chemicals are site related or related to an upstream source such as the town of Fallbrook. Background data are relevant to IR Sites 34b and 34d, as inorganics are part

of the focus of the investigation. A separate base-wide metals background soil study has been conducted (SES-TECH 2012).

All detected analytes will be retained as COPCs and carried through the screening-level HHRA (and quantitative HHRA, if needed), with the exception of inorganic chemicals determined to be related to background. The screening-level HHRA will be based on a ratiometric approach, using 95% upper confidence limit (UCL) exposure point concentrations (EPCs) and appropriate risk-based screening levels. The screening-level HHRA will be employed as an initial screening step to determine if a quantitative HHRA is required for each site. Screening-level risks and hazards for each site will be estimated by dividing selected chemical's 95% UCL EPCs by the associated cancer risk- and/or non-cancer hazard-based level, respectively), summing these fractions, and then scaling the results using a target cancer risk of 1E-6 and target non-cancer hazard of 1.0. For soil, surface water, and sediment, all detected constituents will be retained as COPCs and carried through the screening-level HHRA, and if required, the quantitative HHRA, except for background inorganics. If inorganics are found to be related to background, or related to concentrations measured in upstream surface water and/or sediment samples, then they will not be carried through into the screening-level HHRA.

Relevant exposure pathways include only those associated with soil: incidental ingestion, direct dermal contact, and inhalation for residential, occupational worker, and construction worker scenarios. Groundwater at IR Sites 34b and 34d is not a current source of drinking water and groundwater impacts from IR Sites 34b and 34d are not expected, therefore groundwater sampling is not planned and this medium will not be considered in the HHRA. The sites are currently vacant land and not used, therefore, no current receptors exist. The sites are located in a generally remote location, fenced, and not expected to be visited by trespassers. While there are no current plans for future site use, potential future use could consist of build out for occupational workers or residents. Occupational workers and construction workers will be the primary future receptors at IR Sites 34b and 34d. Future hypothetical residential adults and children will also be evaluated as potential receptors at IR Sites 34b and 34d to provide a baseline for the evaluation of potential recommendation of no further action. In summary, the receptors for the HHRA are as follows (as shown in the CSEM, Appendix C Figure 3):

- Future occupational workers,
- Future construction workers, and
- Hypothetical future residential adults and children.

A summary of potentially complete exposure pathways is provided in Appendix C Table 2. Exposure pathways and selected exposure factor values are discussed in the following sections. The EPC for each COPC present within an exposure medium (soil, surface water, and sediment) will be represented by the 95% UCL of the arithmetic mean concentration of the data set. For

the total soil medium, all surface and subsurface soil sample results for IR Sites 34b and 34d (separately) will be used to calculate the 95% UCL for the COPC. Potentially impacted media at IR Sites 34b and 34d that will be quantified in the HHRA are limited to soil, and for IR Site 34d, surface water and sediment. The equations, exposure factors, and assumptions for the receptor exposures at IR Sites 34b and 34d are provided in Tables 3 through 12 of Appendix C.

The most recently available toxicity factors recommended by California, and then as presented in U.S. EPA's Integrated Risk Information System database will be used, followed by the hierarchy of sources to fill in missing values, summarized as follows:

- Tier 1 – California Office of Environmental Health Hazard Assessment Toxicity Criteria Database
- Tier 2 – Integrated Risk Information System
- Tier 3 – Provisional Peer Reviewed Toxicity Values
- Tier 4 – Other Toxicity Values – including additional U.S. EPA and non-EPA sources of toxicity information, such as the Agency for Toxic Substances Disease Registry Minimum Risk Levels, and the Health Effects Assessment Summary Tables.

As quantitative toxicity criteria are not available for lead, U.S. EPA's Adult Lead Methodology will be used to evaluate risks associated with nonresidential adult exposures to lead in soil. The potential risks associated with residential exposures to lead will be addressed using the Integrated Exposure Uptake Biokinetic Lead Model for children.

For the assessment of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) congener sample results, the relative toxicity of 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD) will be used, based on U.S. EPA toxicity equivalency factors which corresponds to each congener's toxicity in relation to 2,3,7,8-TCDD. There are seventeen of these dioxin-like PCDDs and PCDFs that will be considered in the analysis to estimate the total 2,3,7,8-TCDD toxicity equivalent concentration.

Risk characterization for the HHRA will be presented as both quantitative and qualitative descriptions of exposure, land use, receptors, and risk/hazard. For exposures to potential carcinogens, the individual upper-bound excess lifetime cancer risk will be calculated by multiplying the estimated ingestion or dermal dose by the upper-bound cancer slope factor, while inhalation risks will be estimated by multiplying the estimated concentration in air (adjusted for exposure), by the inhalation unit risk. For noncarcinogens, potential adverse health effects for noncarcinogens will be calculated by means of the hazard index (HI) recommended. The calculated dose divided by the reference dose will be derived for each chemical. For inhalation hazards, the HI will be estimated by dividing the estimated concentration in air (adjusted for exposure, by the reference concentration.

The cumulative cancer risk for each Site will be compared with U.S. EPA's risk range of 1E-6 to 1E-4. The cumulative HIs for non-cancer effects will be compared with a target HI of 1. HIs that exceed an HI of 1 will be further evaluated by target organ. Receptor populations with estimated risks greater than 1E-6 and estimated HIs greater than 1 will be identified in the HHRA.

Based on the results of the HHRA, a list of constituents of concern (COCs) will be developed for each site. COCs will be defined as those chemicals that are present at concentrations exceeding a risk of 1E-6 and/or HI of 1, are not related to background or for surface water and sediment from IR Site 34d, and are not related to an upstream source.

4.2 SLERA Approach

As presented in detail in Appendix D, the primary objective of the SLERA will be to evaluate whether unacceptable adverse risks are or may be posed to ecological receptors as a result of hazardous substance releases (metals, VOCs, SVOCs, and dioxins/furans) at IR Sites 34b and 34d. The assessment objective will be met by characterizing the general plant and animal communities in the vicinity of IR Sites 34b and 34d, defining the particular hazardous substances affecting environmental media at the sites, identifying pathways for receptor exposure, estimating the potential for adverse impacts on ecological receptors, and determining the extent to which response actions are necessary. The three principal steps of SLERAs include:

- Problem formulation,
- Analysis, and
- Risk characterization.

A tiered-analysis approach will be used to perform the ecological risk assessment for the sites. Analysis and risk characterization results from each tier will be used as the basis for scientific/management decisions for no further action, immediate corrective measures, and/or to determine the need for implementation of more detailed evaluations of ecological risk (i.e., the next tier, such as a baseline ecological risk assessment [BERA]). A BERA, however, is currently outside the current scope, and if considered, would require a separate BERA work plan.

The results of the SLERA will be hazard quotients (HQs) and cumulative, which will be used to evaluate potential site-related risks to individuals and receptor populations and, if necessary, incorporated into additional levels of ecological risk assessment evaluation, as mentioned previously.

HQs and HIs will be estimated using ecological screening levels (ESLs) as published by Los Alamos National Laboratory (LANL) for a variety of wildlife species, as well as plant and soil invertebrate receptors, and aquatic receptors. LANL is recommended as the source of ESLs for

the SLERA because screening levels are available for many of these chemical constituents being evaluated, several of the receptors used by LANL are suitable to the Fallbrook California arid environment, values are available for surface water and sediment, in addition to soil, and both no effect and low effect ESLs are available.

Problem formulation is the first step in the SLERA and includes developing the ecological conceptual site model (CSM) and defining the assessment endpoints, ecological receptors, and constituents to be evaluated at IR Sites 34b and 34d. The ecological CSM is presented in Appendix D Figure 2.

Several native plant communities at NAVWPNSTA Seal Beach Det. Fallbrook provide habitat for wildlife, including perennial grassland, coastal sage scrub, chamise chaparral, coast live oak riparian woodland, willow riparian woodland, fresh emergent wetlands, and eucalyptus. Fauna common to the installation include many mammals (kangaroo rats, voles, deer, mice, bats, ground squirrels, opossum, rabbits, and coyotes), reptiles (orange-throated whiptails, rattlesnakes, and horned lizards), and birds (owls, kites, quails, sparrows, kingbirds, and hawks). Suitable habitat for one or more protected species (threatened or endangered) was found at each Site during the SI, as summarized below for IR Sites 34b and 34d:

- IR Site 34b — Vegetation in the area is considered mostly coastal sage scrub and provides suitable habitat for the Coastal California gnatcatcher and SKR, with some burrows observed at the site; therefore, both species could occur at the site.
- IR Site 34d — Vegetation in the area is a mix of oak woodland, riparian woodland, and coastal sage scrub. The Site provides suitable habitat for the Coastal California gnatcatcher, SKR, LBV, and SWFC; therefore, these species could occur at the site.

Sources of potential environmental contamination at IR Sites 34b and 34d result from potential releases associated burning and/or suspected disposal activities. Therefore, COPECs may include metals, VOCs, SVOCs, and dioxins/furans.

Media affected at both sites by constituent releases includes soil and potential bioaccumulation in biota. Release mechanisms generally involve deposition to surface soil, leaching, and overland runoff, although leaching is deemed minor (due to the likely considerable depth to groundwater). Surface water and sediment sampling is planned for IR Site 34d, as it is adjacent to Fallbrook Creek; therefore, exposure pathways associated with these media are also potential concerns. The SLERA will thus quantitatively assess representative receptor exposures to contaminated soil and biota, and for IR Site 34d, contaminated surface water and sediment.

Ecological risks are expressed in terms of a definite endpoint, which is defined as an environmental value to be protected. Assessment endpoints are explicit expressions of the actual environmental value that is to be protected. In the SLERAs, the general assessment endpoint is

the potential reduction in the receptor species due to exposure to site-related chemicals in affected media. The assessment endpoints will be addressed through the assessment of the potential reduction in the survival, growth, and reproduction of receptor populations at IR Sites 34b and 34d. The assessment endpoints will be evaluated using measures of effect (i.e., measurement endpoints) intended to reflect constituent concentrations in environmental media that do not threaten the survival, growth, and reproduction of receptor populations at the sites.

The ecological assessment endpoints and indicators and measures of effect are summarized in Table 1 of Appendix D, along with recommended representative ecological receptors. This list of wildlife receptors (summarized as follows) is contained in the LANL database, for a typical arid environment and these listed species may reasonably be expected to reside or regularly forage at IR Sites 34b and 34d, given current site conditions.

- Montane shrew
- American robin
- American kestrel
- Deer mouse
- Desert cottontail
- Red fox
- Occult little brown bat
- Violet-green swallow

Only limited surveys have been conducted at IR Sites 34b and 34d to characterize terrestrial and semi-aquatic wildlife species. Based on current and expected future site conditions (i.e., vacant land, with vegetation typical of the region), fauna at IR Sites 34b and 34d could include terrestrial invertebrates (e.g., insects), aquatic invertebrates at IR Site 34d (e.g., water column and sediment invertebrates), reptiles, birds, small mammals (e.g., rodents, bats), and larger carnivorous or omnivorous mammals (e.g., red fox). The representative receptor species selected for evaluation in the SLERA were based on those receptors in the LANL database that may be present in a typical arid environment and therefore may reside or forage at IR Sites 34b and/or 34d based on current conditions. The selected wildlife species are intended to represent the dominant trophic levels related to the vegetative communities present at IR Sites 34b and 34d.

IR Sites 34b and 34d are approximately 9 and 1.8 acres in size. These areas will be used to define exposure areas for incidental ingestion of soil and/or, ingestion of surface water from IR Site 34d, and ingestion of plant and prey species. Area use factors (AUFs) will be calculated by dividing the IR Sites 34b and 34d areas (affected by past site activities) by the representative receptor's average home range (also referred to as foraging range). In cases where the average

reported home range is less than the size of IR Sites 34b and 34d, the AUF will be assigned a default value of 1.0.

Effects relative to the assessment endpoints will be extrapolated from the measurement endpoints. The wildlife measurement endpoints selected for the SLERA are chronic No Observed Adverse Effect Levels (NOAELs) derived from controlled toxicity studies, which reflect protection of individual organisms. The measurement endpoints for terrestrial plants and invertebrates will be No Observed Effect Concentrations (NOECs) (receptor-specific benchmark concentrations) in soil. The measurement endpoints for aquatic invertebrates will be NOECs (receptor-specific benchmark concentrations) in surface water and sediment. The NOAEL is a dose of each preliminary COPEC that will produce no known adverse effects on the test species. For the SLERA, NOAELs, as represented by the wildlife-specific NOAEL-based ESLs published by LANL will conservatively be used. In addition, Lowest Observed Adverse Effect Level (LOAEL)/ Lowest Observed Effect Concentration (LOEC) values will be used, which are the lowest dose/exposure concentration of a COPEC at which an adverse effect is observed, and is often considered a more appropriate measure of population-level effects compared with NOAELs. Therefore, the SLERA measures of effect will include both chronic NOAELs/NOECs and LOAELs/LOECs, as represented by the wildlife-specific LOAEL-based ESL published by LANL.

Exposure point concentrations (95% UCL EPCs) and consideration of background will follow the same approach as proposed for the HHRA. The soil exposure intervals, 0 to 2 feet bgs and 2 to 6 feet bgs will be used in the SLERA to evaluate ecological receptor exposures to these two depth intervals. Soil data from the SI for IR Sites 34b and 34d will be merged with the soil data to be collected as part of the RI, in order to generate a more complete and robust data set for use in the SLERA.

Potentially complete pathways for the SLERA are generalized and assume that terrestrial wildlife receptors may be associated with the following pathways: ingestion of soils, ingestion of vegetation, and ingestion of prey items. Semi-aquatic wildlife receptors may be associated with the following pathways: ingestion of surface water and ingestion of prey items (e.g., flying insects that have absorbed constituents from contaminated sediments). In addition, terrestrial wildlife are also assumed to ingest surface water.

Quantification of exposure requires the consideration of numerous variables, including determination of a chemical exposure point concentration, the calculation of food intake rates for site receptors (on a body weight basis), surface water ingestion, incidental soil ingestion, and bioaccumulation in food items. However, rather than calculate intake for each recommended wildlife receptor, wildlife-specific ESLs from LANL will be used to estimate hazards. This

approach is recommended because the LANL ESLs were generally developed to assess arid ecological receptors (as may exist at IR Sites 34b and 34d).

For the assessment of PCDD and PCDF congener sample results, the relative toxicity of 2,3,7,8-TCDD will be used for mammals (similar to the approach recommended for the HHRA), based on mammalian toxicity equivalency factors which corresponds to each congener's toxicity in relation to 2,3,7,8-TCDD. For avian receptors, avian toxicity equivalency factors will be used. Therefore, separate mammalian and avian 2,3,7,8-TCDD toxicity equivalent concentrations will be estimated using site data.

Risk estimation consists of integration of exposure and toxicity, and will result in numerical measurements referred to as HQs and HIs, including the use of AUFs. Risk description will consist of summarizing conclusions of the risk estimates, presenting a weight-of-evidence analysis of the risk estimates, and addressing the uncertainty, assumptions, and limitations of the risk estimates. The SLERA will estimate potential adverse effects occurring as a result of exposure of the selected site receptors to COPECs. This will be done separately for terrestrial wildlife versus plants and soil invertebrates, and semi-aquatic wildlife versus surface water and sediment invertebrates.

While individual constituents may affect distinct target organs or systems within an organism, some chemicals may act in similar ways, thus being additive in effect. HQs will be summed for each receptor at IR Sites 34b and 34d for COPECs that exhibit similar modes of toxicity or effects endpoints.

NOAEL-based HQs and/or HIs that are greater than 1.0 will indicate that the associated COPECs qualify as preliminary COCs. Preliminary COCs will be further evaluated to determine the actual likelihood of harm to ecological receptors using LOAEL-based LANL ESLs, if there is no direct evidence of threatened or endangered species at either of the sites. The final COCs will be determined only after an additional weight-of-evidence evaluation of the conservatism of the exposure assumptions, toxicity values, and other uncertainties. A variety of criteria will be considered in the final determination of whether a given chemical at IR Sites 34b and/or 34d is a COC (likely to cause adverse effects), not a COC (unlikely to cause adverse effects), or requires further analysis or data collection to reduce uncertainty (i.e., a BERA).

Section 5 Project Management Plan

This section presents the site management structure, project organization, key personnel, and schedule.

5.1 Project Organization and Key Personnel

The project team consists of the CFS program manager and Trevet's project manager, field team lead, site safety and health officer, and quality assurance manager. The bullets below outline the project team member's roles.

- The CFS program manager, Rich Wong, will provide overall project guidance and will facilitate interaction between the DON and subcontractors.
- Trevet's project manager, John Willis, will have overall responsibility for all aspects of the project and for communications between Trevet and the DON.
- Day-to-day operations and subcontractor oversight is the responsibility of the field team leader (to be determined), who will report to the project manager on a regular basis.
- The site safety and health officer (to be determined) will have responsibilities including oversight and review of all SSHPs, plan implementation, and policy conformance by all field personnel and subcontractors at the site.
- The quality assurance manager, Gerald Tamashiro, is responsible for all contractual quality assurance and quality control requirements as well as in-house quality assurance requirements for project deliverables and subcontractor work products.
- Technical review will be conducted by an in-house senior staff member to assure that all documents are reviewed and internally consistent prior to submittal to the DON.

A project organization chart is provided in SAP Worksheet #5 (Appendix A).

5.2 Project Schedule

The anticipated project schedule is presented in Worksheet #16 of the SAP (Appendix A).

The RI field investigation is anticipated to be conducted in June 2015.

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Section 6 References

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Tables

Table 1. Background Metals Concentrations

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Table 1. Background Metals Concentrations
Naval Weapons Station Seal Beach Detachment Fallbrook

Analyte	Background Threshold Value[1] (mg/kg)
Aluminum†	32,836
Antimony	<0.61 to 3.3*
Arsenic	2.856
Barium	363.5
Beryllium	0.466
Cadmium	0.199
Calcium†	6,828
Chromium	63.8
Cobalt	20.4
Copper	53.4
Iron†	30,800
Lead	6.836
Magnesium†	15,685
Manganese†	532.7
Molybdenum	--
Nickel	15
Potassium†	6,210
Selenium	0.608
Silver	0.0774
Sodium†	679.5
Strontium†	58.7
Thallium	0.606
Tin†	<1.2 to 55.7*
Vanadium	186.4
Zinc	228.2
Mercury	0.0186

Notes:
[1] - Background threshold values are based on 95% upper tolerance limits applicable to saprolitic soil derived from granitic rock (gabbro/granodiorite/tonalite) at Naval Weapons Station Seal Beach Detachment Fallbrook. Values from *Basewide Metals Background Soil Study* (SES-TECH 2012).
* - Asterisk indicates that the analyte was not detected above the reporting limit in the background study (SES-TECH 2012). Indicated values represent the range of reporting limits in the background study.

Abbreviations and Acronyms:
-- - not included in background study
† - analyte is not an EPA priority pollutant or CAM 17 metal
mg/kg - milligrams per kilogram

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Figures

Figure 1. Site Location Map
Figure 2. IR Site 34b Site Plan
Figure 3. IR Site 34d Site Plan
Figure 4. Site Geology and Hydrogeology
Figure 5. Proposed Test Pit Locations at IR Site 34b
Figure 6. Proposed Test Pit Locations at IR Site 34d

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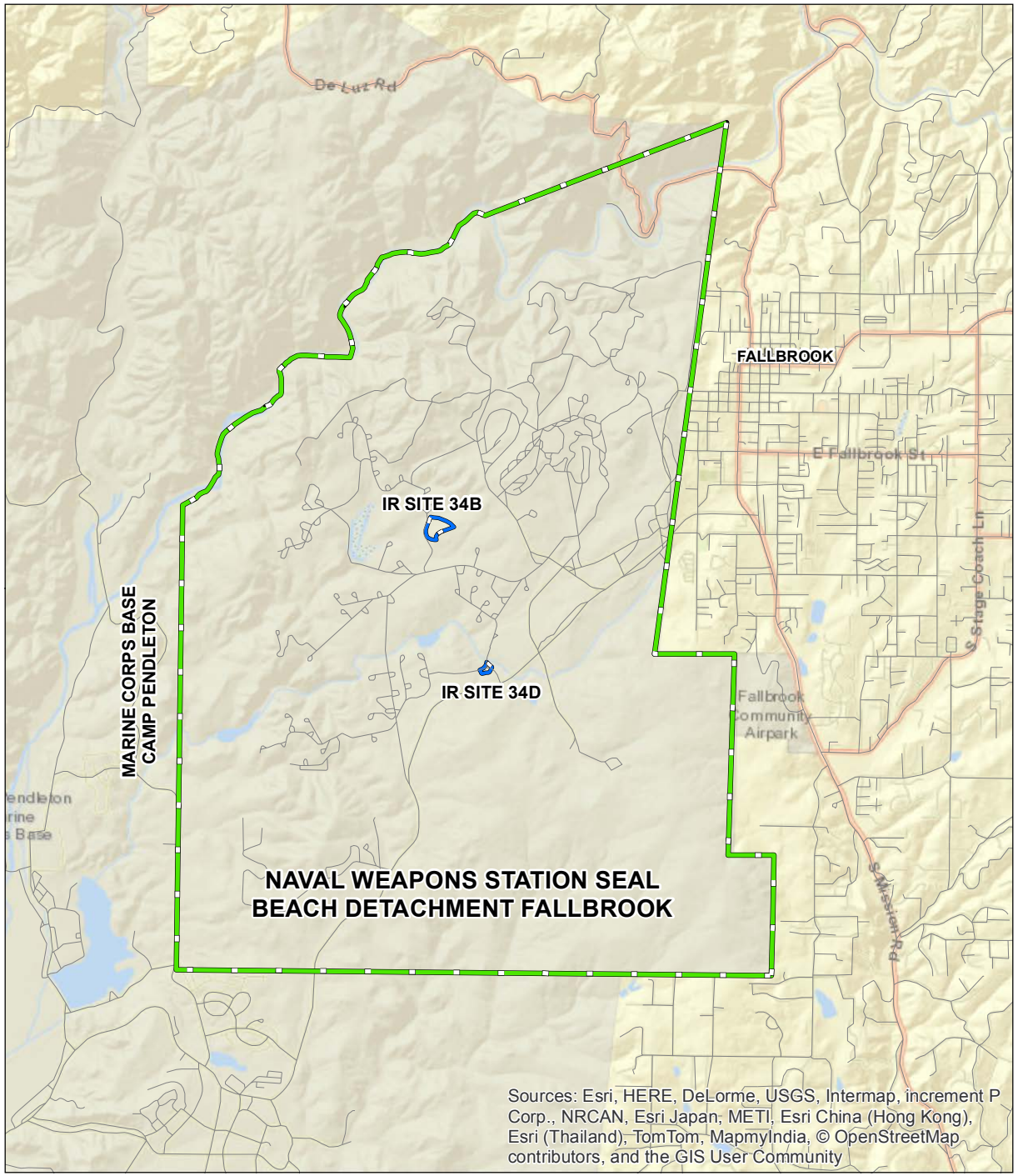
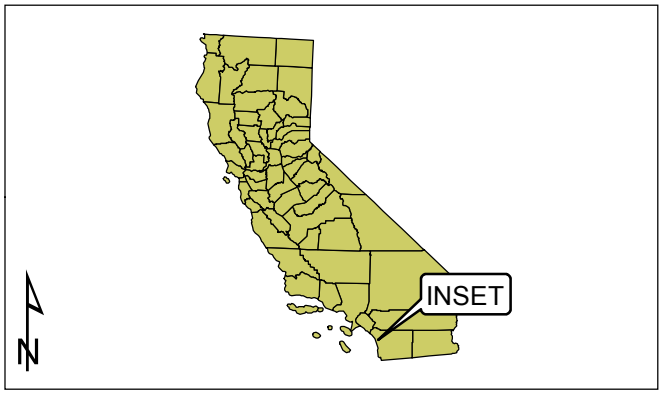
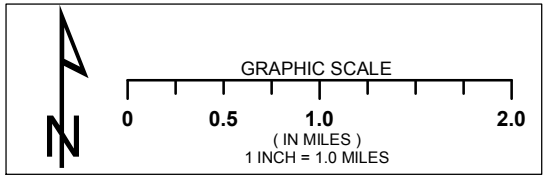




LEGEND

IR SITE BOUNDARY

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT FALLBROOK



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 1

SITE LOCATION MAP

TREVET

DATE: MAY 2015

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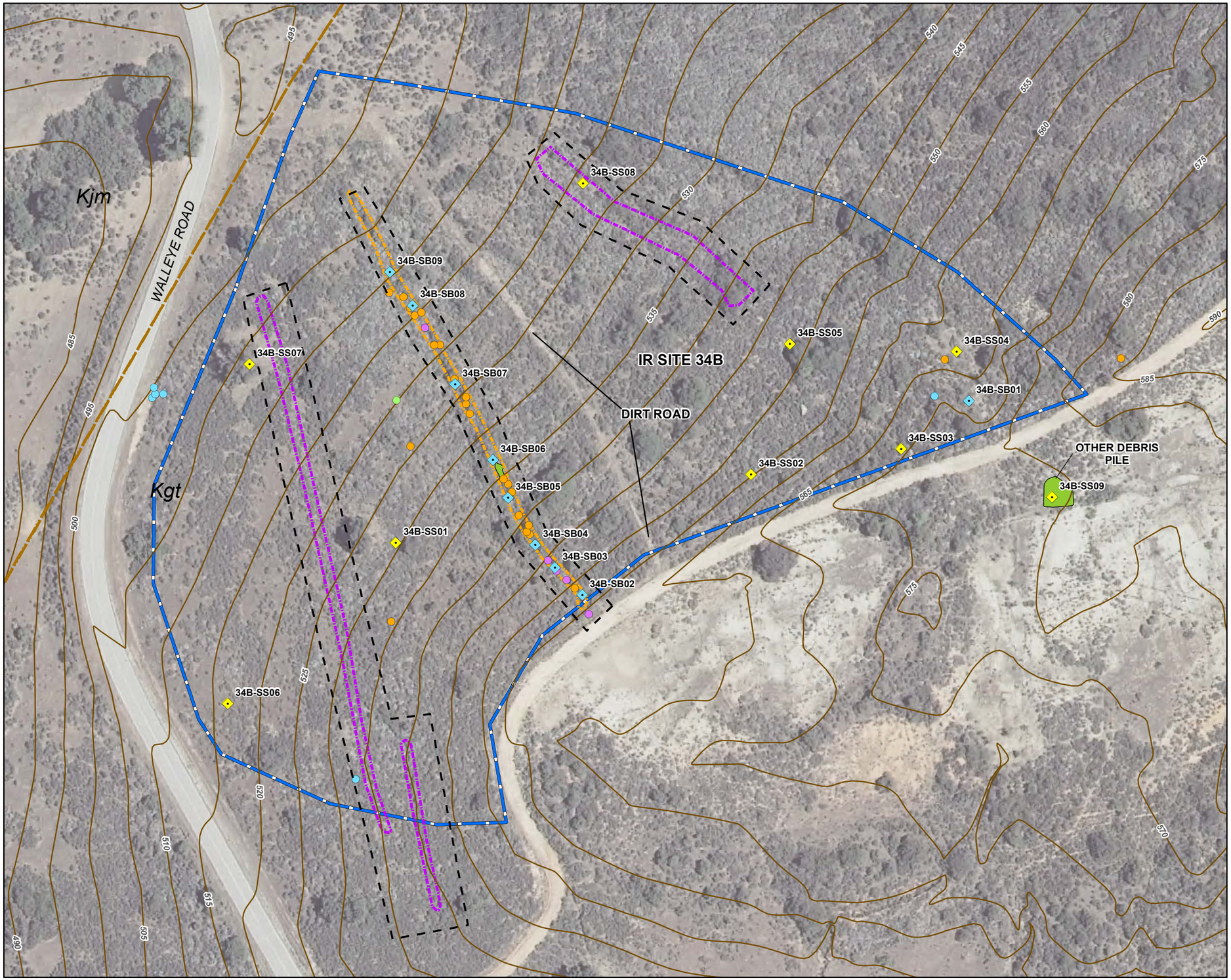

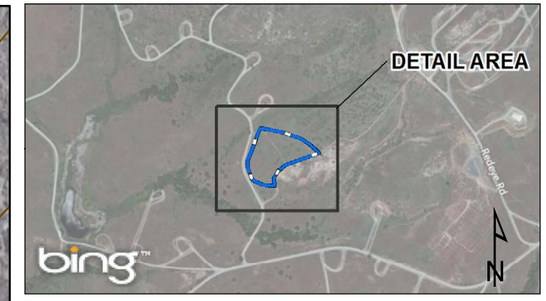

LEGEND

- MAGNETIC ANOMALIES
- METAL DEBRIS
- CONSTRUCTION DEBRIS
- OTHER DEBRIS
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- WASTE DISPOSAL TRENCH
- GEOLOGIC CONTACT
- TOPOGRAPHIC CONTOUR
- PREVIOUSLY SUSPECTED TRENCH AREA
- GEOPHYSICAL INVESTIGATION AREA
- IR SITE 34B BOUNDARY

NOTES::
Kjm - METAVOLCANICS
Kgt - TONALITE

SOURCE:
GOOGLE MAPS AERIAL IMAGE

N

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 2

IR SITE 34B SITE PLAN

TREVET

DATE: MAY 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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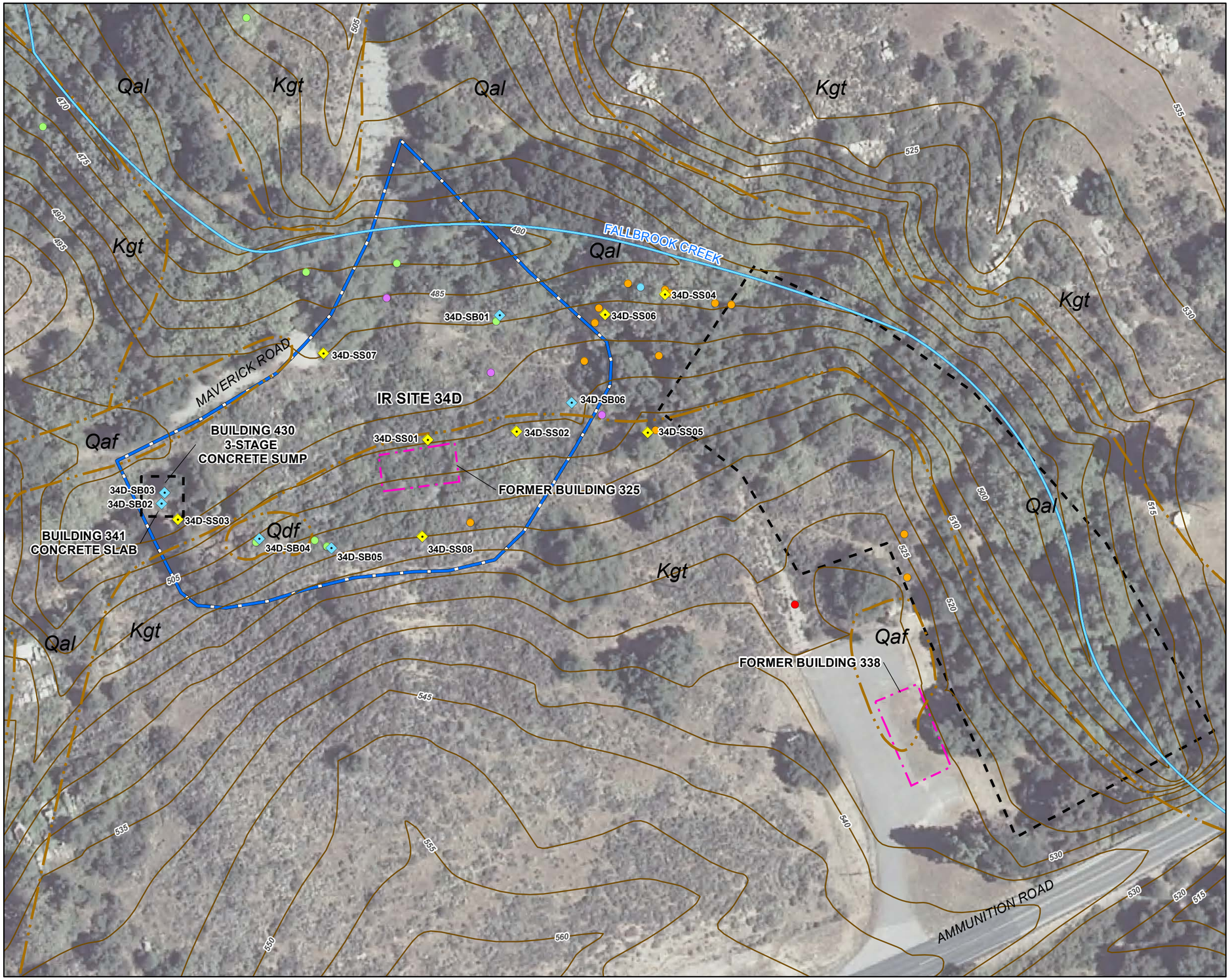

LEGEND

- MAGNETIC ANOMALIES
- 5.56-MM BLANK CASING
- METAL DEBRIS
- CONSTRUCTION DEBRIS
- OTHER DEBRIS
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- GEOLOGIC CONTACT (CHADUXTT 2010)
- TOPOGRAPHIC CONTOUR
- FORMER BUILDING
- OFFSITE INVESTIGATION AREA
- IR SITE34D BOUNDARY

NOTES:
Qdf - DEBRIS FILL
Qaf - ARTIFICIAL FILL
Qal - ALLUVIUM
Kgt - TONALITE

SOURCE:
GOOGLE MAPS AERIAL IMAGE

N

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 3

IR SITE 34D SITE PLAN

TREVET

DATE: MAY 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

Document Path: N:\GIS_Projects\Fallbrook\Figs_Work\Plan_34bd-5-15\Fig3_ir34D_SitePlan_5-15.mxd

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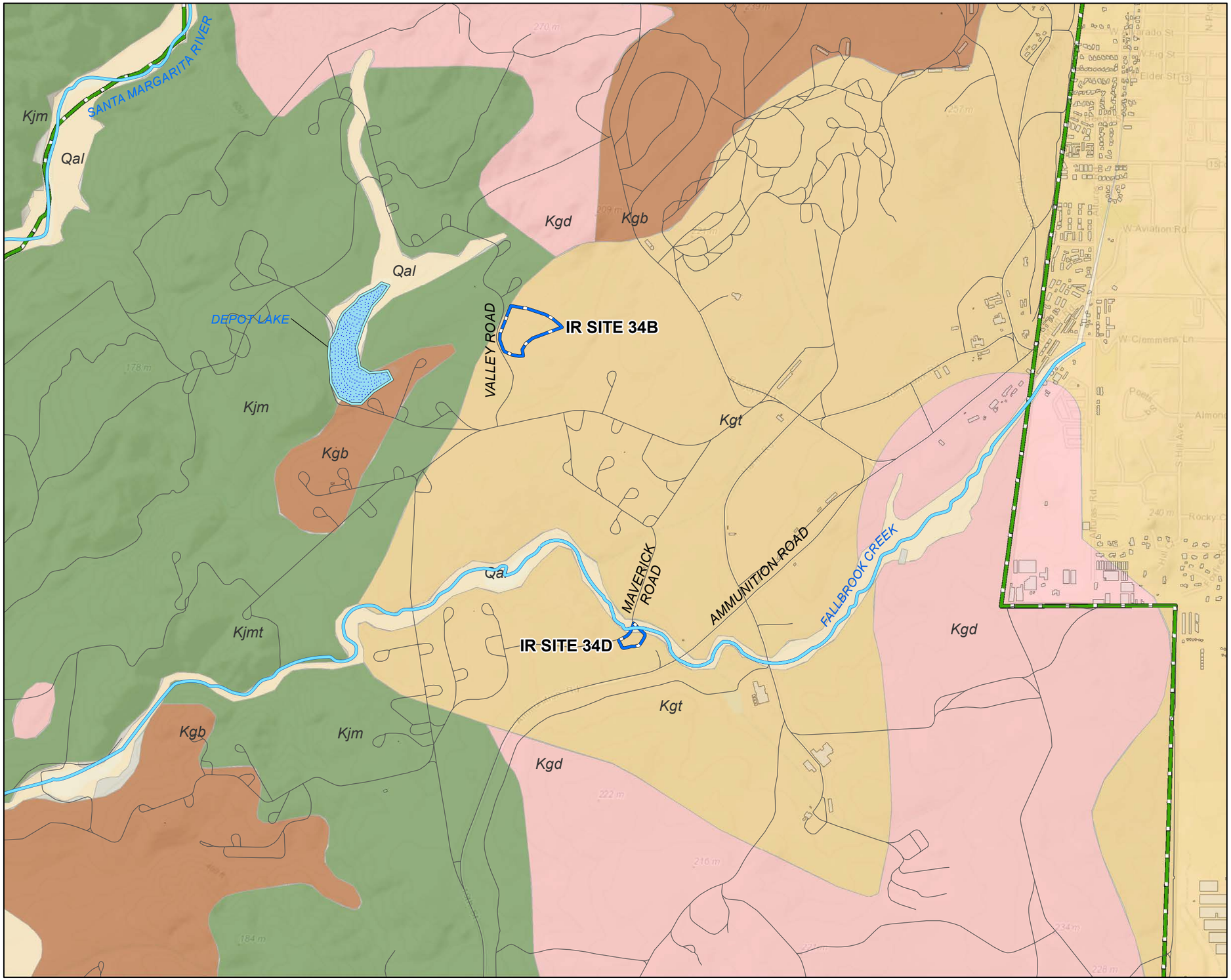

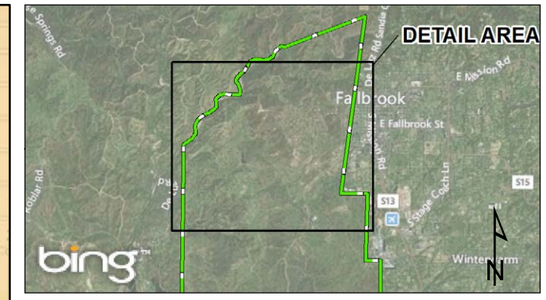

LEGEND

- Kjm - METAVOLCANICS
- Kgb - DIORITE/GABBRO
- Kgt - TONALITE
- Kgd - GRANODIORITE
- Qal - ALLUVIUM
- IR SITE BOUNDARY
- NAVAL WEAPONS STATION SEAL BEACH DETACHMENT FALLBROOK

N

GRAPHIC SCALE

0 750 1500 3000

(IN FEET)
1 INCH = 1500 FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

NAVFAC Naval Facilities Engineering Command NAVFAC SOUTHWEST

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 4

SITE GEOLOGY AND HYDROGEOLOGY

TREVET

DATE: MAY 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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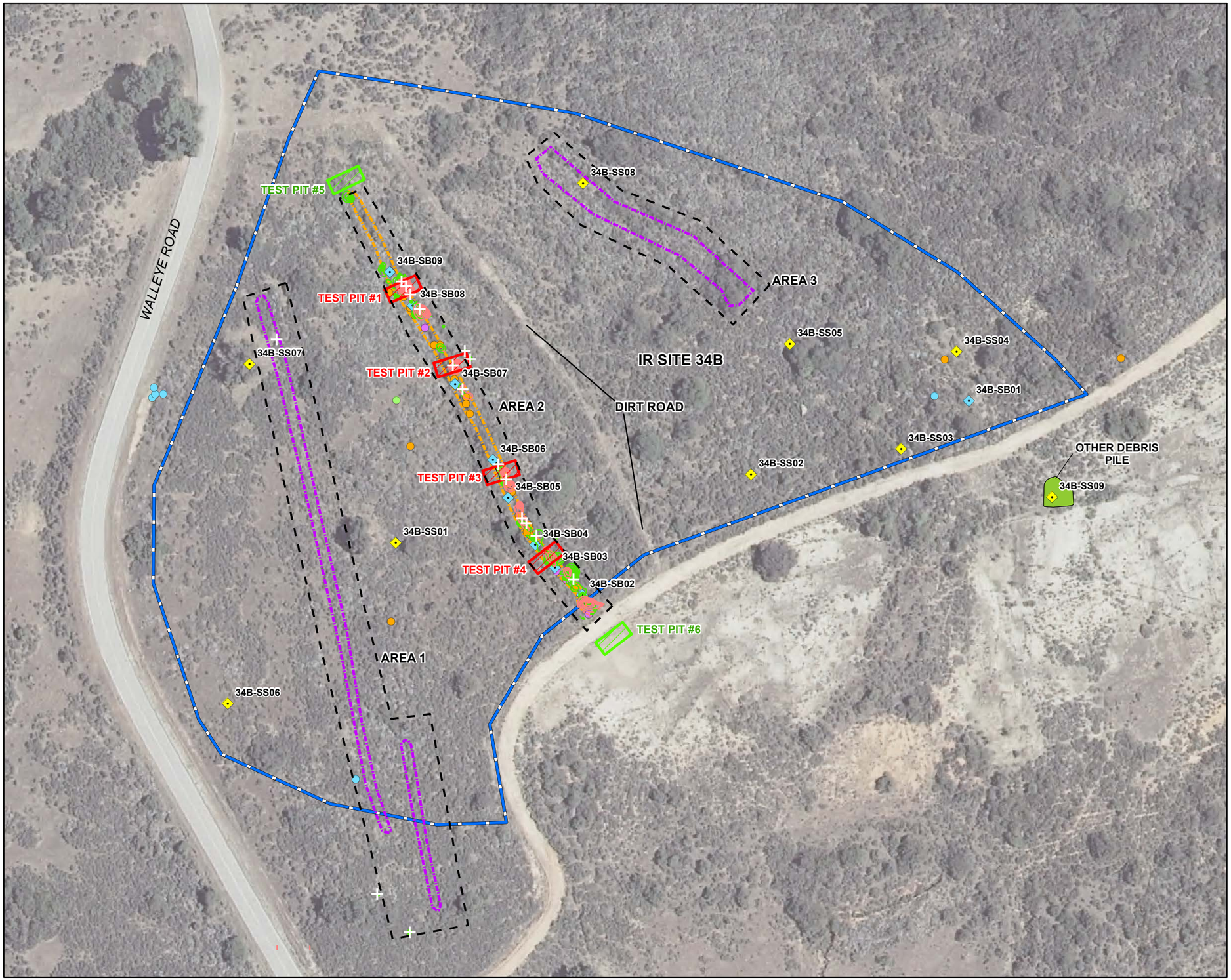

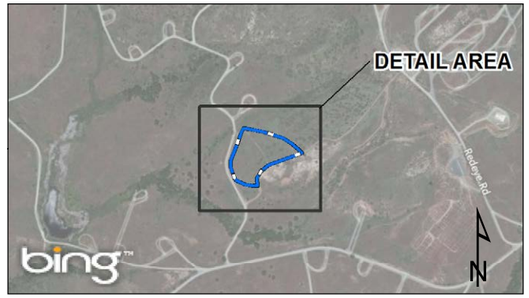

LEGEND

- METAL JUNK AT SURFACE (GEOPHYSICAL)
- MAGNETIC ANOMALIES (IDENTIFIED IN SI)
- METAL DEBRIS (IDENTIFIED IN SI)
- CONSTRUCTION DEBRIS (IDENTIFIED IN SI)
- OTHER DEBRIS (IDENTIFIED IN SI)
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PROPOSED WASTE TEST PIT
- PROPOSED EXPLORATORY TEST PIT
- WASTE DISPOSAL TRENCH
- MAGNETIC ANOMALIES (GEOPHYSICAL)
- EM ANOMALIES (GEOPHYSICAL)
- PREVIOUSLY SUSPECTED TRENCH AREA
- GEOPHYSICAL INVESTIGATION AREA
- IR SITE 34B BOUNDARY

SOURCE:
GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 5

PROPOSED TEST PIT LOCATIONS AT IR SITE 34B

TREVET

DATE: MAY 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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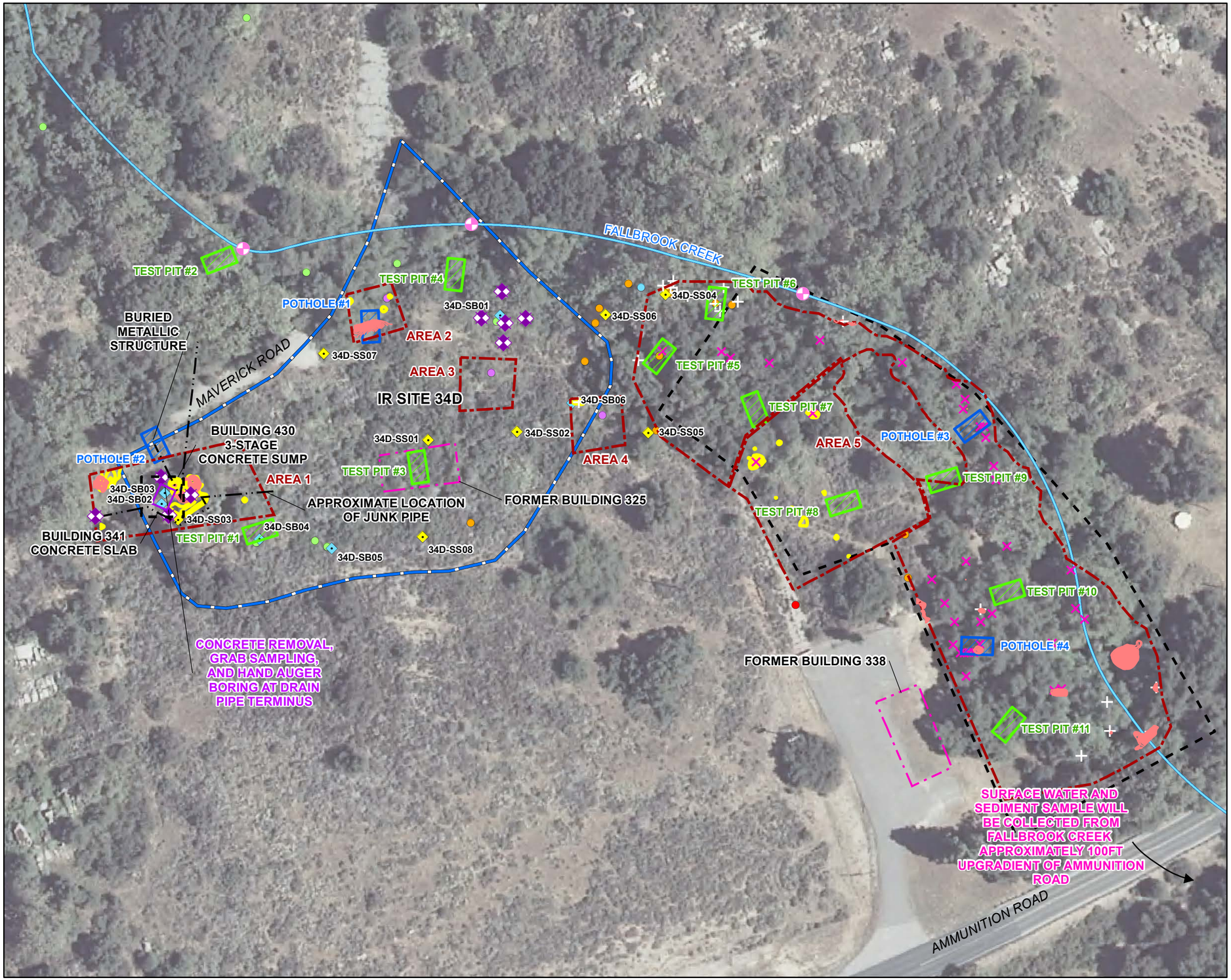

LEGEND

- METAL JUNK SUBSURFACE (GEOPHYSICAL)
- METAL JUNK AT SURFACE (GEOPHYSICAL)
- MAGNETIC ANOMALIES (IDENTIFIED IN SI)
- 5.56-MM BLANK CASING (IDENTIFIED IN SI)
- METAL DEBRIS (IDENTIFIED IN SI)
- CONSTRUCTION DEBRIS (IDENTIFIED IN SI)
- OTHER DEBRIS (IDENTIFIED IN SI)
- PROPOSED HAND AUGER BORING
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATION
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PROPOSED EXPLORATORY TEST PIT
- PROPOSED POTHOLE TEST PIT
- MAGNETIC ANOMALIES (GEOPHYSICAL)
- EM ANOMALIES (GEOPHYSICAL)
- GEOPHYSICAL SURVEY AREA
- FORMER BUILDING
- OFFSITE INVESTIGATION AREA
- IR SITE34D BOUNDARY

SOURCE: GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE

0 50 100 200

(IN FEET)
1 INCH = 100 FEET

N

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA
NAVFAC Naval Facilities Engineering Command NAVFAC SOUTHWEST

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 6

PROPOSED TEST PIT LOCATIONS AT IR SITE 34D

TREVET

DATE: MAY 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

Document Path: N:\GIS_Projects\Fallbrook\Figs_WorkPlan_34bd-5-15\Fig6_ir34D_SampPlan_5-15.mxd

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Appendix A: Sampling and Analysis Plan

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FINAL

Appendix A
Sampling and Analysis Plan
Remedial Investigation at IR Sites 34b and 34d

Naval Weapons Station Seal Beach Detachment Fallbrook
Fallbrook, California

May 2015

Prepared for:

Naval Facilities Engineering Command Southwest
1220 Pacific Highway
San Diego, California 92123-5190

Prepared by:

CB&I Federal Services
1230 Columbia Street, Suite 1200
San Diego, CA 92101

Prepared under:
Contract Number: N62473-10-D-4009
Task Order Number: 0096
DCN: CBI-4009-0096-2146

In Coordination will:

9888 Carroll Centre Road, Suite 228
San Diego, California 92126

SAP Worksheet #1 — Title and Approval Page

Final
SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)

May 2015

Remedial Investigation at IR Sites 34b and 34d
Naval Weapons Station Seal Beach Detachment Fallbrook
Fallbrook, California

Prepared for:
Naval Facilities Engineering Command Southwest
1220 Pacific Highway
San Diego, California 92132-5190

Prepared by:
CB&I Federal Services
1230 Columbia Street, Suite 1200
San Diego, CA 92101

Prepared under:
Contract Number: N62473-10-D-4009
Task Order Number: 0096
DCN: CBI-4009-0096-2146

In Coordination with:
Trevet
9888 Carroll Centre Road, Suite 228
San Diego, California 92126
(858) 578-8859

Reviewed By: _____ 5/18/15
Gerald Tamashiro — Date
Quality Control Manager
Trevet

Approved By: _____ for Joseph Michalowski 5/29/15
Joseph Michalowski — Date
Quality Assurance Officer
NAVFAC SW

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Executive Summary

Trevet has prepared this Sampling and Analysis Plan (SAP) to conduct a Remedial Investigation (RI) at Installation Restoration (IR) Sites 34b and 34d which are located within the Naval Weapons Station (NAVWPNSTA) Seal Beach Detachment Fallbrook in Fallbrook, California (Figure 1). This SAP (Appendix A of the Work Plan) was prepared on behalf of CB&I Federal Services (CFS) under contract with the United States Department of the Navy, Naval Facilities Engineering Command Southwest (NAVFAC SW) under Contract No. N62473-10-D-4009, Task Order No. 0096.

This SAP provides guidance on sampling, analysis, and quality assurance (QA) to further assess potential risk to human health and the environment from historical site uses of IR Sites 34b and 34d. This SAP will be used as a reference document by all field and laboratory personnel engaged in sampling and analysis for the project. The document will be provided to individuals listed in Worksheet #4. Included in this SAP are data quality objectives, field sampling procedures, QA/quality control requirements, and data collection methods that will be used during the project. This SAP is prepared in accordance with United States Environmental Protection Agency (U.S. EPA) requirements: *Uniform Federal Policy for Quality Assurance Project Plans* (IDQTF 2005) and *EPA Guidance for QA Project Plans* (USEPA 2002).

The purpose of this RI is to characterize the nature and extent of soil contamination related to possible past dunnage disposal at IR Sites 34b and 34d. Potential sediment and surface water contamination in Fallbrook Creek will also be characterized at IR Site 34d. These sites have been grouped together because of the sites' similar contaminants, histories, and position in the CERCLA response process. Soil impacts at these sites are thought to be associated with the deposition of dunnage and other debris on the ground surface or in shallow trenches. Dunnage includes generally low-value packing materials used for shipping products, presumably munitions at NAVWPNSTA Seal Beach Det. Fallbrook. The RI will characterize impacted soil (and sediment and surface water at IR Site 34d) to evaluate the extent of chemicals of potential concern (COPC) to human health and/or chemicals of potential ecological concern (COPEC) in the environment. Based on historical site uses, COPCs and COPECs at each site include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides/PCBs (at IR Site 34b) and dioxins and furans. The RI field investigation for IR Site 34d includes an offsite area adjacent east of IR Site 34d where debris was observed during the Site Inspection (SI) (ChaduxTt 2010). Based on the findings of the RI field investigation, the RI report will recommend either further action, such as additional characterization or a remedial response, or no further action.

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Attachments:

Attachment 1: Field Forms
Attachment 2: Analytical Laboratory Standard Operating Procedures
Attachment 3: Analytical Laboratory ELAP Certification

Acronyms and Abbreviations

°C	degrees Celsius
µg/L	microgram per liter
µg/kg	microgram per kilogram
AOC	area of concern
bgs	below ground surface
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	CB&I Federal Services
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
Det.	Detachment
DL	detection limit
DOT	Department of Transportation
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EDL	estimated detection limit
EMAX	EMAX Laboratories, Inc.
ESL	ecological screening level
FS	Feasibility Study
H&S	Health and Safety
HHRA	human health risk assessment
IDW	investigation-derived waste
IR	Installation Restoration
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
LDC	Laboratory Data Consultants, Inc.
LOD	limit of detection
LOQ	limit of quantitation
MC	munitions constituents
MEC	munitions and explosives of concern

Acronyms and Abbreviations (continued)

mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NAVFAC SW	Naval Facilities Engineering Command Southwest
NAVWPNSTA	Naval Weapons Station
ng/kg	nanograms per kilogram
NIRIS	Naval Installation Restoration Information Solution
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PARCC	precision, accuracy, representativeness, completeness, and comparability
pg/L	picograms per liter
PM	project manager
PRG	preliminary remediation goal
QA	quality assurance
QAO	quality assurance officer
QC	quality control
QCM	quality control manager
QL	quantitation limit
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RPD	relative percent difference
RPM	remedial project manager
RSL	regional screening level
RWQCB	California Regional Water Quality Control Board
SAP	sampling and analysis plan
SI	Site Inspection
SLERA	screening-level ecological risk assessment
SOP	standard operating procedure
SVOC	semivolatile organic compound
TOC	total organic carbon
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
U.S. EPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VOC	volatile organic compound

SAP Worksheet #2 — SAP Identifying Information

Site Name/Number: IR Sites 34b and 34d
Contractor Name: CB&I Federal Services (CFS)
Contract Number: N62473-10-D-4009, Task Order Number 0096
Contract Title: Environmental Services for NAVFAC SW Footprint, San Diego, California

Work Assignment Number (optional): Not Applicable

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (IDQTF 2005), and *Guidance for Quality Assurance Project Plans* (USEPA 2002). In accordance with the requirements of contract number N62473-10-D-4009.

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

3. This is a project-specific SAP that supports the *Work Plan for RI at IR Sites 34b and 34d, Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California*.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Meeting with Navy, CFS, Recon, and Trevet	May 7, 2014

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
Final Sampling and Analysis Plan (Field Sampling and/Quality Assurance Project Plan) Site Inspection for Installation Restoration Program Sites 32, 34b, 34d, and 34e and Munitions Response Program Sites UXO1, UXO2, UXO3, UXO4, UXO6, and UXO7, Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California. December 5.	December 2008

6. List organizational partners (stakeholders) and connection with lead organization:

Organization Partners/Stakeholders	Connection
California Department of Toxic Substances Control (DTSC)	State Regulatory Agency

SAP Worksheet #2 (continued)

California Regional Water Quality Control Board (RWQCB), San Diego Region	State Regulatory Agency
NAVFAC SW	Navy
NAVWPNSTA Seal Beach Detachment (Det.) Fallbrook	Base

7. Lead organization: Navy

8. If any required information or SAP elements are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation.

No SAP elements have been excluded from the document.

SAP Worksheet #2 (continued)

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	
2	SAP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
Project Organization		
5	Project Organizational Chart	
6	Communication Pathways	
7	Personnel Responsibilities and Qualifications Table	
8	Special Personnel Training Requirements Table	
Project Planning/Problem Definition		
9	Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	
11	Site-Specific Project Quality Objectives	
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	
14	Summary of Project Tasks	
15	Reference Limits and Evaluation Table	
16	Project Schedule/Timeline Table	
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	
18	Sampling Locations and Methods/Standard Operating Procedures (SOP) Requirements Table	
19	Analytical Methods/SOP Requirements Table	
20	Field Quality Control Sample Summary Table	
21	Project Sampling SOP References Table	
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	
Analytical Tasks		
23	Analytical SOP References Table	
24	Analytical Instrument Calibration Table	
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
Sample Collection		
26	Sample Handling System	
27	Sample Custody Requirements	
Quality Control Samples		

SAP Worksheet #2 (continued)

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
28	Laboratory Quality Control Samples Table	
Data Management Tasks		
29	Project Documents and Records Table	
30	Analytical Services Table	
C. Assessment Oversight		
31	Planned Project Assessments Table	
32	Assessment Findings and Corrective Action	
33	Quality Assurance Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	
35	Validation (Steps IIa and IIb) Process Table	
36	Validation (Steps IIa and IIb) Summary Table	
37	Usability Assessment	

SAP Worksheet #3 — Distribution List

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Ann Colt	Remedial Project Manager (RPM)	NAVFAC SW	(619) 532-1156	ann.colt@navy.mil
Margaret Wallerstein	Activity Point of Contact	NAVWPNSTA Seal Beach	(562) 626-7838	margaret.wallerstein.ctr@navy.mil
Joseph Michalowski	Quality Assurance Officer (QAO)	NAVFAC SW	(619) 532-4125	joseph.michalowski@navy.mil
Diane Silva	Administrative Records Manager	NAVFAC SW	(619) 532-3676	diane.silva@navy.mil
Stephen Niou	State Project Manager (PM)	DTSC	(714) 484-5458	stephen.niou@dtsc.ca.gov
Beatrice Griffey	State PM	RWQCB	(619) 521-3342	beatrice.griffey@waterboards.ca.gov
Richard Wong	CFS Program Manger	CFS	(619) 446-4543	rich.wong@cbifederalservices.com
Amanda Elmore	CFS PM	CFS	(619) 446-4510	amanda.elmore@cbifederalservices.com
John Willis	Trevet PM	Trevet	(858) 578-8859	jwillis@trevetinc.com
Bob Breglio	Technical Lead	Trevet	(619) 733-8538	bob@trevetinc.com
Gerald Tamashiro	Program Quality Control Manager (QCM)	Trevet	(714) 200-3826	gerald@trevetinc.com
Matt Fuller	Field Team Lead	Trevet	(858) 578-8859	mfuller@trevetinc.com
Jordana Bjorkman	Project Chemist	Trevet	(858) 578-8859	jbjorkman@trevetinc.com
Ye Myint	PM (analytical services)	EMAX Laboratories, Inc. (EMAX)	(310) 618-8889	ymyint@emaxlabs.com
Nicole Brown	PM (analytical services)	ALS Laboratories, Inc. (ALS)	(281) 575-2284	nicole.brown@alsglobal.com
Andrew Kong	PM (data validation)	Laboratory Data Consultants, Inc. (LDC)	(760) 634-0437	akong@lab-data.com

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SAP Worksheet #4 — Project Personnel Sign-Off Sheet

Project Personnel	Organization	Title	Signature	Date SAP Read
John Willis	Trevet	PM		
Matt Fuller	Trevet	Field Team Lead		
Ye Myint	EMAX	PM		
Nicole Brown	ALS	PM		
Andrew Kong	LDC	Data Validator		

Worksheet #4 will be completed after the final version of this SAP is submitted. The signed and dated version of Worksheet #4 will be maintained in Trevet's project file, as specified in SAP Worksheet #29.

ALS – ALS Laboratories, Inc.
EMAX – EMAX Laboratories, Inc.
LDC – Laboratory Data Consultants, Inc.
PM – Project Manager
SAP – Sampling and Analysis Plan

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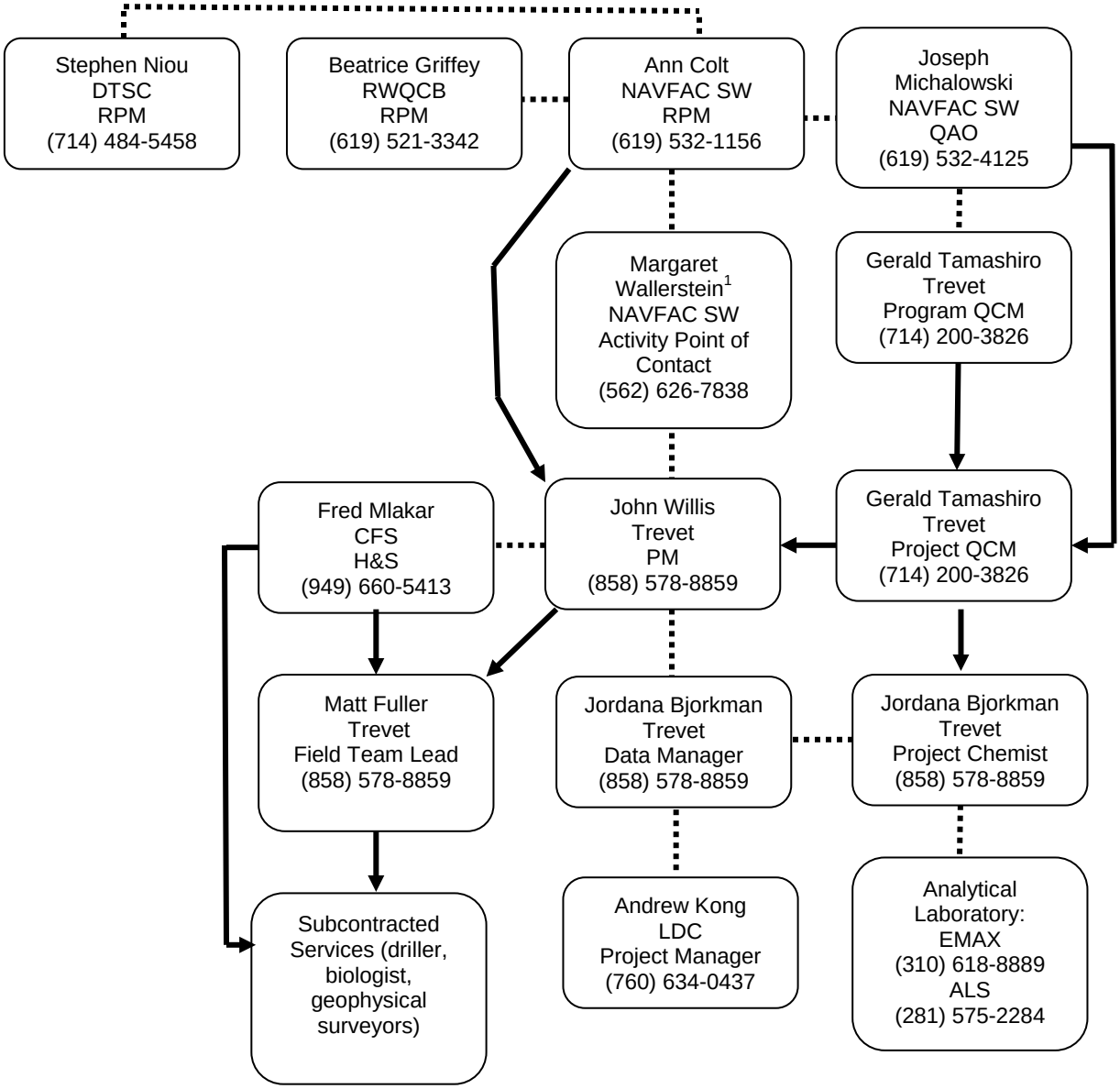
SAP Worksheet #5 — Project Organizational Chart



1 Ms. Margaret Wallerstein is not subordinate to Ms. Ann Colt but is shown on the second line because of space constraints.

ALS – ALS Laboratories, Inc.

EMAX – EMAX Laboratories, Inc.

H&S – Health and Safety

LDC – Laboratory Data Consultants, Inc.

NAVFAC SW – Naval Facilities Engineering Command Southwest

PM – Project Manager

QAO – Quality Assurance Officer

QCM – Quality Control Manager

RPM – Remedial Project Manager

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SAP Worksheet #6 — Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Notification – field sampling activities	Trevet PM	John Willis	(858) 578-8859	One week prior to mobilization of field sampling teams, an e-mail or phone call to the NAVFAC SW RPM from the Trevet PM to confirm the sampling start date and duration.
Notification – laboratory notification and coordination	Trevet Project Chemist	Jordana Bjorkman	(858) 578-8859	One week prior to mobilization of field sampling team, phone call to EMAX from Trevet Project Chemist to coordinate sample supplies and courier pickup of samples.
Stop work	NAVFAC SW QAO	Joseph Michalowski	(619) 532-4125	If a quality issue arises that warrants a stop work order, an immediate phone call to the Trevet QCM from the NAVFAC SW QAO will occur, and a stop work order will be issued.
Stop work	NAVFAC SW RPM	Ann Colt	(619) 532-1156	If an issue arises that warrants a stop work order, an immediate phone call to the Trevet PM from the NAVFAC SW RPM will occur, and a stop work order will be issued.
Stop work	NAVFAC SW Safety Officer	Almario Erasquin	(619) 556-7938	If a safety issue arises that warrants a stop work order, an immediate phone call to the Trevet Health and Safety Officer from the NAVFAC SW Safety Officer will occur, and a stop work order will be issued.
Stop work	Trevet QCM	Gerald Tamashiro	(714) 200-3826	If a quality issue arises that warrants a stop work order, an immediate phone call from the Trevet QCM to the NAVFAC SW QAO will occur, and a stop work order will be issued.

SAP Worksheet #6 (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Stop work	CFS Health and Safety Officer	Fred Mlakar	(949) 660-5413	If a safety issue arises that warrants a stop work order, an immediate phone call from the CFS Health and Safety Officer to the NAVFAC SW Safety Officer will occur, and stop work order will be issued.
Notification – field change request	Trevet QCM	Gerald Tamashiro	(714) 200-3826	If a field change request is warranted, then a written Field Change Request will be e-mailed from the Trevet QCM to the NAVFAC SW RPM and the Trevet PM.
SAP Addendum	Trevet QCM	Gerald Tamashiro	(714) 200-3826	Changes to the SAP will require the Trevet QCM to prepare an addendum that will be approved by the NAVFAC SW RPM before field activities begin.
Daily chain-of-custody reports and shipping documentation	Trevet Field Team Lead	Matt Fuller	(858) 578-8859	At the end of each field sampling day, the chain-of-custody forms and shipping documentation (if applicable) will be submitted via fax or e-mail to the Trevet Project Chemist.
Analytical corrective actions	Trevet Project Chemist	Jordana Bjorkman	(858) 578-8859	The Trevet Project Chemist will immediately notify the Trevet PM in writing of any analytical procedures that were not performed in accordance with this SAP. The Trevet Project Chemist will complete documentation of the non-conformance and corrective actions to be taken. The Trevet QCM will verify that the corrective actions have been implemented. In the event of serious laboratory issues, the Trevet Project Chemist will contact the NAVFAC SW RPM who at their discretion may contact the Navy Chemist.

SAP Worksheet #6 (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Notification - release of analytical data	Trevet Project Chemist	Jordana Bjorkman	(858) 578-8859	The Trevet Project Chemist will review faxed/e-mailed data to verify that data quality is met as described in this SAP before the data are released. Analytical data will be released to the Trevet PM (or designee) after the Trevet Project Chemist has verified that the data are in accordance with the SAP requirements.

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SAP Worksheet #7 — Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications (Optional)
Ann Colt	RPM	NAVFAC SW	• Performs project management for the Navy • Ensures that the project scope of work requirements are fulfilled • Oversees the project cost and schedule • Reviews and approves SAP • Authorizes the suspension of project execution if QA requirements are not adequately followed • Provides formal technical direction to the Trevet project team, as needed • Acts as lead interface with agencies	
Joseph Michalowski	QAO	NAVFAC SW	• Reviews and approves the SAP • Provides Navy oversight of Trevet QA Program • Provides technical and administrative oversight of surveillance audit activities • Acts as point of contact for matters concerning QA and the Navy Laboratory QA Program • Coordinates training on matters pertaining to generation and maintenance of data quality • Authorizes the suspension of project execution if QA requirements are not adequately followed	

SAP Worksheet #7 – continued

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications (Optional)
John Willis	PM	Trevet	• Coordinates work activities of subcontractors and ensures all personnel adhere to the administrative and technical requirements of the project • Monitors and reports the progress of work and ensures that the project deliverables are completed on time and within project budget • Monitors the budget and schedule and notifies the RPM of any changes that may require administrative actions • Ensures adherence to the quality requirements of the contract, project scope of work, and the quality control (QC) plans • Ensures that all work is conducted in accordance with the Work Plan. • Ensures that all work meets the requirements of the technical specifications and complies with applicable codes and regulations • Ensures that all work activities are conducted in a safe manner in accordance with the site-specific health and safety plan, *Safety and Health Requirements Manual* (EM-385-1-1) (USACE 2008), and all applicable Occupational Safety and Health Administration (OSHA) regulations • Serves as the primary contact with the Navy for actions and information related to the work, and includes appropriate Trevet technical personnel in the decision-making process • Coordinates satisfactory resolution and completion of evaluation and acceptance report for nonconformance reports	

SAP Worksheet #7 – continued

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications (Optional)
Gerald Tamashiro	QCM	Trevet	• Establishes and maintains the Trevet Quality Program • Oversees QC, including construction and chemical data acquisition • Acts as a focal point for coordination for quality matters for all projects, and resolves quality issues • Suspends project activities if quality standards are not maintained • Interfaces with the Navy, including RPM, on quality-related items • Conducts field QC audits to ensure that project plans are being followed • Discusses and implements Navy technical direction letters related to quality topics with Trevet PM and field team	
Jordana Bjorkman	Project Chemist	Trevet	• Assists in the development of the SAP • Evaluates and selects a qualified subcontract laboratory • Ensures that sampling personnel have documented training on sampling procedures for specific project requirements • Supports projects as the technical lead for chemical data collection and analysis • Monitors performance of subcontract laboratory and data validator • Audits sample collection activities • Reviews laboratory data before using against the requirements in this SAP • Evaluates and selects a qualified data validation subcontractor • Reviews data validation reports • Prepares data quality assessment report to ensure the quality of the data meets the intended use of the data	

SAP Worksheet #7 – continued

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications (Optional)
Matt Fuller	Field Team Lead	Trevet	• Ensures that all fieldwork is conducted in accordance with the work plan and SAP • Provides direction to field staff and subcontractors • Reports field information to Trevet PM and Project Chemist	
Ye Myint Nicole Brown	Laboratory PM	EMAX ALS	• Ensures laboratory results comply with SAP requirements and are submitted in accordance with the project schedule.	
Andrew Kong	PM	LDC	• Provides third-party validation of laboratory data.	

SAP Worksheet #8 — Special Personnel Training Requirements Table

Project Function	Specialized Training by Title or Course Description	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
No specialized training is required for this project.						

All field personnel who are present at the site are required to meet the health and safety training requirements of the *Code of Federal Regulations* (29 CFR 1910.120[e]). This includes current Hazardous Waste and Emergency Response Training (40-hour and 8-hour refresher), 30-hour OSHA Construction Safety and Health training, and 40-hour U.S. Army Corps of Engineers EM-385-1-1 (USACE 2008) training. Copies of field personnel health and safety training records will be maintained in the Trevet project file.

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SAP Worksheet #9 — Project Scoping Session Participants Sheet

Project Name: RI for IR Sites 34b and 34d **Projected Date(s) of Sampling:** Excavating and sampling event during January 2015. **Project Manager**: John Willis	**Site Name:** IR Sites 34b and 34d **Site Location:** NAVWPNSTA Seal Beach Det. Fallbrook

Date of Session: May 7, 2014
Scoping Session Purpose: To discuss the dunnage debris and soil investigation objectives, equipment use, project coordination, and project schedule

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Ann Colt	RPM	NAVFAC SW	(619) 532-1156	ann.colt@navy.mil	Navy RPM
Margaret Wallerstein	Activity Point of Contact	NAVWPNSTA Seal Beach	(562) 626-7838	margaret.wallerstein.ctr@ navy.mil	Activity Point of Contact
Ryan Lockwood	NWS Fallbrook Natural Resources	NAVWPNSTA Seal Beach	(760) 731-3516	ryan.s.lockwood1.ctr@navy.mil	NWS Fallbrook Natural Resources
Richard Wong	Program Manager	CFS	(619) 778-6122	richard.wong@ cbifederalservices.com	CFS Program Manager
Amanda Elmore	PM	CFS	(619) 446-4510	amanda.elmore@ cbifederalservices.com	CFS Project Manager
Brian White	Geologist	CFS	(619) 446-4510	brian.white@ cbifederalservices.com	CFS Geologist/ Alternate PM
John Willis	PM	Trevet	(858) 578-8859	jwillis@trevetinc.com	Trevet PM
Bob Breglio	Geologist	Trevet	(858) 858-8859	bob@trevetinc.com	Technical Lead
Patrick Hamner	Geologist	Trevet	(858) 578-8859	phamner@trevetinc.com	Staff Geologist
Matt Fuller	Scientist	Trevet	(858) 578-8859	mfuller@trevetinc.com	Staff Scientist
Wendy Loeffler	Biologist	RECON	(619) 308-9333	wloeffler@recon-us.com	Biological Monitoring

9.1 Action Items

The following items are among those discussed during the project scoping meeting:

- Proposed locations of test pits and hand auger borings.
- Base and activity coordination, including badging, and the need for Hazard Control safety briefing for all field personnel.

SAP Worksheet #9 – continued

- Proposed schedule for excavating and sampling activities.
- If a suspicious item is encountered during fieldwork activities, work will immediately stop and the field team leader will contact Glenn Mosely, the Explosive Safety Officer at NAVWPNSTA Seal Beach Det. Fallbrook.
- CFS will coordinate a site visit with the project site superintendent to discuss equipment and personnel access to IR Site 34d.
- Margaret Wallerstein will be the point of contact for the camera pass permit form.

9.2 Consensus Decisions

The start date of the field activities will be based upon approval of the planning documents, the RPM's notice to proceed, and base operations approval. Currently, the initial sampling is planned for January 2015.

SAP Worksheet #10 — Conceptual Site Model

The following is a discussion of the problem definition, background, and previous investigations pertaining to IR Sites 34b and 34d at NAVWPNSTA Seal Beach Det. Fallbrook, Fallbrook, California (Figure 1). The problem definition presented below in Section 10.1 is essentially Step 1 of the of the data quality objective (DQO) criteria (USEPA 2006). DQOs are discussed in detail in Worksheet #11.

10.1 Problem Definition

Based on review of the Final Site Inspection (SI) Report (ChaduxTt 2010), the Navy and regulatory agencies agreed that a release has occurred at IR Sites 34b and 34d and that additional sampling during an RI is needed to evaluate the nature and extent of the release and whether chemicals of potential concern (COPCs) and/or chemicals of potential ecological concern (COPECs) pose a risk to human health or the environment.

10.1.1 IR Site 34b

IR Site 34b is located in the north-central portion of NAVWPNSTA Seal Beach Det. Fallbrook (Figures 1 and 2), east of Walleye Road. It encompasses approximately 9 acres of northwest-facing hillside covered with native vegetation. Historical information documented in the Preliminary Assessment (PA) (Malcolm Pirnie 2006) indicated that IR Site 34b was reportedly used as a disposal or burial area for dunnage and other debris from 1942 to 1978. The site is not developed and has no current land use other than open space. No manmade structures or evidence of previously existing structures were observed at the site during the SI (ChaduxTt 2010).

The SI report identified a shallow waste disposal trench in the central portion of the site as the primary area of concern (AOC) for IR Site 34b. This trench will be referred to as the “known disposal trench” in this RI work plan and SAP. The known disposal trench extended 480 feet in a northwesterly direction down slope from a nearby access road (Figure 2). The known disposal trench was estimated to be 3.5 feet wide and contained debris from the surface to a depth of 4 feet below the surface. The known disposal trench was partially filled with undocumented fill soil or slough from the trench walls, along with metal, wood, and glass debris. The debris consisted of weathered and deteriorated 2- to 5-gallon metal containers, metal banding, empty 55-gallon drums, glass bottles, cans, and other miscellaneous solid waste, some of which indicated that it had been burned. The known disposal trench was identified in a 1953 photograph along with two less conspicuous linear features identified located farther west, which were similar in appearance to the known disposal trench (Figure 2). The two additional linear surface disturbances were suspected to also be disposal trenches and were therefore included as

SAP Worksheet #10 – continued

AOCs for IR Site 34b (ChaduxTt 2010). A fourth potential disposal area east of the known disposal trench identified based on topography is also included as an AOC for IR Site 34b (Figure 2). These four potential disposal trenches were selected for geophysical survey as shown on Figure 5.

During a site visit after the May 2014 wildfires that burned IR Sites 34b and 34d, visual indications of disposal at the three potential disposal trenches were not observed. The fire cleared much of the vegetation at IR Site 34b and little dunnage and/or debris was visible outside of the known disposal trench. However, the three potential disposal trenches were included in the geophysical investigation. Based on the results of the geophysical survey, as well as visual assessment and a review of aerial photographs conducted in response to agency comments (Work Plan, Appendix E) the Navy and its Agency partners agreed that intrusive investigation at IR Site 34b should be focused on the single known disposal trench, and that the other locations evaluated do not warrant further investigation.

10.1.2 IR Site 34d

IR Site 34d is located in the central portion of NAVWPNSTA Seal Beach Det. Fallbrook, north of Ammunition Road and along the south side of Fallbrook Creek (Figures 1 and 3). The site encompasses 1.8 acres. Old asphalt paving associated with Maverick Road and improvements related to the former crossing over Fallbrook Creek are located in the northern portion of the site. Fallbrook Creek flows westward through the northern portion of the site (Figures 3 and 4). The site is vacant and has no current land use other than open space.

IR Site 34d was reportedly used as a disposal and possibly a burial area for dunnage and other debris from 1942 until 1978. In addition to the possible disposal of dunnage, at least three former structures were known to have existed at the site: Buildings 341, 430, and 325 (Figure 3). In addition one former building (Building 338) was located adjacent to the site to the Southeast. The SI identified these former buildings as a former restroom, a former boiler house, and a former wooden ammunition magazine, respectively. Subsequent evaluation of historical maps for the area indicates that Building 325 was a testing facility for wet munitions, shown on a 1944 map as “Mark 8 Depth Charge Testing Bldg”. A review of aerial photographs (Appendix E) indicated that this building was completely removed sometime between 1953 and 1964. Building 338 has been identified as office space related to weapons testing (ChaduxTt 2010). Only the remnants of the concrete slab from Building 341 and the adjacent below grade three-stage concrete sump (Building 430) with an adjoining drainpipe currently remain on site. These building remnants are located within the western portion of IR Site 34d (Figure 3). No remnants of Building 325 were evident at the site.

SAP Worksheet #10 – continued

During the SI field investigation, surficial and buried debris was observed near the slab remnants of former Building 341. Detector-aided visual surveys performed during the SI indicated metal debris, construction debris, and other debris within and adjacent (uphill to the east) to IR Site 34d. Debris observed at the site and adjacent to Fallbrook Creek included metal piping, asphalt, wood pallets, boards and burnt wood remains, plastic piping, aluminum canisters, and glass. Three magnetic anomalies were detected with a hand-held magnetic gradiometer along the location of the former access road that cuts through the site. Along with observed debris, several weathered small arms ammunition canisters and spent small caliber blank casings were observed on the south side of the creek. The canisters and casings are considered isolated debris and were not taken to indicate the presence of munitions and explosives of concern (MEC) or munitions constituents (MC) at the site (ChaduxTt 2010).

The SI identified the following areas that will be investigated further as AOCs in this RI for IR Site 34d:

- areas near the slab of former Building 341 and three-stage concrete sump (Building 430) and drainpipe to investigate the soil impacts from buried debris
- the areas near the wood debris and burnt wood located near borings IRP34D-SB01, IRP34D-SB04, and IRP34D-SB05 (Figure 3)
- several on site areas and the offsite area east of IR Site 34d and Fallbrook Creek to investigate potential buried debris

Based on the recommendations of the SI, the areas near former Building 341 and the offsite area east of IR Site 34d were selected for geophysical evaluation, as shown on Figure 6.

10.2 Groundwater Quality and Beneficial Use

The general hydrologic setting for the northern portion of the installation is dominated by the Santa Margarita River channel that defines the northern boundary of NAVWPNSTA Seal Beach Det. Fallbrook. Surface runoff from the northern portion of the installation flows into the Santa Margarita River, which is considered part of the Santa Margarita–Upper Ysidora Watershed. The central portion of the installation, where IR Sites 34b and 34d are located, is characterized by first-and second-order ephemeral drainages associated with Fallbrook Creek and other tributaries to the Santa Margarita River. Fallbrook Creek traverses the community of Fallbrook and enters the installation near the east gate at Ammunition Road. The creek flows west through the installation and exits NAVWPNSTA Seal Beach Det. Fallbrook along the middle of the west boundary, entering Marine Corps Base Camp Pendleton. The southern portion of the installation drains southward via first- and second-order ephemeral drainages that include Pilgrim Creek. Pilgrim Creek exits the installation along the southern boundary and continues southward, where it eventually joins the San Luis Rey River Channel. Fallbrook Creek traverses the northern

SAP Worksheet #10 – continued

portion of IR Site 34d. IR Site 34b is drained by an unnamed tributary to the Santa Margarita River feeding most directly to Depot Lake (Figure 4).

Although groundwater within the installation is considered beneficial use by the RWQCB, NAVWPNSTA Seal Beach Det. Fallbrook receives all of its potable water from the San Diego County Water Authority (ChaduxTt 2010). Depths to water in three monitoring wells located on Ammunition Road, 1.2 to 1.3 miles east of IR Sites 34b and 34d, were measured between 50 and 60 feet below ground surface (bgs) in 2003 (Malcolm Pirnie 2006). These wells are adjacent to IR Site 30 and relatively close to IR Sites 31 and 32. Based on the data from these wells, direction of groundwater flow was toward the southwest, consistent with the direction of surface water flow. The wells are located within the Fallbrook Creek drainage basin, 700 feet north of Fallbrook Creek.

No site-specific groundwater depth data were available for IR Sites 34b and 34d. No groundwater was encountered during the SI in borings completed to a maximum depth of 6 feet within IR Site 34b. It is anticipated that groundwater may be present in the alluvial soils along the bedrock-to-alluvium contact, adjacent to Fallbrook Creek at IR Site 34d. Groundwater is not anticipated to be contacted during the field investigations at IR Sites 34b and 34d due to the shallow depths of the proposed soil borings.

10.3 Current and Future Land Use Considerations

IR Sites 34b and 34d have no current land use other than open space. There are no buildings or habitable structures on either site. IR Site 34b is in a highly secured weapons storage area and future development is unlikely. Future land use considerations for IR Site 34b likely include use as grazing land for cattle. Fallbrook Creek flows westward through the northern portion of Site 34d. Future land use considerations for IR Site 34d likely include use as grazing land for cattle. The continued presence of a parking area adjacent to IR Site 34d also may increase the likelihood of future industrial development at this location.

10.4 Potential Exposure Pathways

The RI at IR Sites 34b and 34d is being conducted to further delineate the nature and extent of contaminants from historical site use as dunnage disposal sites. Likely future activities at the site include environmental and ecological surveys, fence installation and maintenance, as well as cattle grazing. Current and anticipated future human receptors for IR Sites 34b and 34d include Navy personnel and Navy-permitted visitors/contractors, as well as potential future industrial development by the Navy. Although highly unlikely, a potentially complete exposure pathway exists for the public to come into contact with contaminants migrating off IR Sites 34b and 34d

SAP Worksheet #10 – continued

through the surface water system. Potential exposure pathways to contaminants in soil for human and/or ecological receptors may include: direct exposure to soil, direct exposure to soil in the air in the form of dust, plant/animal uptake through ingestion of vegetation or prey, and soil runoff to localized surface water (i.e., Fallbrook Creek and Depot Lake). No complete exposure pathway to groundwater is anticipated at IR Sites 34b and 34d.

SAP Worksheet #10 – continued

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SAP Worksheet #11 — Project Quality Objectives/Systematic Planning Process Statements

The DQOs specify the project objectives, the data collection boundaries and limitations, the most appropriate type of data to collect, and the level of decision error that will be acceptable for the decision. The quality and quantity of data required to implement an environmental remedial action are also defined. The scope, level of detail, and verification for the design and planning documents may vary from project to project, depending on the project-specific conditions and the nature and complexity of the proposed activities. The project-specific DQOs, as defined through the seven-step process (USEPA 2006), are as follows:

1. State the problem
2. Identify the goals of the study
3. Identify information inputs
4. Define the boundaries of the study
5. Develop the decision rules
6. Specify performance or acceptance criteria
7. Develop the plan for obtaining data

The DQOs are presented in the following sections. General discussions of each step of the DQO process are presented below.

11.1 State the Problem

Dunnage and buried debris were reported as potentially present at both IR Sites 34b and 34d. The purpose of the RI is to determine the nature and extent of dunnage debris and waste in the known disposal trench at IR Site 34b, and evaluate the presence of dunnage debris in potential or suspected debris areas at IR Sites 34b and 34d and characterize impacted soil to evaluate whether COPCs and/or COPECs have been released and whether they pose unacceptable risk to human health or the environment. Based on the findings of the RI field investigation, the RI report will recommend either further action, such as additional characterization or a remedial response, or no further action.

11.2 Identify the Goals of the Study

Defining questions that this investigation will attempt to resolve requires identification of questions and alternative outcomes. The primary decision questions for this investigation are risk related. A detailed discussion of the risk assessment methodology is contained in the Work Plan to which this SAP is attached:

1. For each site, have the limits of dunnage debris, and COPCs and COPECs in soil been adequately delineated?

SAP Worksheet #11 – continued

2. At IR Site 34d have surface water and sediment in Fallbrook Creek been impacted by historical site activities?
3. For each site, are the human health risks due to COPCs acceptable?
4. For each site, are the ecological risks due to COPECs acceptable?

11.3 Identify Information Inputs

Inputs necessary to resolve decision questions include the following information resources.

- Results of the geophysical investigation
- Validated soil data collected during previous SI field events from IR Sites 34b and 34d.
- Validated soil data collected in accordance with this SAP.
- Current and project land use and associated exposure scenarios.

The analytical methods and analytes for each sampling matrix are listed on Worksheet #15.

11.4 Define the Boundaries of the Study

The lateral, vertical, and temporal study boundaries are defined below.

11.4.1 Lateral Boundaries

The lateral study boundaries are defined by the established boundary of IR Site 34b and 34d. Within these sites, soil investigations are focused on the locations of dunnage disposal trenches and suspected disposal areas as shown on Figures 5 and 6. At IR Site 34d, the lateral boundaries of the RI include the area east of the site where dunnage and other debris have been observed.

11.4.2 Vertical Boundaries

The vertical boundaries of the investigation are based on the maximum depth of buried debris in the trenches or debris areas. The vertical boundaries for soil investigation are expected to include soil from the surface to an approximate depth between 4 and 8 feet bgs, depending on the depth of encountered debris at the location.

11.4.3 Temporal Boundaries

Field activities will be conducted in accordance with the project schedule included as Worksheet #16.

SAP Worksheet #11 – continued

11.5 Develop the Decision Rules

1. If the horizontal and vertical limits of COPCs and COPECs at each site have been adequately delineated to the screening levels identified in Worksheet #15, then no further sampling will be recommended; otherwise, additional sampling may be warranted.
2. If COPCs and COPECs are detected in surface water and sediment at IR Site 34d at concentrations exceeding screening levels identified in Worksheet #15, then the data will be evaluated to assess if the impacts are site related or from and upstream source.

3a. If the incremental cancer risk is less than 10^{-6} and the HI is less than or equal to 1, then no further action regarding human health will be recommended for that IR site; otherwise the evaluation will proceed to the criteria listed below.

3b. If the incremental cancer risk falls within the generally acceptable "risk management range" between 10^{-6} to 10^{-4} and the HI is less than or equal to 1, then a risk management evaluation regarding human health will be undertaken for that IR site and a recommendation may be made for a Feasibility Study (FS) to evaluate remedial alternatives; otherwise the evaluation will proceed to the criteria listed below.

3c. If the incremental cancer risk is greater than 10^{-4} and/or the HI is greater than 1, then the need for further action will be discussed by the project team.

4. If the ecological risk for the IR site is found to be unacceptable, then a recommendation will be made for an FS to evaluate remedial alternatives, otherwise a recommendation of no further action regarding ecological risk will be made for the site.

11.6 Specify Performance or Acceptance Criteria

There are two types of decision errors: sampling design and measurement errors. Sampling design errors are a function of the selection of sample locations or analytical methods used to characterize the site to be studied. Measurement errors are a function of the procedures used to collect and analyze the samples. Decision errors will be limited by a careful evaluation of the data and adherence to established data collection procedures.

The sampling design error was controlled by careful planning. Measurement errors that arise during the various steps of the sample-measurement process (i.e., sample collection, sample handling, sample preservation, sample analysis, data reduction, and data handling) are possible regardless of the sample design. Neither measurement errors nor variability can be eliminated,

SAP Worksheet #11 – continued

but they can be controlled by selecting appropriate procedures. The analytical methods, method reporting limits, and project-specific screening criteria for samples are discussed in Worksheet #15. Measurement error is further managed by using standard procedures, reviewing data records, and managing data quality.

Field crews will review the SAP before samples are collected and sign off on SAP Worksheet #4. A copy of the SAP will be given to laboratories solicited during procurement to ensure that the laboratory can meet all SAP requirements. Third-party data validation will be performed on samples.

11.7 Develop the Plan for Obtaining Data

The sampling scheme was developed to complete the investigation for soil at the sites and results will be used to complete the human health risk assessment (HHRA) and screening-level ecological risk assessment (SLERA) to meet the DQOs established for this project. Sampling locations and rationale are discussed in SAP Worksheet #17. SAP Worksheet #18 lists each planned sample and the planned analytical suite associated with that sample.

SAP Worksheet #12 — Measurement Performance Criteria Table

Measurement Performance Criteria Table – Field QC Samples (Soil/Sediment/Surface Water)

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria	QC Sample Assessment Error[1]
Trip Blank	Volatile organic compounds (VOCs)	1 per sampling cooler containing VOC samples	Accuracy	No Analyte > LOQ	S&A
Equipment Rinsate	Inclusive of analytical group for the day's sampling event	1 per day (if non-dedicated sampling equipment is used)	Accuracy	No Analyte > LOQ	S&A
Source Blank	All analytes	1 per lot of water used to collect equipment blank samples (if non-dedicated sampling equipment is used)	Accuracy	No Analyte > LOQ	S&A
Matrix Spike / Matrix Spike Duplicate	All	5% of Samples	Accuracy	See SAP Worksheet #28	A
Temperature Blank	All	1 per sampling cooler	Representativeness	2 to 6ºC	S&A

Note: Field duplicates will not be collected for soil samples due to the heterogeneous nature of soil matrices.

Abbreviations and Acronyms:
A – analysis
QC – Quality control
LOQ – limit of quantification
RPD – Relative percent difference
S - sampling
VOCs – volatile organic compounds
> - greater than
ºC – degrees Celsius

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SAP Worksheet #13 — Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization report title and date)	Data Generators (originating organization, data types, data generation/ collection dates)	How Data Will Be Used	Limitations on Data Use
Soil data	Final Site Inspection Report for Installation Restoration Sites 32, 34b, 34d, and 34e, and Munitions Response Program Sites UX01, UX02, UX03, UX04, UX06, and UX07 (ChaduxTt 2010)	ChaduxTt Soil data was generated during the SI at IR Sites 34b and 34d (ChaduxTt 2010)	Data will be used to further assess the nature and extent of contamination, and will be used to perform HHRAs and SLERAs for IR Sites 34b and 34d.	None

Abbreviations and Acronyms:

IR – Installation Restoration
SI – Site Inspection
HHRA – Human-health risk assessment
SLERA – Screening-level ecological risk assessment

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SAP Worksheet #14 — Summary of Project Tasks

This worksheet summarizes the project tasks for this investigation.

14.1 Major Tasks

The following major tasks will be performed during this investigation for IR Sites 34b and 34d.

- Permitting/notice of intent
- Biological monitoring
- Utility clearance
- Site preparation
- Test pit excavations
- Soil and sediment sampling
- Surface water sampling
- Land surveying
- Equipment decontamination
- Investigation-derived waste (IDW) management
- Data management (including third-party validation)

Specific procedures to be followed during field activities are described in detail in the sections below. Stand-alone SOPs are not included.

14.2 Permitting/Notice of Intent

The Navy is conducting this project under CERCLA. CERCLA Section 121(e) (Title 42 *U.S. Code*, Pt. 9621) and *Code of Federal Regulations* Title 40, Pt. 300.400(e) provide exemption from federal, state, and local permit fees for CERCLA response actions on a CERCLA site. No CERCLA permits are required for this project.

14.3 Biological Monitoring

The planned biological monitoring is presented in an Effects Analysis document that is presented as Attachment B to the Work Plan.

14.4 Utility Clearance

Underground utility clearance will be completed prior to intrusive fieldwork. A 5-foot radius around each of the proposed test pit and boring locations will be cleared by a subcontracted private utility locating company. In addition, Underground Service Alert will be notified at least

SAP Worksheet #14 – continued

48 hours prior to intrusive activities to obtain clearance from service providers who may have utilities running through the sites. If a utility is identified within 3 feet of a proposed sampling or test pit location, the sampling or test pit will be moved and the clearance procedures will be repeated. Clearance of each boring and test pit location will be documented in the field logbook.

14.5 Site Preparation

Proposed test pit and hand auger boring locations will be acquired using Global Positioning System equipment and staked or marked on the ground with numbered identifiers.

At IR Site 34d, the concrete building slab (Building 341) and three-stage concrete sump (Building 430) will be demolished and removed to permit sampling directly under the structures. The concrete rubble will be set aside and left on site.

An IDW staging area will be located on each site. The staging area will be used to store IDW generated during field efforts and will be used as a decontamination area. IDW will be stored in 55-gallon drums, and/or a polyethylene tank in a secondary containment structure.

14.6 Test Pit Excavations and Potholes

Test pits and potholes will be excavated at IR Sites 34b and 34d (Figures 5 and 6) using a backhoe excavator. Test pits are anticipated to be at least the width of the excavator bucket, and typically at least 5 feet in length. Tests pits will generally be excavated to approximately 5 feet bgs. In the event that buried waste is encountered that extends to a greater depth than expected, then the depth of the excavation will be increased as feasible based on the limitations of the excavation equipment or refusal. Following the logging of the test pits and the collection of the soil samples, the test pits will be backfilled with the excavated soil. .

14.7 Soil and Sediment Sampling

Soil samples will be collected using hand augers, slide hammers, hand trowels, or plastic scoops from IR Sites 34b and 34d, as described in Section 14.7.1 of the SAP. Sampling depths are expected to not exceed 8 feet bgs at either site. Soil sample locations are detailed in Worksheet #18. Surface soil samples will be collected using an individually packaged, disposable, plastic scoop. Subsurface samples will be excavated with a hand auger or shovel and trowel, and once at depth, the sample will be collected with a slide hammer or plastic scoop as described above. Sediment samples will be collected using a disposable plastic scoop to transfer soil from the sampling location into laboratory-supplied containers.

SAP Worksheet #14 – continued

Disposable nitrile gloves will be worn by field personnel while sampling and new scoops and gloves will be used at each sampling location. Samples will be immediately transferred into clean, appropriate sample containers provided by the analytical laboratory. Sample containers will be immediately labeled, placed in a sample cooler with bagged ice, and then sample information will be documented on a chain-of-custody form and in the field logbook.

The following subsections detail soil sampling and preparation procedures.

14.7.1 Hand Auger/Slide Hammer Sampling

The following is a detailed description of the hand auger/drive hammer sampling procedures.

1. A decontaminated stainless steel trowel is used to scrape the loose soil and wildfire ash from the top 1-inch of the surface.
2. A decontaminated hand auger is used to advance the borehole to the top depth of the desired sample interval.
3. The slide hammer is used to drive the decontaminated sampler equipped with new, decontaminated stainless steel liners into the ground until a 6-inch sample depth is achieved.
4. The sampler is recovered and opened and the soil-filled liner immediately removed from the sampler.
5. The sample is screened for VOCs using a photo-ionization detector (PID) and the results recorded on the boring log. To screen the samples for VOCs using a PID, a portion of soil from the liner is transferred into a zip-lock plastic bag and the bag is sealed. After at least one minute the PID probe tip is inserted into the bag to measure VOCs.
6. The soil-filled liner is then capped, temporarily labeled, and delivered to the designated sample handling area. Refer to the Section 14.7.3 for sample preparation procedures.
7. The hand auger is then used to advance the borehole to the top depth of the next desired sample interval.
8. The recovered soil-filled sampler is then handled in the same manner as described above.

14.7.2 Test Pit Sampling

Soil sampling from the sidewalls and floor of test pits will be collected either using the slide hammer method described above or directly from the excavator bucket if the slide hammer method is not practicable (e.g., it the test pit is not safe to enter). For the slid hammer sampling technique, sampling personnel will enter the test pit (if it is 3 feet deep or less) and determine the sampling location. If there is any foreign material from outside the trench, such as ash from the recent wildfire, then that material will be scraped away using a decontaminated trowel until the

SAP Worksheet #14 – continued

foreign material is completely removed. The sample will then be obtained using a slide hammer sampler as outlined above. If the test pit is not safe for entry, then a grab soil sample will be obtained directly from the excavator bucket. Once the sample location is determined, the sampling personnel will direct the excavator operator to scrape away any foreign material. Once the foreign material is removed, the excavator bucket will be used to scrape the sidewall or floor. The bucket will be returned to the surface and positioned safely, then the sampling personnel will approach the bucket, select the representative soil in the bucket, and scoop the soil sample into a laboratory-supplied container using a disposable plastic scoop. If the sample will be analyzed for VOCs, then refer to Step 4 of Section 14.7.3.

14.7.3 Soil Sample Preparation Procedures

The following describes the sample preparation process.

1. If the analytical suite for the sample includes VOC analysis, skip to Step 4.

2. Cap the stainless steel sleeves with Teflon™ film and tight-fitting plastic end caps, properly label the sample, place into a resealable plastic bag, and place the sample in a cooler with ice. The orientation of the stainless steel sleeves (top vs. bottom of boring) will be marked with an arrow.

3. Record the sample number, date, time, and required analyses on the COC form and in the field logbook. All entries will be written in indelible blue or black ink.

4. If the sample is to be analyzed for VOCs, an Encore® sampling method will be followed as described below.

   – Holding the coring body, the plunger rod will be pushed down until the small o-ring rests against the tabs. This will assure that the plunger will move easily;

   – The locking lever on the Encore® T-handle will be depressed. The coring body, with the plunger end first, will be placed into the open end of the T-handle, aligning the slots of the coring body with the locking pins in the T-handle. The coring body will be twisted clockwise to lock the pins in the slots. The sampler will be checked to ensure that it is locked in place. The sampler will now be ready for use;

   – By holding the T-handle, the coring body will be pushed into the soil in the liner until the coring body is full. When full, the small o-ring will be centered in the T-handle viewing hole. The sampler will then be removed from the soil and any excess soil will be wiped from the coring body exterior;

SAP Worksheet #14 – continued

- The coring body will be capped while it is still on the T-handle. The cap should be pushed over the flat area of the ridge. To lock the cap in place, the cap will be pushed and twisted so that it seals the sampler;

- The capped sampler will be removed by depressing the locking lever on the T-handle while twisting and pulling the sampler from the T-handle;

- This procedure will be performed two more times for a total collection of three Encore® samplers per sample. The three Encore® samplers will then be placed into one of the aluminum bags the samplers came in and the bag labeled;

- Place the aluminum bag containing the three Encore® Samplers into a resealable plastic bag and immediately place the bag in a cooler with ice The sample number, date, time, and required analysis will be recorded on the COC form and in the field logbook. All entries will be written in indelible blue or black ink.

- If the sample requires additional analyses other than VOCs, process the stainless steel sleeves as described in Steps 2 through 4 above.

If the soil samples are to be only analyzed for VOCs, then an additional soil aliquot from each depth interval sampled will be cut and capped and submitted to the laboratory for moisture content analysis.

14.8 Surface Water Sampling

Surface water samples will be collected from the same location as sediment samples and will only be collected if there is surface water in the stream. To avoid any unnecessary agitation and handling, each sample will be collected by dipping the laboratory-supplied sample containers directly into the stream flow. The containers will be filled by submerging in the containers while avoiding washing out the preservative. If the preservative is washed out or overly diluted, then the sample container will be discarded and a new one will be filled. For dissolved metals analysis, the sample will be collected using a peristaltic pump with disposable tubing placed in the stream flow. The peristaltic pump will push the sample through a disposable 0.45 micron filter cartridge. The filtered water will then be placed in a properly-preserved, laboratory-supplied container.

All surface water samples will be handled and documented similar to the soil samples. The sample containers will be closed tightly, labeled with sample identification, date, time, sampler's initials, and analyses requested, placed inside resealable plastic bags, and placed in a cooler with double-bagged ice. Appropriate sample information will be logged on the chain-of-custody form, the boring log, and in the sample log book.

SAP Worksheet #14 – continued

14.9 Land Surveying

Each soil sampling location will be surveyed to establish the horizontal positions and elevations of each location. The locations will be surveyed by a California-registered professional land surveyor. All elevations will be determined and reported to the nearest 0.01 foot relative to the North American Vertical Datum 1988. The horizontal positions will be reported to the nearest 0.1 foot defined relative to the State Plane Coordinate System, North American Datum 1983.

14.10 Equipment Decontamination Procedures

Prior to collecting a subsurface soil sample, hand augers and equipment used to dig will be decontaminated using the three-step wash procedure outlined below:

1. **Wash with nonphosphate detergent and water solution.** This step will remove all visible contamination from the equipment. A bucket of suitable size, water with nonphosphate detergent, and a brush will be used for this step. The nonphosphate detergent will be diluted as directed by the manufacturer.
2. **Rinse with potable water.** This step will rinse the detergent solution away from the equipment. A bucket of suitable size filled with water and a brush will be used for this step. Periodic changing of this water is required. Perform this rinse twice.
3. **Rinse with deionized/laboratory reagent-grade water.** This step will include double rinsing any detergent solution and potable water residues. Rinsing will include spraying the equipment being cleaned with a stainless steel Hudson-type sprayer or plastic squeeze bottle while holding the equipment over a bucket of suitable size.

When equipment rinsate samples are collected, water from the final rinse that is falling off the sampling equipment will be collected in appropriate sample bottles and analyzed for the same parameters as the field samples.

All decontamination water will be containerized in Department of Transportation (DOT)-approved 55-gallon drums and stored at the IDW staging area.

14.11 IDW Management

All decontamination water and soil cuttings from soil borings will be containerized into DOT-approved, 55-gallon drums, roll-off bins, or a polyethylene tank and stored on site in a designated IDW storage area. The contained media will be sampled and analyzed for classification purposes and will be transported to an appropriate off-site disposal and/or treatment facility.

The appropriate disposal facility will be determined by the following hazardous classifications:

SAP Worksheet #14 – continued

- Although not anticipated to be present, any soil or water classified as Resource Conservation and Recovery Act (RCRA) hazardous waste will be transported to a licensed treatment, storage, and disposal facility for treatment and disposal.
- Any soil or water classified as non-RCRA hazardous waste will be transported for disposal to a licensed landfill facility in accordance with the CERCLA Off-Site Rule.
- Soil classified as nonhazardous waste, or inert, will be transported for disposal to a licensed landfill or soil treatment facility permitted to accept such waste in accordance with the CERCLA Off-Site Rule.
- Water classified as nonhazardous will be transported for disposal to a licensed treatment facility permitted to accept such waste in accordance with the CERCLA Off-Site Rule.

All waste manifests and profiles, along with analytical data and land disposal restrictions, will be routed through NAVWPNSTA Seal Beach Det. Fallbrook for signature. Original copies of the manifest packages will be provided to the transporter for shipment. All wastes will be removed from the site within 90 days and will be transported via a licensed transporter.

14.12 Data Management

Data collected in the field is to be managed using the following procedures.

14.12.1 Field Logbooks

A permanently bound field logbook with consecutively numbered pages, used for sampling activities only, will be assigned to this project. All entries will be recorded in indelible ink. The logbook pages will be signed by the responsible sampler at the end of each workday, and any unused portions of the logbook pages will be crossed out, signed, and dated.

If it is necessary to transfer the logbook to another person, the person relinquishing the logbook will sign and date the last page used, and the person receiving the logbook will sign and date the next page to be used.

At a minimum, the logbook will contain the following information:

- Project name and location
- Date and time
- Personnel in attendance
- General weather information

SAP Worksheet #14 – continued

- Work performed
- Field observations
- Sampling performed, including specific information such as location, type of sample, type of analysis, and sample identification
- Field analysis performed, including results, instrument checks, problems, and calibration records for field instruments
- Descriptions of deviations from this SAP
- Problems encountered and corrective action taken
- Identification of field QC samples
- Verbal or written instructions
- Any other events that may affect the samples

Variances or changes to field activities will be documented in the field logbook. The field team lead or Trevet PM will review field logbooks for accuracy at the end of each field day.

14.12.2 Document Corrections

Project documentation will be changed or corrected by crossing out the erroneous item with a single line and initialing (by the person making the correction) and dating the correction. The original item, although erroneous, must remain legible beneath the cross-out line. The new information should be written clearly above the crossed-out item.

14.12.3 Data Collected in the Field

Data collected in the field will include soil descriptions made during drilling and excavation as well as geophysical data collected during survey activities. Soil will be described in general accordance with the Unified Soil Classification System. The field geologist will record soil descriptions by hand on a borehole log or test pit log (included in Attachment 1). The boring log subsequently will be recorded in electronic format and each log will be reviewed and approved by a licensed professional geologist or engineer. Geophysical data will be reviewed, interpreted, and approved by a licensed geophysicist.

14.12.4 Data Validation

The analytical data validation component follows NAVFAC SW Environmental Work Instruction #1 (NAVFAC 2001). The analytical data will be sent to a third-party data validation company. The data validation prescribed for this project is 90 percent Level III and 10 percent

SAP Worksheet #14 – continued

Level IV. The flagging associated with a third-party data validation report will be entered into the database for each sample and used during data interpretation activities. The analytical data will be uploaded to the NAVFAC SW NIRIS website in accordance with NAVFAC SW Environmental Work Instruction #6 (NAVFAC 2005) after completion of the third-party data validation report.

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SAP Worksheet #15 — Reference Limits and Evaluation Table

The abbreviations below are used in each table heading in Worksheet #15. Additional notes and abbreviations may appear at the end of tables as needed.

- µg/L – micrograms per liter
- µg/kg – micrograms per kilogram
- CAS – Chemical Abstract Service
- DL – detection limit
- EDL – estimated detection limit
- LOD – limit of detection
- LOQ – limit of quantitation
- mg/L – milligrams per liter
- mg/kg – milligrams per kilogram
- ng/kg – nanograms per kilogram
- pg/L – picograms per liter

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
1,1,1-Trichloroethane	71-55-6	260,000	LANL	5	5	1	0.5
1,1,2,2-Tetrachloroethane	79-34-5	600	RSL	5	5	1	0.5
1,1,2-Trichloroethane	79-00-5	1,100	RSL [2]	5	5	1	0.5
1,1-Dichloroethane	75-34-3	3,600	RSL	5	5	1	0.5
1,1-Dichloroethene	75-35-4	11,000	LANL	5	5	1	0.5
1,2,4-Trimethylbenzene	95-63-6	58,000	RSL	5	5	2	0.55
1,2-Dichloroethane	107-06-2	460	RSL	5	5	1	0.5
1,2-Dichloropropane	78-87-5	1,000	RSL	5	5	1	0.5
1,3,5-Trimethylbenzene	108-67-8	21,300	Cal Modified PRG	5	5	2	0.59
2-Butanone	78-93-3	360,000	LANL	10	10	5	2.5
2-Hexanone	591-78-6	360	LANL	10	10	5	2.9
4-Methyl-2-Pentanone	108-10-1	9,800	LANL	10	10	5	2.8
Acetone	67-64-1	1,200	LANL	10	10	5	3.1
Benzene	71-43-2	1,200	RSL	5	5	1	0.5
Bromodichloromethane	75-27-4	290	RSL	5	5	1	0.5
Bromoform	75-25-2	67,000	RSL	5	5	2	1
Bromomethane	74-83-9	6,800	RSL	10	10	5	1.8
Carbon disulfide	75-15-0	820	LANL	5	5	1	0.5

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Carbon tetrachloride	56-23-5	650	RSL	5	5	2	0.54
Chlorobenzene	108-90-7	2,400	LANL	5	5	1	0.5
Chloroethane	75-00-3	14,000,000	RSL	5	5	2	1.3
Chloroform	67-66-3	320	RSL	5	5	1	0.5
Chloromethane	74-87-3	110,000	RSL	5	5	2	1
cis-1,2-Dichloroethene	156-59-2	23,000	LANL	5	5	1	0.5
cis-1,3-Dichloropropene	542-75-6	1,800	RSL [3]	5	5	1	0.5
Dibromochloromethane	124-48-1	730	RSL	5	5	1	0.5
Ethylbenzene	100-41-4	5,800	RSL	5	5	1	0.5
Isopropyl benzene	98-82-8	1,900,000	RSL	5	5	2	0.64
m/p-Xylenes	136777-61-2	1,400	LANL [4]	10	10	2	1
Methylene chloride	75-09-2	2,600	LANL	10	10	5	2
n-Butylbenzene	104-51-8	580,000	Cal Modified PRG	5	5	2	0.7
n-Propylbenzene	103-65-1	3,300,000	RSL	5	5	2	0.65
o-Xylene	95-47-6	1,400	LANL	5	5	1	0.5
p-Isopropyltoluene	99-87-6	NVA	N/A	5	5	2	0.62
sec-Butylbenzene	135-98-8	450,000	Cal Modified PRG	5	5	2	0.67
Styrene	100-42-5	1,200	LANL	5	5	1	0.5

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Tert-Butylbenzene	98-06-6	530,000	Cal Modified PRG	5	5	2	0.62
Tetrachloroethene	127-18-4	180	LANL	5	5	1	0.5
Toluene	108-88-3	23,000	LANL	5	5	1	0.5
trans-1,2-Dichloroethene	156-60-5	23,000	LANL [5]	5	5	1	0.5
trans-1,3-Dichloropropene	10061-02-6	1,800	RSL	5	5	1	0.5
Trichloroethene	79-01-6	940	RSL	5	5	1	0.5
Vinyl chloride	75-01-4	59	RSL	5	5	2	1.4

Cal Modified PRG – California modified Preliminary Remediation Goal based on DTSC HHRA Note 3 (DTSC 2013)
DTSC – Department of Toxic Substances Control
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
LANL – Los Alamos National Laboratory ESL (LANL 2012)
NVA – no value available
RSL - Regional Screening Level based on U.S. EPA Region 9 soil criteria (USEPA 2014)
[1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (soil), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum No Effect ESL
[2] RSL value for 1,1,1-trichloroethane was used
[3] RSL value for 1,3-dichloropropane was used
[4] LANL value for total xylenes was used
[5] LANL value for cis/trans-1,2-dichloroethene was used

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
1,2,4,5-Tetrachlorobenzene	95-94-3	18,000	RSL	333	333	167	83
1,2,4-Trichlorobenzene	120-82-1	270 [c]	LANL	167	333	167	83
1,2-Dichlorobenzene	95-50-1	920	LANL	333	333	167	83
1,3-Dichlorobenzene	541-73-1	730	LANL	333	333	167	83
1,4-Dichlorobenzene	106-46-7	880	LANL	333	333	167	83
2,2-Oxybis (1-Chloropropane)	108-60-1	4,900	RSL	333	333	167	83
2,4,5-Trichlorophenol	95-95-4	6,200,000	RSL	333	333	167	91
2,4,6-Trichlorophenol	88-06-2	48,000	RSL	333	333	167	83
2,4-Dichlorophenol	120-83-2	180,000	RSL	333	333	167	83
2,4-Dimethylphenol	105-67-9	1,200,000	RSL	333	333	167	83
2,4-Dinitrophenol	51-28-5	120,000	RSL	667	667	167	86
2,4-Dinitrotoluene	121-14-2	1,700	RSL	333	333	167	83
2,6-Dichlorophenol	87-65-0	180,000	RSL [2]	333	333	167	83
2-Chloronaphthalene	91-58-7	6,300,000	RSL	333	333	167	83
2-Chlorophenol	95-57-8	390	LANL	333	333	167	83
2-Methylphenol	95-48-7	670	LANL	333	333	167	83
2-Nitroaniline	88-74-4	540	LANL	333	333	167	83
2-Nitrophenol	88-75-5	NVA	N/A	333	333	167	83
3,3'-Dichlorobenzidine	91-94-1	1,200	RSL	333	333	167	84

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
3,3'-Dimethylbenzibine	119-93-7	48 [a]	RSL	167	667	167	130
3.4-Methylphenol	106-44-5	6,200,000	RSL	333	333	167	83
3-Nitroaniline	99-09-2	18,000	Cal Modified PRG	333	333	167	83
4,6-Dinitro-2-methylphenol	534-52-1	4,900	RSL	667	667	167	83
4-Bromophenyl-phenyl ether	101-55-3	NVA	N/A	333	333	167	90
4-Chloro-3-methylphenol	59-50-7	6,200,000	RSL	333	333	167	83
4-Chloroaniline	106-47-8	1,000	LANL	333	333	167	83
4-Chlorophenyl-phenyl ether	7005-72-3	NVA	N/A	333	333	167	83
4-Nitroaniline	100-01-6	27,000	RSL	333	333	167	120
4-Nitrophenol	100-02-7	NVA	N/A	667	667	167	106
5-Nitro-o-toluidine	99-55-8	59,000	RSL	333	333	167	106
A,A-Dimethylphenethylamine	122-09-8	NVA	N/A	NA	NA	NA	NA
Acenaphthene	83-32-9	250 [c]	LANL	167	333	167	83
Acetophenone	98-86-2	7,800,000	RSL	333	333	167	83
Aniline	62-53-3	93,000	RSL	667	667	330	167
Aramite	140-57-8	21,000	RSL	333	333	167	83
Benzo(a)anthracene	56-55-3	150 [b]	RSL	167	333	167	83
Benzo(a)pyrene	50-32-8	15 [a]	RSL	167	333	167	83
Benzo(b)fluoranthene	205-99-2	150 [b]	RSL	167	333	167	86

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Benzo(g,h,i)perylene	191-24-2	24,000	LANL	333	333	167	87
Benzo(k)fluoranthene	207-08-9	380	Cal Modified PRG	333	333	167	83
Benzyl alcohol	100-51-6	120,000	LANL	333	333	167	83
bis(2-Chloroethoxy)methane	111-91-1	180,000	RSL	333	333	167	83
bis(2-Chloroethyl)ether	111-41-1	230 [c]	RSL	167	333	167	83
Bis(2-ethylhexyl)phthalate	117-81-7	20 [a]	LANL	167	333	167	115
Butylbenzylphthalate	85-68-7	90,000	LANL	333	333	167	83
Chlorobenzilate	510-15-6	4,800	RSL	333	333	167	83
Chrysene	218-01-9	2,400	LANL	333	333	167	83
Diallate	2303-16-4	8,700	RSL	333	333	167	100
Dibenzo(a,h)anthracene	53-70-3	15 [a]	RSL	167	333	167	83
Dibenzofuran	132-64-9	6,100	LANL	333	333	167	83
Diethylphthalate	84-66-2	100,000	LANL	333	333	167	83
Dimethylphthalate	131-11-3	10,000	LANL	333	333	167	83
Di-n-butylphthalate	84-74-2	11 [a]	LANL	167	333	167	97
Di-n-octylphthalate	117-84-0	910	LANL	333	333	167	97
Diphenylamine	122-39-4	10,000	LANL	333	333	167	153
Fluoranthene	205-99-2	10,000	LANL	333	333	167	126
Fluorene	191-24-2	3,700	LANL	333	333	167	83

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Hexachlorobenzene	118-74-1	79 [a]	LANL	167	333	167	83
Hexachlorobutadiene	87-68-3	6,800	RSL	333	333	167	83
Hexachlorocyclopentadiene	77-47-4	370,000	RSL	333	333	167	83
Hexachloroethane	67-72-1	13,000	RSL	333	333	167	83
Indeno(1,2,3-cd)pyrene	193-39-5	150 [b]	RSL	167	333	167	83
Isophorone	78-59-1	560,000	RSL	333	333	167	83
Kepone	143-50-0	21 [a]	LANL	1,330	3330	1330	667
Naphthalene	91-20-3	1,000	LANL	333	333	167	83
N-Nitroso-di-n-butylamine	924-16-3	94 [b]	RSL	167	333	167	83
N-Nitrosodimethylamine	62-75-9	2.3 [a]	RSL	167	333	167	83
N-Nitroso-di-n-propylamine	621-64-7	76 [a]	RSL	167	333	167	83
N-Nitrosomethylethylamine	10595-95-6	24 [a]	RSL	167	333	167	83
N-Nitrosopyrrolidine	930-55-2	250 [c]	RSL	167	333	167	83
O-toluidine	95-53-4	18,000	RSL [3]	333	333	167	83
Pentachlorobenzene	608-93-5	49,000	RSL	333	333	167	83
Pentachloroethane	76-01-7	5,900	RSL	333	333	167	83
Pentachloronitrobenzene	82-68-8	700	LANL	333	333	167	83
Pentachlorophenol	87-86-5	360 [c]	LANL	330	667	330	167
Phenanthrene	85-01-8	5,500	LANL	333	333	167	83

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Phenol	108-95-2	790	LANL	333	333	167	83
Pronamide	23950-58-5	4,600,000	RSL	333	333	167	83
Pyrene	129-00-0	10,000	LANL	333	333	167	160
Pyridine	110-86-1	78,000	RSL	1,333	1,333	667	333

Cal Modified PRG – California modified Preliminary Remediation Goal based on DTSC HHRA Note 3 (DTSC 2013)
DTSC – Department of Toxic Substances Control
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
LANL – Los Alamos National Laboratory No Effect ESL (LANL 2012)
N/A – not applicable
NVA – No value available
RSL - Regional Screening Level based on U.S. EPA Region 9 Soil criteria (USEPA 2014)
[1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Soil), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum Ecological Screening Levels (No Effect ESL)
[2] RSL value for 2,4-dichlorophenol was used
[3] RSL value for p-toluidine was used
[a] –The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.
[b] – The Project Screening Level is below the LOQ and LOD but at or above the DL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and DL. Any uncertainty associated with the analyte will be discussed in the data summary report.
[c] – The Project Screening Level is below the LOQ but at or above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: PAHs – U.S. EPA Method 8270C SIM

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
2-Methylnaphthalene	91-57-6	16,000	LANL	10	10	2.5	1.25
Acenaphthene	83-32-9	250	LANL	10	10	2.5	1.25
Acenaphthylene	208-96-8	120,000	LANL	10	10	2.5	1.25
Anthracene	120-12-7	6,800	LANL	10	10	2.5	1.25
Benzo[a]anthracene	56-55-3	150	RSL	10	10	2	2.45
Benzo[b]fluoranthene	205-99-2	150	RSL	10	10	2.5	1.25
Benzo[k]fluoranthene	207-08-9	380	Cal Modified PRG	10	10	2.5	1.25
Benzo[g,h,i]perylene	191-24-2	24,000	LANL	10	10	2.5	1.25
Benzo[a]pyrene	50-32-8	15	RSL	10	10	2.5	1.25
Chrysene	218-01-9	2,400	LANL	10	10	5	2.2
Dibenz(a,h)anthracene	53-70-3	15	RSL	10	10	2.5	1.25
Fluoranthene	206-44-0	10,000	LANL	10	10	2.5	1.25
Fluorene	86-73-7	3,700	LANL	10	10	2.5	1.25
Indeno[1,2,3-cd]pyrene	193-39-5	150	RSL	10	10	2.5	1.25
Naphthalene	91-20-3	1,000	LANL	10	10	2.5	1.25
Phenanthrene	85-01-8	5,500	LANL	10	10	2.5	1.25

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: PAHs – U.S. EPA Method 8270C SIM

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Pyrene	129-00-0	10,000	LANL	10	10	2.5	1.25

Background – Background threshold values are from Basewide Metals Background Soil Study (SES-TECH 2012)
Cal Modified PRG – California modified Preliminary Remediation Goal based on DTSC HHRA Note 3 (DTSC 2013)
DTSC – Department of Toxic Substances Control
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
LANL – Los Alamos National Laboratory ESL (LANL 2012)
RSL - Regional Screening Level based on U.S. EPA Region 9 Soil criteria (USEPA 2014)

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: Metals – U.S. EPA Method 6020A/7471B

Analyte	CAS Number	Project Screening Level [1] (mg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory-Specific (mg/kg)		
					LOQ	LOD	DL
Aluminum	7429-90-5	77,000	RSL	100	100	20	10
Antimony	7440-36-0	0.05 [a]	LANL	0.2	0.5	0.2	0.1
Arsenic	7440-38-2	2.856	Background	0.5	0.5	0.10	0.05
Barium	7440-39-3	363.5	Background	0.5	0.5	0.2	0.072
Beryllium	7440-41-7	2.5	LANL	0.5	0.5	0.1	0.05
Cadmium	7440-43-9	0.27 [c]	LANL	0.2	0.5	0.2	0.057
Calcium	7440-70-2	6,828	Background	100	100	50	17
Chromium	7440-47-3	63.8	Background	0.5	0.5	0.1	0.05
Cobalt	7440-48-4	20.4	Background	0.5	0.5	0.1	0.05
Copper	7440-50-8	53.4	Background	0.5	0.5	0.2	0.1
Iron	7439-89-6	55,000	RSL	100	100	20	10
Lead	7439-92-1	14	LANL	0.5	0.5	0.1	0.05
Magnesium	7439-95-4	15,685	Background	100	100	20	10
Manganese	7439-96-5	532.7	Background	0.5	0.5	0.3	0.153
Mercury	7439-97-6	0.0186 [b]	Background	0.02	0.1	0.02	0.01
Nickel	7440-02-0	15	Background	0.5	0.5	0.2	0.063

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: Metals – U.S. EPA Method 6020A/7471B

Analyte	CAS Number	Project Screening Level [1] (mg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory-Specific (mg/kg)		
					LOQ	LOD	DL
Potassium	7440-09-7	6,210	Background	100	100	20	10
Selenium	7782-49-2	0.608	Background	0.5	0.5	0.1	0.5
Silver	7440-22-4	2.6	LANL	0.5	0.5	0.1	0.05
Sodium	7440-23-5	679.5	Background	100	100	20	10
Thallium	7440-28-0	0.606	Background	0.5	0.5	0.1	0.05
Vanadium	7440-62-2	186.4	Background	0.5	0.5	0.25	0.19
Zinc	7440-66-6	228.2	Background	2	2	1	0.683

Background – Background threshold values are from Basewide Metals Background Soil Study (SES-TECH 2012)
Cal Modified PRG – California modified Preliminary Remediation Goal based on DTSC HHRA Note 3 (DTSC 2013)
DTSC – Department of Toxic Substances Control
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
LANL – Los Alamos National Laboratory ESL (LANL 2012)
RSL - Regional Screening Level based on U.S. EPA Region 9 Soil criteria (USEPA 2014)
[1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Soil), DTSC HHRA Note 3 (Cal Modified PRG), LANL minimum No Effect ESL and Background
[a] –The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.
[b] – The Project Screening Level is below the LOQ and LOD but at or above the DL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and DL. Any uncertainty associated with the analyte will be discussed in the data summary report.
[c] – The Project Screening Level is below the LOQ but at or above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: ALS Laboratories
Matrix: Soil
Analytical Group: Dioxins/Furans – U.S. EPA Method 8290

Analyte	CAS Number	Project Screening Level [1] (ng/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (ng/kg)	Laboratory-Specific (ng/kg)		
					LOQ	LOD	EDL
2378-TCDD	1746-01-6	0.29 [a]	LANL	0.15	0.5	0.15	0.0562
12378-PeCDD	40321-76-4	0.29 [b]	LANL [2]	0.75	2.5.	0.75	0.0312
123478-HxCDD	39227-28-6	2.9	LANL [2]	2.5	2.5	0.75	0.0322
123678-HxCDD	57653-85-7	2.9	LANL [2]	2.5	2.5	0.75	0.0304
123789-HxCDD	19408-74-3	2.9	LANL [2]	2.5	2.5	0.75	0.0291
1234678-HpCDD	35822-46-9	290	LANL [2]	2.5	2.5	0.75	0.0208
OCDD	3268-87-9	967	LANL [2]	5	5	1.5	0.0381
2378-TCDF	51207-31-9	0.29 [a]	LANL [2]	0.15	0.5	0.15	0.0415
12378-PeCDF	57117-41-6	2.9	LANL [2]	2.5	2.5	0.75	0.0324
23478-PeCDF	57117-31-4	0.29 [b]	LANL [2]	0.75	2.5	0.75	0.0351
123478-HxCDF	70648-26-9	2.9	LANL [2]	2.5	2.5	0.75	0.0195
123678-HxCDF	57117-44-9	2.9	LANL [2]	2.5	2.5	0.75	0.0188
123789-HxCDF	72918-21-9	2.9	LANL [2]	2.5	2.5	0.75	0.0248
234678-HxCDF	60851-34-5	2.9	LANL [2]	2.5	2.5	0.75	0.0204
1234678-HpCDF	67562-39-4	290	LANL [2]	2.5	2.5	0.75	0.0278
1234789-HpCDF	55673-89-7	290	LANL [2]	2.5	2.5	0.75	0.0373

SAP Worksheet #15 – continued

Laboratory: ALS Laboratories
Matrix: Soil
Analytical Group: Dioxins/Furans – U.S. EPA Method 8290

Analyte	CAS Number	Project Screening Level [1] (ng/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (ng/kg)	Laboratory-Specific (ng/kg)		
					LOQ	LOD	EDL
OCDF	39001-02-2	967	LANL [2]	5	5	1.5	0.0661
Total TCDD	41903-57-5-	N/A	N/A	0.5	0.5	NA	NA
Total PeCDD	3608-22-9	N/A	N/A	2.5	2.5	NA	NA
Total HxCDD	34465-46-8	N/A	N/A	2.5	2.5	NA	NA
Total HpCDD	37871-00-4	N/A	N/A	2.5	2.5	NA	NA
Total HpCDD	37871-00-4	N/A	N/A	2.5	2.5	NA	NA
Total TCDF	30402-14-3	N/A	N/A	0.5	0.5	NA	NA
Total PeCDF	30402-15-4	N/A	N/A	2.5	2.5	NA	NA
Total HxCDF	55684-94-1	N/A	N/A	2.5	2.5	NA	NA
Total HpCDF	38998-75-3	N/A	N/A	2.5	2.5	NA	NA

Cal Modified PRG – California modified Preliminary Remediation Goal based on DTSC HHRA Note 3 (DTSC 2013)
DTSC – Department of Toxic Substances Control
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
HpCDD – heptachloro dibenzo-p-dioxin
HxCDD – hexachloro dibenzo-p-dioxin
HpCDF – heptachloro dibenzo-p-furan
HxCDF – hexachloro dibenzo-p-furan
LANL – Los Alamos National Laboratory ESL (LANL 2012)
N/A – not applicable

SAP Worksheet #15 – continued

OCDD – octachloro dibenzo-p-dioxin

OCDF – octachloro dibenzo-p-furan

PeCDD – pentachloro dibenzo-p-dioxin

PeCDF – pentachloro dibenzo-p-furan

RSL - Regional Screening Level based on U.S. EPA Region 9 Tap water criteria (USEPA 2014)

TCDD – tetrachloro dibenzo-p-dioxin

TCDF – tetrachloro dibenzo-p-furan

[1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Soil), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum No Effect ESL

[2] The Project Screening Level is TCDD toxicity equivalent value (individual congener values estimated using toxicity equivalency factors for 2,3,7,8-TCDD)

[a] The Project Screening Level is below the LOQ but above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

[b] The Project Screening Level is below the LOQ and LOD but at or above the EDL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and EDL. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: Pesticides – U.S. EPA Method 8081A

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
4,4'-DDD	72-54-8	6.3	LANL	2	2	0.4	0.20
4,4'-DDE	72-55-9	110	LANL	2	2	0.4	0.20
4,4'-DDT	50-29-3	44	LANL	2	2	0.4	0.20
Aldrin	309-00-2	31	RSL	2	2	0.4	0.20
alpha-BHC	319-84-6	85	RSL	2	2	0.4	0.20
alpha-Chlordane	5103-71-9	270	LANL	2	2	0.4	0.20
beta-BHC	319-85-7	270	LANL	2	2	0.4	0.20
delta-BHC	319-86-8	NVA	N/A	2	2	0.4	0.27
Dieldrin	60-57-1	4.5	LANL	2	2	0.4	0.20
Endosulfan I	959-98-8	640	LANL	2	2	0.4	0.20
Endosulfan II	33213-65-9	640	LANL	2	2	0.4	0.20
Endosulfan sulfate	1031-07-8	640	LANL	2	2	0.4	0.20
Endrin	72-20-8	1.4 [a]	LANL	0.4	2	0.4	0.20
Endrin aldehyde	7421-93-4	1.4 [a]	LANL	0.4	2	0.4	0.35
Endrin ketone	53494-70-5	1.4 [a]	LANL	0.4	2	0.4	0.20
gamma-BHC (Lindane)	58-89-9	9.4	LANL	2	2	0.4	0.20
gamma-Chlordane	5103-74-2	1,800	RSL	2	2	0.4	0.20
Heptachlor	76-44-8	59	LANL	2	2	0.4	0.20
Heptachlor epoxide	1024-57-3	59	RSL	2	2	0.4	0.20

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: Pesticides – U.S. EPA Method 8081A

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Methoxychlor	72-43-5	5,000	LANL	4	10	4	2.00
Toxaphene	8001-35-2	480	RSL	10	50	10	5.00

LANL – Los Alamos National Laboratory ESL (LANL 2012)
N/A – not applicable
NVA – No value available
RSL - Regional Screening Level based on U.S. EPA Region 9 residential soil criteria (USEPA 2014)
[1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Soil), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum No Effect ESL
[a] The Project Screening Level is below the LOQ but above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Soil
Analytical Group: PCBs – U.S. EPA Method 8082

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
PCB-1016	12674-11-2	1,000	LANL	50	50	17	13
PCB-1221	11104-28-2	150	RSL	50	50	17	8.3
PCB-1232	11141-16-5	150	RSL	50	50	17	9
PCB-1242	53469-21-9	41 [a]	LANL	17	50	17	9.3
PCB-1248	12672-29-6	7.2 [b]	LANL	17	50	17	8.3
PCB-1254	11097-69-1	41 [a]	LANL	17	50	17	8.3
PCB-1260	11096-82-5	140	LANL	50	50	17	9.9

LANL – Los Alamos National Laboratory ESL (LANL 2012)

RSL - Regional Screening Level based on U.S. EPA Region 9 residential soil criteria (USEPA 2014) [1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Soil), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum No Effect ESL

[a] The Project Screening Level is below the LOQ but above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

[b] The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Solid
Analytical Group: TOC – Walkley-Black

Analyte	CAS Number	Project Screening Level (mg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory-Specific (mg/kg)		
					LOQ	LOD	DL
TOC	-28 [a]	N/A [1]	N/A	600	600	600	600

TOC- total organic carbon

[a] A single CAS number has not been assigned by the American Chemical Society for TOC. For this project, the CAS number was obtained from the NEDD specifications for "TOC".

[1] TOC is not a COC. Project screening levels are only applicable to the COC.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
1,1,1-Trichloroethane	71-55-6	70	LANL	5	5	1	0.5
1,1,2,2-Tetrachloroethane	79-34-5	NVA	N/A	5	5	1	0.5
1,1,2-Trichloroethane	79-00-5	70	LANL [2]	5	5	1	0.5
1,1-Dichloroethane	75-34-3	20	LANL	5	5	1	0.5
1,1-Dichloroethene	75-35-4	100	LANL	5	5	1	0.5
1,2,4-Trimethylbenzene	95-63-6	NVA	N/A	5	5	2	0.55
1,2-Dichloroethane	107-06-2	6300	LANL	5	5	1	0.5
1,2-Dichloropropane	78-87-5	NVA	N/A	5	5	1	0.5
1,3,5-Trimethylbenzene	108-67-8	NVA	N/A	5	5	2	0.59
2-Butanone	78-93-3	3,300,000	LANL	10	10	5	2.5
2-Hexanone	591-78-6	NVA	N/A	10	10	5	2.9
4-Methyl-2-Pentanone	108-10-1	NVA	N/A	10	10	5	2.8
Acetone	67-64-1	65	N/A	10	10	5	3.1
Benzene	71-43-2	10	LANL	5	5	1	0.5
Bromodichloromethane	75-27-4	NVA	N/A	5	5	1	0.5
Bromoform	75-25-2	NVA	N/A	5	5	2	1
Bromomethane	74-83-9	NVA	N/A	10	10	5	1.8

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Carbon disulfide	75-15-0	NVA	N/A	5	5	1	0.5
Carbon tetrachloride	56-23-5	NVA	N/A	5	5	2	0.54
Chlorobenzene	108-90-7	30	LANL	5	5	1	0.5
Chloroethane	75-00-3	NVA	N/A	5	5	2	1.3
Chloroform	67-66-3	10,000	LANL	5	5	1	0.5
Chloromethane	74-87-3	NVA	N/A	5	5	2	1
cis-1,2-Dichloroethene	156-59-2	200	LANL [3]	5	5	1	0.5
cis-1,3-Dichloropropene	542-75-6	NVA	N/A	5	5	1	0.5
Dibromochloromethane	124-48-1	NVA	N/A	5	5	1	0.5
Ethylbenzene	100-41-4	NVA	N/A	5	5	1	0.5
Isopropyl benzene	98-82-8	NVA	N/A	5	5	2	0.64
m/p-Xylenes	136777-61-2	130	LANL [4]	10	10	2	1
Methylene chloride	75-09-2	18	LANL	10	10	5	2
n-Butylbenzene	104-51-8	NVA	N/A	5	5	2	0.7
n-Propylbenzene	103-65-1	NVA	N/A	5	5	2	0.65
o-Xylene	95-47-6	130	LANL [4]	5	5	1	0.5
p-Isopropyltoluene	99-87-6	NVA	N/A	5	5	2	0.62

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
sec-Butylbenzene	135-98-8	NVA	N/A	5	5	2	0.67
Styrene	100-42-5	NVA	N/A	5	5	1	0.5
Tert-Butylbenzene	98-06-6	NVA	N/A	5	5	2	0.62
Tetrachloroethene	127-18-4	2 [a]	LANL	1	5	1	0.5
Toluene	108-88-3	10	LANL	5	5	1	0.5
trans-1,2-Dichloroethene	156-60-5	200	LANL [3]	5	5	1	0.5
trans-1,3-Dichloropropene	10061-02-6	NVA	N/A	5	5	1	0.5
Trichloroethene	79-01-6	78	LANL	5	5	1	0.5
Vinyl chloride	75-01-4	NVA	N/A	5	5	2	1.4

LANL – Los Alamos National Laboratory ESL (LANL 2012)
N/A – not applicable
NVA – No value available
[1] The Project Screening Levels shown are the LANL minimum sediment No Effect ESL (LANL 2012)
[2] LANL value for 1,1,1-trichloroethane was used
[3] LANL value for cis/trans-1,2-dichlroethene was used
[4] LANL value for total xylenes was used
[a] The Project Screening Level is below the LOQ but above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
1,2,4,5-Tetrachlorobenzene	95-94-3	NVA	N/A	333	333	167	83
1,2,4-Trichlorobenzene	120-82-1	11 [a]	LANL	167	333	167	83
1,2-Dichlorobenzene	95-50-1	NVA	N/A	333	333	167	83
1,3-Dichlorobenzene	541-73-1	NVA	N/A	333	333	167	83
1,4-Dichlorobenzene	106-46-7	30 [a]	LANL	333	333	167	83
2,2-Oxybis (1-Chloropropane)	108-60-1	NVA	N/A	333	333	167	83
2,4,5-Trichlorophenol	95-95-4	NVA	N/A	333	333	167	91
2,4,6-Trichlorophenol	88-06-2	NVA	N/A	333	333	167	83
2,4-Dichlorophenol	120-83-2	NVA	N/A	333	333	167	83
2,4-Dimethylphenol	105-67-9	NVA	N/A	333	333	167	83
2,4-Dinitrophenol	51-28-5	NVA	N/A	667	667	167	86
2,4-Dinitrotoluene	121-14-2	290 [c]	LANL	333	333	167	83
2,6-Dichlorophenol	87-65-0	NVA	N/A	333	333	167	83
2-Chloronaphthalene	91-58-7	NVA	N/A	333	333	167	83
2-Chlorophenol	95-57-8	55 [a]	LANL	333	333	167	83
2-Methylphenol	95-48-7	NVA	N/A	333	333	167	83
2-Nitroaniline	88-74-4	NVA	N/A	333	333	167	83
2-Nitrophenol	88-75-5	NVA	N/A	333	333	167	83
3,3'-Dichlorobenzidine	91-94-1	NVA	N/A	333	333	167	84

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
3,3'-Dimethylbenzibine	119-93-7	NVA	N/A	167	667	167	130
3.4-Methylphenol	106-44-5	NVA	N/A	333	333	167	83
3-Nitroaniline	99-09-2	NVA	N/A	333	333	167	83
4,6-Dinitro-2-methylphenol	534-52-1	NVA	N/A	667	667	167	83
4-Bromophenyl-phenyl ether	101-55-3	NVA	N/A	333	333	167	90
4-Chloro-3-methylphenol	59-50-7	NVA	N/A	333	333	167	83
4-Chloroaniline	106-47-8	NVA	N/A	333	333	167	83
4-Chlorophenyl-phenyl ether	7005-72-3	NVA	N/A	333	333	167	83
4-Nitroaniline	100-01-6	NVA	N/A	333	333	167	120
4-Nitrophenol	100-02-7	NVA	N/A	667	667	167	106
5-Nitro-o-toluidine	99-55-8	NVA	N/A	333	333	167	106
A,A-Dimethylphenethylamine	122-09-8	NVA	N/A	NA	NA	NA	NA
Acenaphthene	83-32-9	76 [a]	LANL	167	333	167	83
Acetophenone	98-86-2	NVA	N/A	333	333	167	83
Aniline	62-53-3	NVA	N/A	667	667	330	167
Aramite	140-57-8	NVA	N/A	333	333	167	83
Benzo(a)anthracene	56-55-3	100 [b]	LANL	167	333	167	83
Benzo(a)pyrene	50-32-8	150 [b]	LANL	167	333	167	83
Benzo(b)fluoranthene	205-99-2	190 [c]	LANL	167	333	167	86

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Benzo(g,h,i)perylene	191-24-2	170 [c]	LANL	333	333	167	87
Benzo(k)fluoranthene	207-08-9	240 [c]	LANL	333	333	167	83
Benzyl alcohol	100-51-6	330,000	LANL	333	333	167	83
bis(2-Chloroethoxy)methane	111-91-1	NVA	N/A	333	333	167	83
bis(2-Chloroethyl)ether	111-41-1	NVA	N/A	167	333	167	83
Bis(2-ethylhexyl)phthalate	117-81-7	26 [a]	LANL	167	333	167	115
Butylbenzylphthalate	85-68-7	100 [b]	LANL	333	333	167	83
Chlorobenzilate	510-15-6	NVA	N/A	333	333	167	83
Chrysene	218-01-9	160 [b]	LANL	333	333	167	83
Diallate	2303-16-4	NVA	N/A	333	333	167	100
Dibenzo(a,h)anthracene	53-70-3	33 [a]	LANL	167	333	167	83
Dibenzofuran	132-64-9	510	LANL	333	333	167	83
Diethylphthalate	84-66-2	NVA	N/A	333	333	167	83
Dimethylphthalate	131-11-3	100,000	LANL	333	333	167	83
Di-n-butylphthalate	84-74-2	11 [a]	LANL	167	333	167	97
Di-n-octylphthalate	117-84-0	1100	LANL	333	333	167	97
Diphenylamine	122-39-4	NVA	N/A	333	333	167	153
Fluoranthene	205-99-2	420	LANL	333	333	167	126
Fluorene	191-24-2	77 [a]	LANL	333	333	167	83

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Hexachlorobenzene	118-74-1	NVA	N/A	167	333	167	83
Hexachlorobutadiene	87-68-3	NVA	N/A	333	333	167	83
Hexachlorocyclopentadiene	77-47-4	NVA	N/A	333	333	167	83
Hexachloroethane	67-72-1	NVA	N/A	333	333	167	83
Indeno(1,2,3-cd)pyrene	193-39-5	200 [c]	LANL	167	333	167	83
Isophorone	78-59-1	NVA	N/A	333	333	167	83
Kepone	143-50-0	27 [a]	LANL	1,330	3330	1330	667
Naphthalene	91-20-3	170 [c]	LANL	333	333	167	83
N-Nitroso-di-n-butylamine	924-16-3	NVA	N/A	167	333	167	83
N-Nitrosodimethylamine	62-75-9	NVA	N/A	167	333	167	83
N-Nitroso-di-n-propylamine	621-64-7	NVA	N/A	167	333	167	83
N-Nitrosomethylethylamine	10595-95-6	NVA	N/A	167	333	167	83
N-Nitrosopyrrolidine	930-55-2	NVA	N/A	167	333	167	83
O-toluidine	95-53-4	NVA	N/A	333	333	167	83
Pentachlorobenzene	608-93-5	NVA	N/A	333	333	167	83
Pentachloroethane	76-01-7	NVA	N/A	333	333	167	83
Pentachloronitrobenzene	82-68-8	920	LANL	333	333	167	83
Pentachlorophenol	87-86-5	10 [a]	LANL	330	667	330	167
Phenanthrene	85-01-8	200 [c]	LANL	333	333	167	83

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/kg)	Laboratory-Specific (µg/kg)		
					LOQ	LOD	DL
Phenol	108-95-2	840,000	LANL	333	333	167	83
Pronamide	23950-58-5	NVA	N/A	333	333	167	83
Pyrene	129-00-0	190 [c]	LANL	333	333	167	160
Pyridine	110-86-1	NVA	N/A	1,333	1,333	667	333

LANL – Los Alamos National Laboratory ESL (LANL 2012)

N/A – not applicable

NVA – No value available

[1] The Project Screening Levels shown are the LANL minimum sediment No Effect ESL

[a] –The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.

[b] – The Project Screening Level is below the LOQ and LOD but at or above the DL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and DL. Any uncertainty associated with the analyte will be discussed in the data summary report.

[c] – The Project Screening Level is below the LOQ but at or above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: Metals – U.S. EPA Method 6020A/7471B

Analyte	CAS Number	Project Screening Level [1] (mg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory-Specific (mg/kg)		
					LOQ	LOD	DL
Aluminum	7429-90-5	0	LANL	100	100	20	10
Antimony	7440-36-0	0.36 [c]	LANL	0.2	0.5	0.2	0.1
Arsenic	7440-38-2	9.7	LANL	0.5	0.5	0.10	0.05
Barium	7440-39-3	150	LANL	0.5	0.5	0.2	0.072
Beryllium	7440-41-7	73	LANL	0.5	0.5	0.1	0.05
Cadmium	7440-43-9	0.33 [c]	LANL	0.2	0.5	0.2	0.057
Calcium	7440-70-2	NVA	N/A	100	100	50	17
Chromium	7440-47-3	43	LANL [2]	0.5	0.5	0.1	0.05
Cobalt	7440-48-4	230	LANL	0.5	0.5	0.1	0.05
Copper	7440-50-8	23	LANL	0.5	0.5	0.2	0.1
Iron	7439-89-6	20,000	LANL	100	100	20	10
Lead	7439-92-1	27	LANL	0.5	0.5	0.1	0.05
Magnesium	7439-95-4	NVA	N/A	100	100	20	10
Manganese	7439-96-5	460	LANL	0.5	0.5	0.3	0.153
Mercury	7439-97-6	0.018 [b]	LANL	0.02	0.1	0.02	0.01
Nickel	7440-02-0	NVA	LANL	0.5	0.5	0.2	0.063

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Sediment
Analytical Group: Metals – U.S. EPA Method 6020A/7471B

Analyte	CAS Number	Project Screening Level [1] (mg/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory-Specific (mg/kg)		
					LOQ	LOD	DL
Potassium	7440-09-7	13	N/A	100	100	20	10
Selenium	7782-49-2	0.72	LANL	0.5	0.5	0.1	0.5
Silver	7440-22-4	0.5	LANL	0.5	0.5	0.1	0.05
Sodium	7440-23-5	NVA	N/A	100	100	20	10
Thallium	7440-28-0	0.044 [a]	LANL	0.5	0.5	0.1	0.05
Vanadium	7440-62-2	30	LANL	0.5	0.5	0.25	0.19
Zinc	7440-66-6	65	LANL	2	2	1	0.683

LANL – Los Alamos National Laboratory (LANL 2012)
N/A – not applicable
[1] The Project Screening Levels shown are the LANL minimum sediment No Effect ESL
[2] LANL value for total chromium was used
[a] –The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.
[b] – The Project Screening Level is below the LOQ and LOD but at or above the DL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and DL. Any uncertainty associated with the analyte will be discussed in the data summary report.
[c] – The Project Screening Level is below the LOQ but at or above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: ALS Laboratories
Matrix: Sediment
Analytical Group: Dioxins/Furans – U.S. EPA Method 8290

Analyte	CAS Number	Project Screening Level [1] (ng/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (ng/kg)	Laboratory-Specific (ng/kg)		
					LOQ	LOD	EDL
2378-TCDD	1746-01-6	0.36 [a]	LANL	0.15	0.5	0.15	0.0562
12378-PeCDD	40321-76-4	0.36 [b]	LANL [2]	0.75	2.5.	0.75	0.0312
123478-HxCDD	39227-28-6	3.6	LANL [2]	2.5	2.5	0.75	0.0322
123678-HxCDD	57653-85-7	3.6	LANL [2]	2.5	2.5	0.75	0.0304
123789-HxCDD	19408-74-3	3.6	LANL [2]	2.5	2.5	0.75	0.0291
1234678-HpCDD	35822-46-9	36	LANL [2]	2.5	2.5	0.75	0.0208
OCDD	3268-87-9	1,200	LANL [2]	5	5	1.5	0.0381
2378-TCDF	51207-31-9	0.36 [a]	LANL [2]	0.15	0.5	0.15	0.0415
12378-PeCDF	57117-41-6	3.6	LANL [2]	2.5	2.5	0.75	0.0324
23478-PeCDF	57117-31-4	0.36 [b]	LANL [2]	0.75	2.5	0.75	0.0351
123478-HxCDF	70648-26-9	3.6	LANL [2]	2.5	2.5	0.75	0.0195
123678-HxCDF	57117-44-9	3.6	LANL [2]	2.5	2.5	0.75	0.0188
123789-HxCDF	72918-21-9	3.6	LANL [2]	2.5	2.5	0.75	0.0248
234678-HxCDF	60851-34-5	3.6	LANL [2]	2.5	2.5	0.75	0.0204
1234678-HpCDF	67562-39-4	36	LANL [2]	2.5	2.5	0.75	0.0278
1234789-HpCDF	55673-89-7	36	LANL [2]	2.5	2.5	0.75	0.0373

SAP Worksheet #15 – continued

Laboratory: ALS Laboratories
Matrix: Sediment
Analytical Group: Dioxins/Furans – U.S. EPA Method 8290

Analyte	CAS Number	Project Screening Level [1] (ng/kg)	Project Screening Level Reference	Project Quantitation Limit Goal (ng/kg)	Laboratory-Specific (ng/kg)		
					LOQ	LOD	EDL
OCDF	39001-02-2	1,200	LANL [2]	5	5	1.5	0.0661
Total TCDD	41903-57-5-	N/A	N/A	0.5	0.5	NA	NA
Total PeCDD	3608-22-9	N/A	N/A	2.5	2.5	NA	NA
Total HxCDD	34465-46-8	N/A	N/A	2.5	2.5	NA	NA
Total HpCDD	37871-00-4	N/A	N/A	2.5	2.5	NA	NA
Total TCDF	30402-14-3	N/A	N/A	0.5	0.5	NA	NA
Total PeCDF	30402-15-4	N/A	N/A	2.5	2.5	NA	NA
Total HxCDF	55684-94-1	N/A	N/A	2.5	2.5	NA	NA
Total HpCDF	38998-75-3	N/A	N/A	2.5	2.5	NA	NA

HpCDD – heptachloro dibenzo-p-dioxin
HxCDD – hexachloro dibenzo-p-dioxin
HpCDF – heptachloro dibenzo-p-furan
HxCDF – hexachloro dibenzo-p-furan
LANL – Los Alamos National Laboratory ESL (LANL 2012)
N/A – not applicable
OCDD – octachloro dibenzo-p-dioxin
OCDF – octachloro dibenzo-p-furan
PeCDD – pentachloro dibenzo-p-dioxin
PeCDF – pentachloro dibenzo-p-furan
RSL - Regional Screening Level based on U.S. EPA Region 9 tap water criteria (USEPA 2014)
TCDD – tetrachloro dibenzo-p-dioxin

SAP Worksheet #15 – continued

TCDF – tetrachloro dibenzo-p-furan

[1] – The Project Screening Levels shown are the LANL minimum sediment No Effect ESL

[2] The Project Screening Level is TCDD toxicity equivalent value (individual congener values estimated using toxicity equivalency factors for 2,3,7,8-TCDD)

[a] The Project Screening Level is below the LOQ but above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

[b] The Project Screening Level is below the LOQ and LOD but at or above the EDL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and EDL. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
1,1,1-Trichloroethane	71-55-6	11	LANL	1	1	0.2	0.10
1,1,2,2-Tetrachloroethane	79-34-5	0.076 [a]	RSL	0.2	1	0.2	0.11
1,1,2-Trichloroethane	79-00-5	0.28 [c]	RSL	0.2	1	0.2	0.10
1,1-Dichloroethane	75-34-3	2.7	RSL	1	1	0.2	0.10
1,1-Dichloroethene	75-35-4	25	LANL	1	1	0.2	0.10
1,2,4-Trimethylbenzene	95-63-6	15	RSL	1	1	0.2	0.11
1,2-Dichloroethane	107-06-2	0.17 [b]	RSL	0.2	1	0.2	0.10
1,2-Dichloropropane	78-87-5	0.44 [c]	RSL	0.2	1	0.2	0.1
1,3,5-Trimethylbenzene	108-67-8	12.3	Cal Modified PRG	1	1	0.2	0.13
2-Butanone	78-93-3	5600	RSL	10	10	4	2.0
2-Hexanone	591-78-6	38	RSL	10	10	4	2.30
4-Methyl-2-Pentanone	108-10-1	1200	RSL	10	10	4	2.1
Acetone	67-64-1	1500	LANL	10	10	5	2.6
Benzene	71-43-2	0.45 [c]	RSL	0.2	1	0.2	0.10
Bromodichloromethane	75-27-4	0.13 [b]	RSL	0.2	1	0.2	0.10
Bromoform	75-25-2	9.2	RSL	1	1	0.3	0.15
Bromomethane	74-83-9	7.5	RSL	1	1	0.3	0.16
Carbon disulfide	75-15-0	810	RSL	1	1	0.5	0.25

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
Carbon tetrachloride	56-23-5	0.45 [c]	RSL	0.2	1	0.2	0.10
Chlorobenzene	108-90-7	78	RSL	1	1	0.2	0.10
Chloroethane	75-00-3	21000	RSL	1	1	0.5	0.27
Chloroform	67-66-3	0.22 [c]	RSL	0.2	1	0.2	0.10
Chloromethane	74-87-3	190	RSL	1	1	0.3	0.15
cis-1,2-Dichloroethene	156-59-2	36	RSL	1	1	0.2	0.10
cis-1,3-Dichloropropene	542-75-6	0.47 [c]	RSL [2]	0.2	1	0.2	0.11
Dibromochloromethane	124-48-1	0.17 [b]	RSL	0.2	1	0.2	0.10
Ethylbenzene	100-41-4	1.5	RSL	1	1	0.2	0.1
Isopropyl benzene	98-82-8	450	RSL	1	1	0.2	0.10
m/p-Xylenes	136777-61-2	13	LANL [3]	2	2	0.4	0.21
Methylene chloride	75-09-2	4.3	Cal Modified PRG	2	2	1	0.50
n-Butylbenzene	104-51-8	1000	RSL	1	1	0.2	0.17
n-Propylbenzene	103-65-1	660	RSL	1	1	0.3	0.13
o-Xylene	95-47-6	13	LANL	1	1	0.2	0.10
p-Isopropyltoluene	99-87-6	NVA	N/A	1	1	0.3	0.14
sec-Butylbenzene	135-98-8	240	RSL	1	1	0.2	0.13
Styrene	100-42-5	1200	RSL	1	1	0.5	0.25

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: VOCs - U.S. EPA Method 8260B

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
Tert-Butylbenzene	98-06-6	240	Cal Modified PRG	1	1	0.2	0.13
Tetrachloroethene	127-18-4	0.1 [a]	Cal Modified PRG	0.2	1	0.2	0.15
Toluene	108-88-3	9.8	LANL	1	1	0.2	0.10
trans-1,2-Dichloroethene	156-60-5	360	RSL	1	1	0.2	0.10
trans-1,3-Dichloropropene	10061-02-6	0.47 [c]	RSL [2]	0.2	1	0.2	0.11
Trichloroethene	79-01-6	0.49 [c]	RSL	0.2	1	0.2	0.10
Vinyl chloride	75-01-4	0.019 [a]	RSL	0.2	1	0.2	0.12

Cal Modified PRG – California modified Preliminary Remediation Goal based on Department of Toxic Substances Control (DTSC) HHRA Note 3 (DTSC 2013)
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
LANL – Los Alamos National Laboratory ESL (LANL 2012)
N/A – not applicable
NVA – No value available
RSL - Regional Screening Level based on U.S. EPA Region 9 Tap water criteria (USEPA 2014)
[1] – The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Tap water), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum No Effect ESL
[2] RSL value for 1,3-dichloropropene was used
[3] RSL value for total xylenes was used
[a] –The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.
[b] – The Project Screening Level is below the LOQ and LOD but at or above the DL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and DL. Any uncertainty associated with the analyte will be discussed in the data summary report.
[c] – The Project Screening Level is below the LOQ but at or above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
1,2,4,5-Tetrachlorobenzene	95-94-3	1.7 [a]	RSL	5	10	5	2.5
1,2,4-Trichlorobenzene	120-82-1	1.1 [a]	RSL	5	10	5	3.6
1,2-Dichlorobenzene	95-50-1	300	RSL	10	10	5	2.5
1,3-Dichlorobenzene	541-73-1	180	Cal Modified PRG	10	10	5	2.5
1,4-Dichlorobenzene	106-46-7	0.48 [a]	RSL	5	10	5	2.5
2,2-Oxybis (1-Chloropropane)	108-60-1	0.36 [a]	RSL	5	10	5	2.5
2,4,5-Trichlorophenol	95-95-4	1200	RSL	10	10	5	2.5
2,4,6-Trichlorophenol	88-06-2	4 [b]	RSL	5	10	5	2.5
2,4-Dichlorophenol	120-83-2	46	RSL	10	10	5	2.5
2,4-Dimethylphenol	105-67-9	360	RSL	10	10	5	2.6
2,4-Dinitrophenol	51-28-5	39	RSL	20	20	10	5
2,4-Dinitrotoluene	121-14-2	0.24 [a]	RSL	5	10	5	2.5
2,6-Dichlorophenol	87-65-0	46	RSL [2]	10	10	5	2.5
2-Chloronaphthalene	91-58-7	750	RSL	10	10	5	2.5
2-Chlorophenol	95-57-8	91	RSL	10	10	5	2.5
2-Methylphenol	95-48-7	930	RSL	10	10	5	2.5
2-Nitroaniline	88-74-4	190	RSL	10	10	5	2.5
2-Nitrophenol	88-75-5	NVA	N/A	10	10	5	2.5

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
3,3'-Dichlorobenzidine	91-94-1	0.12 [a]	RSL	5	10	5	2.5
3,3'-Dimethylbenzibine	119-93-7	0.0065 [a]	RSL	10	20	10	5
3.4-Methylphenol	106-44-5	1900	RSL	10	10	5	5
3-Nitroaniline	99-09-2	3.2 [b]	Cal Modified PRG	5	10	5	2.5
4,6-Dinitro-2-methylphenol	534-52-1	1.5 [a]	RSL	10	20	10	5
4-Bromophenyl-phenyl ether	101-55-3	NVA	N/A	10	10	5	2.5
4-Chloro-3-methylphenol	59-50-7	1400	RSL	10	20	10	5
4-Chloroaniline	106-47-8	0.36 [a]	RSL	20	20	10	4.2
4-Chlorophenyl-phenyl ether	7005-72-3	NVA	N/A	10	10	5	2.5
4-Nitroaniline	100-01-6	3.8 [b]	RSL	5	10	5	2.5
4-Nitrophenol	100-02-7	NVA	N/A	10	20	10	5
5-Nitro-o-toluidine	99-55-8	8.1 [c]	RSL	5	10	5	2.6
A,A-Dimethylphenethylamine	122-09-8	NVA	N/A	40	40	20	13
Acenaphthene	83-32-9	5.8 [c]	LANL	5	10	5	2.5
Acetophenone	98-86-2	1900	RSL	10	10	5	2.5
Aniline	62-53-3	13 [c]	RSL	10	20	10	5.3
Aramite	140-57-8	1.3 [a]	RSL	5	10	5	2.5
Benzo(a)anthracene	56-55-3	0.027 [a]	LANL	5	10	5	2.5
Benzo(a)pyrene	50-32-8	0.0034 [a]	RSL	5	10	5	2.5

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
Benzo(b)fluoranthene	205-99-2	0.034 [a]	RSL	5	10	5	2.6
Benzo(g,h,i)perylene	191-24-2	7.6 [c]	LANL	5	10	5	2.5
Benzo(k)fluoranthene	205-99-2	0.0041 [a]	LANL	5	10	5	2.5
Benzyl alcohol	100-51-6	2000	RSL	10	10	5	2.5
bis(2-Chloroethoxy)methane	111-91-1	59	RSL	5	10	5	2.5
bis(2-Chloroethyl)ether	111-41-1	0.014 [a]	RSL	5	10	5	2.5
bis(2-ethylhexyl)phthalate	117-81-7	5.6 [c]	RSL	5	10	5	2.5
Butylbenzylphthalate	85-68-7	16	RSL	10	10	5	2.5
Chlorobenzilate	510-15-6	0.31 [a]	RSL	5	10	5	2.5
Chrysene	218-01-9	0.0018 [a]	LANL	5	10	5	2.5
Diallate	2303-16-4	0.52 [a]	RSL	5	10	5	2.5
Dibenzo(a,h)anthracene	53-70-3	0.0034 [a]	RSL	5	10	5	2.5
Dibenzofuran	132-64-9	3.7 [b]	LANL	5	10	5	2.5
Diethylphthalate	84-66-2	15000	RSL	10	10	5	2.5
Dimethylphthalate	131-11-3	3 [b]	LANL	5	10	5	2.5
Di-n-butylphthalate	84-74-2	19	LANL	10	10	5	2.5
Di-n-octylphthalate	117-84-0	3 [b]	LANL	5	10	5	2.5
Diphenylamine [d]	122-39-4	310	RSL	10	10	5	2.5
Fluoranthene	206-44-0	0.04 [a]	LANL	5	10	5	2.5

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
Fluorene	86-73-7	3.9 [b]	LANL	5	10	5	2.5
Hexachlorobenzene	118-74-1	0.049 [a]	RSL	5	10	5	2.5
Hexachlorobutadiene	87-68-3	0.3 [a]	RSL	5	10	5	2.5
Hexachlorocyclopentadiene	77-47-4	31	RSL	10	10	5	2.5
Hexachloroethane	67-72-1	0.9 [a]	RSL	5	10	5	2.5
Indeno(1,2,3-cd)pyrene	193-39-5	0.034 [a]	RSL	5	10	5	2.5
Isophorone	78-59-1	78	RSL	10	10	5	2.5
Kepone	143-50-0	0.0035 [a]	RSL	20	50	20	10
Naphthalene	91-20-3	0.17 [a]	RSL	5	10	5	2.5
N-Nitroso-di-n-butylamine	924-16-3	0.0027 [a]	RSL	5	10	5	2.5
N-Nitrosodimethylamine	62-75-9	0.00049 [a]	RSL	5	10	5	2.5
N-Nitroso-di-n-propylamine	621-64-7	0.011 [a]	RSL	5	10	5	2.5
N-Nitrosomethylethylamine	10595-95-6	0.0035 [a]	RSL	5	10	5	2.5
N-Nitrosopyrrolidine	930-55-2	0.037 [a]	RSL	5	10	5	2.5
O-toluidine	95-53-4	2.5 [b]	RSL [3]	5	10	5	2.5
Pentachlorobenzene	608-93-5	3.2 [b]	RSL	5	10	5	2.5
Pentachloroethane	76-01-7	0.64 [a]	RSL	5	10	5	2.5
Pentachloronitrobenzene	82-68-8	0.12 [a]	RSL	5	10	5	2.5
Pentachlorophenol	87-86-5	0.04 [a]	RSL	10	20	10	5

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: SVOCs – U.S. EPA Method 8270C

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
Phenanthrene	85-01-8	6.3 [c]	LANL	5	10	5	2.5
Phenol	108-95-2	320	LANL	10	10	5	2.5
Pronamide	23950-58-5	1200	RSL	10	10	5	2.5
Pyrene	129-00-0	0.025 [a]	LANL	5	10	5	2.5
Pyridine	110-86-1	20 [c]	RSL	20	40	20	5

Cal Modified PRG – California modified Preliminary Remediation Goal based on DTSC HHRA Note 3 (DTSC 2013)
DTSC – Department of Toxic Substances Control
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
LANL – Los Alamos National Laboratory ESL (LANL 2012)
N/A – not applicable
NVA – No value available
RSL - Regional Screening Level based on U.S. EPA Region 9 Tap water criteria (USEPA 2014)
[1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Tap water), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum No Effect ESL
[2] RSL value for 2,4-dichlorophenol was used
[3] RSL value for p-toluidine was used

[a] –The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.
[b] – The Project Screening Level is below the LOQ and LOD but at or above the DL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and DL. Any uncertainty associated with the analyte will be discussed in the data summary report.
[c] – The Project Screening Level is below the LOQ but at or above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.
[d] – diphenylamine cannot be separated from N-nitrosodiphenylamine.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: Metals – U.S. EPA Method 6020A/7471B

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
Aluminum	7429-90-5	530	LANL	100	100	20	10
Antimony	7440-36-0	7.8	RSL	1	1	0.5	0.25
Arsenic	7440-38-2	0.0071 [a]	Cal Modified PRG	0.2	1	0.2	1
Barium	7440-39-3	3.9	LANL	1	1	0.5	0.25
Beryllium	7440-41-7	0.66 [b]	LANL	0.1	1	0.1	0.05
Cadmium	7440-43-9	0.28 [c]	LANL	0.2	1	0.2	0.1
Calcium	7440-70-2	NVA	N/A	100	100	25	13
Chromium	7440-47-3	11	LANL	1	1	0.2	0.1
Cobalt	7440-48-4	3	LANL	1	1	0.2	0.1
Copper	7440-50-8	5	LANL	1	1	0.5	0.25
Iron	7439-89-6	1000	LANL	100	100	10	5
Lead	7439-92-1	1	LANL	1	1	0.1	0.05
Magnesium	7439-95-4	NVA	N/A	100	100	10	5
Manganese	7439-96-5	430	RSL	1	1	0.2	0.1
Mercury	7439-97-6	0.63	RSL [2]	0.5	0.5	0.1	0.054
Nickel	7440-02-0	29	LANL	1	1	0.2	0.1

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: Metals – U.S. EPA Method 6020A/7471B

Analyte	CAS Number	Project Screening Level [1] (µg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)		
					LOQ	LOD	DL
Potassium	7440-09-7	NVA	N/A	100	100	20	10
Selenium	7782-49-2	5	LANL	1	1	0.3	0.15
Silver	7440-22-4	0.1 [b]	LANL	0.2	1	0.2	0.1
Sodium	7440-23-5	NVA	N/A	100	100	50	25
Thallium	7440-28-0	0.03 [a]	LANL	0.2	1	0.2	0.1
Vanadium	7440-62-2	19	LANL	1	1	0.5	0.25
Zinc	7440-66-6	65	LANL	20	20	10	5

Cal Modified PRG – California modified Preliminary Remediation Goal based on Department of Toxic Substances Control (DTSC) HHRA Note 3 (DTSC 2013)
ESL – Ecological Screening Level
HHRA – Human Health Risk Assessment
LANL – Los Alamos National Laboratory ESL (LANL 2012)
N/A – not applicable
NVA – No value available
RSL - Regional Screening Level based on U.S. EPA Region 9 Tap water criteria (USEPA 2014)
[1] The Project Screening Levels shown are the lowest between the U.S. EPA RSLs (Tap water), DTSC HHRA Note 3 (Cal Modified PRG), and LANL minimum No Effect ESL
[2] RSL value for mercury (elemental) was used
[a] –The Project Screening Level is below the laboratory LOQ, LOD and DL. The DL presented is the lowest possible DL. Any uncertainty associated with analyte will be discussed in the data summary report.
[b] – The Project Screening Level is below the LOQ and LOD but at or above the DL. The laboratory will report analyte at estimated concentrations that are detected between the LOQ and DL. Any uncertainty associated with the analyte will be discussed in the data summary report.
[c] – The Project Screening Level is below the LOQ but at or above the LOD. The laboratory will report analyte at estimated concentrations that are detected between the LOD and LOQ. Any uncertainty associated with the analyte will be discussed in the data summary report.

SAP Worksheet #15 – continued

Laboratory: EMAX Laboratory
Matrix: Aqueous
Analytical Group: Hardness – SM 2340C

Analyte	CAS Number	Project Screening Level (mg/L)	Project Screening Level Reference	Project Quantitation Limit Goal (mg/L)	Laboratory-Specific (mg/L)		
					LOQ	LOD	DL
Hardness (as calcium carbonate)	-8 [a]	N/A [1]	N/A	10	10	10	10

N/A – not applicable

NEDD – Naval Electronic Data Deliverable

[a] A single CAS number has not been assigned by the American Chemical Society for hardness. For this project, the CAS number was obtained from the NEDD specifications for "Hardness".

[1] Hardness is not a contaminant of concern (COC). Project screening levels are only applicable to the COC.

SAP Worksheet #16 — Project Schedule/Timeline Table

The project schedule is included on the next page.

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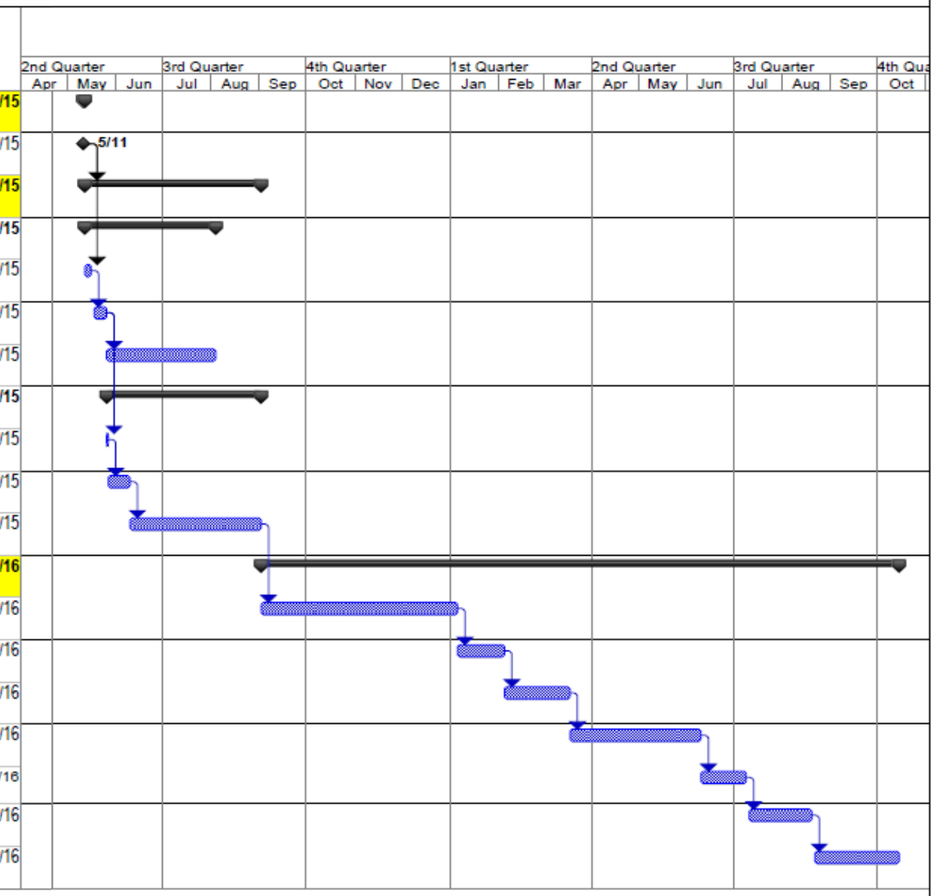
TO-0096 Project Schedule
IR Sites 34B & 34D NWS Fallbrook CERCLA Investigations

ID	Task Name	Duration	Start	Finish
1	**IR Sites 34b & 34d Work Plan**	**1 day**	**Mon 5/11/15**	**Mon 5/11/15**
2	Final Plan	1 day	Mon 5/11/15	Mon 5/11/15
3	**IR Sites 34b & 34d Field Work**	**81 days**	**Tue 5/12/15**	**Tue 9/1/15**
4	**IR Site 34b**	**60 days**	**Tue 5/12/15**	**Mon 8/3/15**
5	Mobilization	4 days	Tue 5/12/15	Fri 5/15/15
6	Excavate Trenches & Collect Samples	6 days	Mon 5/18/15	Mon 5/25/15
7	Laboratory Analysis + Data Validation	50 days	Tue 5/26/15	Mon 8/3/15
8	**IR Site 34d**	**71 days**	**Tue 5/26/15**	**Tue 9/1/15**
9	Mobilization	1 day	Tue 5/26/15	Tue 5/26/15
10	Excavate Trenches & Collect Samples	10 days	Wed 5/27/15	Tue 6/9/15
11	Laboratory Analysis + Data Validation	60 days	Wed 6/10/15	Tue 9/1/15
12	**IR Sites 34b & 34d Reporting**	**293 days**	**Wed 9/2/15**	**Fri 10/14/16**
13	Produce Internal Draft 34b and 34d RI Reports	90 days	Wed 9/2/15	Tue 1/5/16
14	Navy Review	22 days	Wed 1/6/16	Thu 2/4/16
15	Address Navy Comments and Produce Draft Report	30 days	Fri 2/5/16	Thu 3/17/16
16	Agency Review	60 days	Fri 3/18/16	Thu 6/9/16
17	RTC/Address Agency Comments	21 days	Fri 6/10/16	Fri 7/8/16
18	Agency Review Draft Final RI/RTC	30 days	Mon 7/11/16	Fri 8/19/16
19	Final RI Reports	40 days	Mon 8/22/16	Fri 10/14/16



Project: TO-0096 NWS Fallbrook
Date: Tue 4/21/15

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Progress	
Split		External Tasks		Inactive Summary		Manual Summary		Deadline	
Milestone		External Milestone		Manual Task		Start-only			
Summary		Inactive Task		Duration-only		Finish-only			

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SAP Worksheet #17 — Sampling Design and Rationale

The goal of the RI at IR Sites 34b and 34d is to delineate the extent of buried dunnage and other debris at the sites and to evaluate the potential risks from impacted soil to human health and the environment. Characterization of VOCs, SVOCs, metals, and dioxins/furans (in areas with burned debris) in soil is included in the investigation. At IR Site 34d, sediment and surface water samples will also be collected from Fallbrook Creek which runs through the northern portion of the site.

Using the results of the geophysical investigation, test pit and hand auger boring locations have been selected to investigate anomalies that most likely indicate the locations of buried debris (Figures 5 and 6). Test pits at both sites will be excavated using a back hoe excavator and the borings at IR Site 34d will be advanced with a hand auger. Soil samples will be collected at the field geologist's discretion following the sampling guidelines presented below and in the Work Plan. The following summarizes the proposed sampling design for each IR site.

For IR Site 34b:

- Based on the results of the geophysical investigation, six test pits will be excavated at the site. Four of the six test pits will be placed within the waste disposal area itelf, and are designated as Waste Test Pits. Two of the test pits are planned to bound the ends of the disposal trench, and are designated as Exploratory Test Pits as waste or dunnage debris are not anticipated in these test pits. (Figure 5). Test pits will be excavated to a depth of approximately 3 to 6 feet bgs, depending on the depth of encountered debris at that location. Following the logging of the trenches and the collection of the soil samples, the trenches will be backfilled with the excavated soil.
- Up to 32 soil samples will be collected from the test pits at the geologist's discretion using a slide hammer or from the excavator bucket. It is anticipated that there will be 6 to 7 samples per Waste Test Pit and two samples in each of the two Exploratory Test Pits. Samples will be biased toward potential indications of contamination, either visual, smell, or PID readings. Soil samples will be analyzed for VOCs, SVOCs, metals, and total organic carbon (TOC), with the four samples collected in soil associated with the waste itself additionally analyzed for pesticides and PCBs. Up to 10 of the soil samples may be also be analyzed for dioxins/furans based on visual indications of historic burn activities such as ash or carbonized/scorched debris. Samples will be selected to exclude burned material from the May 2014 wildfire at the site.

SAP Worksheet 17 (continued)

For IR Site 34d:

- The existing concrete building slab (Building 341) and three-stage concrete sump (Building 430) will be removed to permit soil sampling directly under the structures.
- Twenty-two soil samples will be collected from underneath and adjacent to the concrete slab and three-stage concrete sump and adjacent drainpipe. Five grab samples are anticipated from within the footprint of each of the two concrete structures, three soil samples are planned at each of three hand auger borings next to the slab for Building 341 (Figure 6), and three soil samples are anticipated from a hand auger boring at the terminus of the clay drainpipe west of the three-stage concrete sump. The hand auger borings are expected to extend to approximately 6 feet bgs (or refusal), with samples collected near the surface, at 3-4 feet bgs, and at 5-6 feet bgs. These 22 soil samples will be submitted for laboratory analysis for VOCs, SVOCs, metals, and TOC.
- Five hand auger borings will be advanced to laterally and vertically delineate SVOC impact associated with wood debris near the SI boring IRP34D-SB01. The borings are expected to extend to approximately 6 feet bgs (or refusal), with samples collected near the surface, at 3-4 feet bgs, and at 5-6 feet bgs. Up to 15 soil samples will be submitted for laboratory analysis for VOCs, SVOCs, PAHs by Selective Ion Monitoring (SIM), metals, and TOC. Up to 5 of these soil samples may be additionally analyzed for dioxins/furans, based on visual indications of historic burn activities.
- For IR Site 34d, 11 Exploratory Test Pits are planned to evaluate areas where dunnage disposal may have taken place. Test pits were initially planned to evaluate areas of buried debris as identified by the geophysical investigation. However, no such areas were identified. As a result, the purpose of the test pits has been shifted slightly from the evaluation of identified areas of buried waste or debris, to exploration and confirmation of the results of the geophysical investigation. Test pits will be excavated to a depth of 3 to 8 feet bgs, depending on the depth of encountered debris at the location. Following the logging of the trenches and the collection of the soil samples, the trenches will be backfilled with the excavated soil.
- Twenty-two soil samples are planned from Exploratory Test Pits in the possible debris disposal areas. These soil samples may be collected at or near the surface and/or from the test pits using a slide hammer or from the excavator bucket. Soil samples will be analyzed for VOCs, SVOCs, metals, and TOC. Up to 10 of these soil

SAP Worksheet 17 (continued)

samples may be additionally analyzed for dioxins/furans, based on visual indications of historic burn activities.

- Four sediment samples and four surface water samples will be collected from portions of Fallbrook Creek that are adjacent or east of the site (Figure 6). The surface water and sediment samples will be collocated. Surface water samples will only be collected if Fallbrook Creek, an ephemeral stream, is flowing during the fieldwork activities. One of the four sediment/surface water sample locations will be collected from an upgradient portion of Fallbrook Creek and will be used as a upgradient/background value to compare with the three samples collected adjacent to the site. Sediment samples will be analyzed for VOCs, SVOCs, metals, and TOC to evaluate the potential impacts to Fallbrook Creek, and may additionally be analyzed for dioxins/furans. The sediment samples collected will only be analyzed for dioxins/furans if one or more soil samples collected at the site is selected for dioxin/furan analysis. The surface water samples will be analyzed for VOCs, SVOCs, metals, and hardness (as calcium carbonate). Both filtered and unfiltered surface water samples will be collected.

SAP Worksheet 17 (continued)

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SAP Worksheet #18 — Sampling Locations/IDs, Sample Depths, Sample Analyses, and Sampling Procedures Table

Sampling Location/ ID Number	Matrix	Depth[1] (feet)	Analytical Group	Sampling SOP Reference
IR Site 34b				
34B-TP01-SW1-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP01-SW2-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP01-SW3-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP01-SW4-0	Soil	Soil surface [6]	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP01-SW5-0[7]	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP01-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP01-FS2-6	Soil	6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP02-SW1-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP02-SW2-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP02-SW3-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP02-SW4-0	Soil	Soil surface [6]	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP02-SW5-0[7]	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP02-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP02-FS2-6	Soil	6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP03-SW1-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP03-SW2-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP03-SW3-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP03-SW4-0	Soil	Soil surface [6]	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP03-SW5-0[7]	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP03-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14

SAP Worksheet 18 (continued)

Sampling Location/ ID Number	Matrix	Depth[1] (feet)	Analytical Group	Sampling SOP Reference
34B-TP03-FS2-6	Soil	6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP04-SW1-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP04-SW2-2	Soil	2	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP04-SW3-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP04-SW4-0	Soil	Soil surface [6]	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP04-SW5-0[7]	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, pesticides, PCBs, dioxins/furans[2]	SAP Worksheet #14
34B-TP04-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP04-FS2-6	Soil	6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP05-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP05-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP06-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
34B-TP06-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[2]	SAP Worksheet #14
IR Site 34d				
Beneath Concrete Slab Samples (Building 341)				
34D-GS01-02	Soil	2	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS02-02	Soil	2	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS03-02	Soil	2	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS04-02	Soil	2	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS05-02	Soil	2	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
Beneath Three-stage Concrete Sump Samples (Building 430)				
34D-GS06-05	Soil	5	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS07-05	Soil	5	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS08-05	Soil	5	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS09-05	Soil	5	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-GS10-05	Soil	5	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14

SAP Worksheet 18 (continued)

Sampling Location/ ID Number	Matrix	Depth[1] (feet)	Analytical Group	Sampling SOP Reference
Drain Pipe Terminus Samples				
34D-SB07-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-SB07-04	Soil	3-4	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
34D-SB07-06	Soil	5-6	VOCs, SVOCs, metals, mercury, and TOC	SAP Worksheet #14
Samples Near Boring IRP34D-SB01				
34D-SB08-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB08-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB08-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB09-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB09-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB09-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB10-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB10-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB10-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB11-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB11-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB11-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB12-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB12-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
34D-SB12-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[3]	SAP Worksheet #14
Samples Near Slab for Former Building 341				
34D-SB13-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
34D-SB13-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
34D-SB13-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
34D-SB14-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
34D-SB14-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
34D-SB14-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
34D-SB15-00	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14

SAP Worksheet 18 (continued)

Sampling Location/ ID Number	Matrix	Depth[1] (feet)	Analytical Group	Sampling SOP Reference
34D-SB15-04	Soil	3-4	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
34D-SB15-06	Soil	5-6	VOCs, SVOCs, metals, mercury, TOC	SAP Worksheet #14
Exploratory Test Pit Samples				
34D-TP01-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP01-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP02-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP02-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP03-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP03-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP04-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP04-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP05-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP05-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP06-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP06-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP07-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP07-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP08-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP08-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP09-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP09-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP10-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP10-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP11-SW1-0	Soil	Soil surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
34D-TP11-FS1-5	Soil	5	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[4]	SAP Worksheet #14
Sediment and Surface Water Samples				
34D-SED01-00	Sediment	Sediment surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[8]	SAP Worksheet #14
34D-SED02-00	Sediment	Sediment surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[8]	SAP Worksheet #14

SAP Worksheet 18 (continued)

Sampling Location/ ID Number	Matrix	Depth[1] (feet)	Analytical Group	Sampling SOP Reference
34D-SED03-00	Sediment	Sediment surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[8]	SAP Worksheet #14
34D-SED04-00	Sediment	Sediment surface	VOCs, SVOCs, metals, mercury, TOC, dioxins/furans[8]	SAP Worksheet #14
34D-SW01	Surface water	Surface water	VOCs, SVOCs, metals (dissolved), mercury (dissolved), hardness[5]	SAP Worksheet #14
34D-SW01T	Surface water	Surface water	VOCs, SVOCs, metals (total), mercury (total), hardness[5]	SAP Worksheet #14
34D-SW02	Surface water	Surface water	VOCs, SVOCs, metals (dissolved), mercury (dissolved), hardness[5]	SAP Worksheet #14
34D-SW02T	Surface water	Surface water	VOCs, SVOCs, metals (total), mercury (total), hardness[5]	SAP Worksheet #14
34D-SW03	Surface water	Surface water	VOCs, SVOCs, metals (dissolved), mercury (dissolved), hardness[5]	SAP Worksheet #14
34D-SW03T	Surface water	Surface water	VOCs, SVOCs, metals (total), mercury (total), hardness[5]	SAP Worksheet #14
34D-SW04	Surface water	Surface water	VOCs, SVOCs, metals (dissolved), mercury (dissolved), hardness[5]	SAP Worksheet #14
34D-SW04T	Surface water	Surface water	VOCs, SVOCs, metals (total), mercury (total), hardness[5]	SAP Worksheet #14

1. Actual depth of soil samples collected from the excavations and test pits will be determined in the field based on observations made by the sampler. Surface soil samples will be collected from 0 – 2 inch bgs.
2. Up to 10 of the soil samples at IR Site 34b may be additionally analyzed for dioxins/furans, based on visual indications of burned material.
3. Up to 5 of the samples from near boring IRP34D-SB01 may be additionally analyzed for dioxins/furans, based on visual indications of burned material.
4. Up to 10 of the samples from the Exploratory Test Pits may be additionally analyzed for dioxins/furans, based on visual indications of burned material.
5. All surface water sample analyses will be collected as both filtered and unfiltered aliquots.
6. This waste sample will be collected at a depth of 0-6 inches, unless the geologist chooses to sample deeper to bias towards visual indications of potential contamination.
7. This shallow waste sample will only be collected if the preceding waste sample in the test pit is collected at deeper than 6 inches.
8. Sediment samples will only be analyzed for dioxins/furans if one or more of the soil samples at Subarea 34d are analyzed for that suite.

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SAP Worksheet #19 — Analytical Methods, Containers, Preservatives, and Holding Times Table

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, etc.)	Maximum Holding Time (preparation/ analysis)
Soil/Sediment	VOCs	U.S. EPA Method 8260B EMAX-8260	Three 5 gram Encore	Cool, 2 to 6ºC	48 hours
Soil/Sediment	SVOCs	U.S. EPA Method 8270C EMAX-8270	One 8 ounce Jar or sleeve		14 days for extraction/ 40 days to analysis
Soil/Sediment	Metals	U.S. EPA Method 6020A EMAX-6020			6 months
Soil/Sediment	Mercury	U.S. EPA Method 7471B EMAX-7471			28 days
Soil/Sediment	TOC	Walkley-Black EMAX-TOCWB			28 days
Soil	Pesticides	U.S. EPA Method 8081A EMAX-8081			14 days for extraction/ 40 days to analysis
Soil	PCBs	U.S. EPA Method 8082 EMAX-8082			14 days for extraction/ 40 days to analysis
Soil	PAHs	U.S. EPA Method 8270C EMAX-8270SIM			14 days for extraction/ 40 days to analysis
Soil/Sediment	Dioxins/Furans	U.S. EPA Method 8290 HE-HMS001	One 8 ounce Jar or sleeve	Cool, 2 to 6ºC	30 days
Surface Water	VOCs	U.S. EPA Method 8260B EMAX-8260	Three 40-mL VOA vials	pH ≤ 2 w/HCl, 4±2°C Cool, 2 to 6ºC	14 days
Surface Water	SVOCs	U.S. EPA Method 8270C EMAX-8270	Two 1-L Amber glass bottles	Cool, 2 to 6ºC	7 days to extraction/ 40 days to analysis

SAP Worksheet 19 (continued)

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, etc.)	Maximum Holding Time (preparation/ analysis)
Surface Water	Metals (dissolved)	U.S. EPA Method 6020A EMAX-6020	One 250-mL HDPE bottle	Filter with 0.45 micron cartridge; pH ≤ 2 w/HNO_3 Cool, 2 to 6ºC	6 months
Surface Water	Mercury (dissolved)	U.S. EPA Method 7471B EMAX-7471			28 days
Surface Water	Metals (total)	U.S. EPA Method 6020A EMAX-6020	One 250-mL HDPE bottle	pH ≤ 2 w/HNO_3 Cool, 2 to 6ºC	6 months
Surface Water	Mercury (total)	U.S. EPA Method 7471B EMAX-7471			28 days
Surface Water	Hardness	SM 2340C EMAX-2340C	One 250-mL HDPE bottle	pH ≤ 2 w/HNO_3 Cool, 2 to 6ºC	6 months

ºC – degrees Celsius
mL – milliliter
HCl – hydrochloric acid
HNO3 – nitric acid
PAHs – polyaromatic hydrocarbons
PCBs – polychlorinated biphenyls
SM – Standard Method
SVOCs – semivolatile organic compounds
U.S. EPA – United States Environmental Protection Agency
VOCs – volatile organic compounds

SAP Worksheet #20 — Field Quality Control Sample Summary Table

Matrix	Analytical Group	Analytical/ Preparation SOP Reference	# of Primary Sampling Locations	# of Field Duplicates	# of Matrix Spike/Matrix Spike Duplicates	# of Source Blanks	# of Equip. Rinsates	# of Trip Blanks	Total # of Samples to Lab
IR Sites 34b									
Soil/Sediment	VOCs	EMAX-8260	24	0	2	1	5	5	37
Soil/Sediment	SVOCs	EMAX-8270	24	0	2	1	5	0	32
Soil/Sediment	Metals	EMAX-6020	24	0	2	1	5	0	32
Soil/Sediment	Mercury	EMAX-7471	24	0	2	1	5	0	32
Soil/Sediment	TOC	EMAX-TOCWB	24	0	2	1	5	0	32
Soil/Sediment	Pesticides	EMAX-8081	4	0	1	1	4	0	10
Soil/Sediment	PCBs	EMAX-8082	4	0	1	1	4	0	10
Soil	PAHs	EMAX-8270SIM	15	0	1	1	1	0	18
Soil/Sediment	Dioxins/Furans	HE-HMS001	10	0	1	1	5	0	17

SAP Worksheet 20 (continued)

Matrix	Analytical Group	Analytical/ Preparation SOP Reference	# of Primary Sampling Locations	# of Field Duplicates	# of Matrix Spike/Matrix Spike Duplicates	# of Source Blanks	# of Equip. Rinsates	# of Trip Blanks	Total # of Samples to Lab
IR Sites 34d									
Soil/Sediment	VOCs	EMAX-8260	63	0	4	1	8	8	84
Soil/Sediment	SVOCs	EMAX-8270	63	0	4	1	8	0	76
Soil/Sediment	Metals	EMAX-6020	63	0	4	1	8	0	76
Soil/Sediment	Mercury	EMAX-7471	63	0	4	1	8	0	76
Soil/Sediment	TOC	EMAX-TOCWB	63	0	4	0	8	0	76
Soil/Sediment	Dioxins/Furans	HE-HMS001	19	0	2	0	8	0	29
Surface Water	VOCs	EMAX-8260	4	1	1	1	5	5	17
Surface Water	SVOCs	EMAX-8270	4	1	1	1	5	0	12
Surface Water	Metals	EMAX-6020	4	1	1	1	5	0	12
Surface Water	Mercury	EMAX-7471	4	1	1	1	5	0	12
Surface Water	Hardness	EMAX-2340C	4	1	1	1	5	0	12

Assumes 5 days of sampling at each site and samples shipped daily to lab.

SAP Worksheet #21 — Project Sampling SOP References Table

No stand-alone SOPs have been referenced in this SAP. All project-specific tasks and procedures are detailed within SAP Worksheet #14.

SAP Worksheet 21 (continued)

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SAP Worksheet #22 — Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]	Comments
Photoionization detector	Calibration with isobutylene (100 parts per million)	Daily	Within manufacturer's recommended value	According to manufacturer's instructions	Site health and safety specialist	Manufacturer's instructions	
Water quality meter	Calibration with standards for pH, turbidity, specific conductance, oxidation reduction potential, and dissolved oxygen per manufacturers' recommendation	Daily	Within manufacturer's recommended value	According to manufacturer's instructions	Sampling personnel	Manufacturer's instructions	

1. Standard Operating Procedure or SAP Section that describes the calibration/maintenance/testing/inspection procedures

SAP Worksheet 22 (continued)

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SAP Worksheet #23 — Analytical SOP References Table

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?(Y/N)	Laboratory SOP Compliant with QSM? (Y/N)
EMAX-8260	Volatile Organics by GC/MS, Revision 10, 6/04/2014	Definitive Data	Soil/Sediment/Water VOCs	GC/MS	EMAX	N	Y
EMAX-8270C	Semivolatile Organics by GC/MS, Revision 5, 5/07/2014	Definitive Data	Soil/Sediment/Water SVOCs	GC/MS	EMAX	N	Y
EMAX-6020	Trace Metals by ICP-MS, Revision 9, 7/8/2014	Definitive Data	Soil/Sediment/Water Metals	ICP/MS	EMAX	N	Y
EMAX-7471	Mercury by Solid or Semisolid Waste, Revision 7, 1/07/2014	Definitive Data	Soil/Sediment/Water Mercury	CVAA	EMAX	N	Y
EMAX-8081	Organochlorine Pesticides by Gas Chromatography, Revision 8, 6/16/14	Definitive Data	Soil Pesticides	GC	EMAX	N	Y
EMAX-8082	Polychlorinated Biphenyls (PCB) and Polychlorinated Terphenyls (PCT) by Gas Chromatography, Revision 5, 7/2/14	Definitive Data	Soil PCBs	GC	EMAX	N	Y
EMAX-8270SIM	Semivolatile Organics by GC/MS SIM, Revision 2, 7/3/14	Definitive Data	Soil PAHs	GC/MS	EMAX	N	Y
EMAX-2340C	Hardness, Total, Revision 3. Annual Review Date 4/28/2014	Definitive Data	Water Hardness	NA	EMAX	N	Y

SAP Worksheet 23 (continued)

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?(Y/N)	Laboratory SOP Compliant with QSM? (Y/N)
EMAX-TOCWB	Total Organics Carbon by Walkley-Black Method, Revision 2, Annual Review Date 4/23/2014	Definitive Data	Soil/Sediment TOC	NA	EMAX	N	Y
HE-HMS001	Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans by High Resolution Mass Spectrometry (HRGC/HRMS)	Definitive Data	Soil/Sediment Dioxins/Furans	HRGC/HRMS	ALS	N	Y

Analytical Laboratory SOPs will be provided on CD ROM with the final version of the SAP as Attachment 2.
GC – gas chromatography
HRGC – high resolution gas chromatography
HRMS – high resolution mass spectrometry
ICP – inductively coupled plasma
MS – mass spectrometry
PAHs – polyaromatic hydrocarbons
PCBs – polychlorinated biphenyls
SVOCs – semi-volatile organic compounds
TOC – total organic compound
VOCs – volatile organic compounds

SAP Worksheet #24 — Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (VOCs)	ICAL	Initially; as needed	SPCCs: RF ≥ 0.1 for Bromoform, Chloromethane and 1,1-Dichloroethane. RF ≥ 0.3 for Chlorobenzene and 1,1,2,2-Tetrachloroethane. CCCs: Chloroform, 1,1-DCE, 1,2-DCP (dichloropropane), Ethylbenzene, Toluene and Vinyl Chloride. %RSD ≤ 30% and one option below: (1). linear- mean RSD for all analytes ≤ 15% (2). linear – least squares regression r ≥ 0.995, when RSD >15% (3). non-linear – COD > 0.990 (6 points will be used for second order; 7 points will be used for third).	If SPCC is non-compliant it could be due to standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant it could be due to system leaks, reactive column sites, or standard degradation. Correct the problem and recalibrate. If RSD is non-compliant, check for outlier and repeat that ICAL point; otherwise perform instrument troubleshooting, then repeat calibration.	EMAX Analyst	EMAX-8260

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (VOCs)	ICV	After ICAL.	All analytes within ± 25% of expected value, except for the following compounds because of their erratic chromatographic behavior: Bromomethane, Chloroethane, Choromethane, Dichlorodifluoromethane within ± 35% of expected value.	If no data quality indicators are observed in the ICAL, it is indicative of standard degradation. Prepare a new standard and reanalyze ICV. Otherwise check and correct probable cause of problem and repeat ICAL.	EMAX Analyst	EMAX-8260
GC/MS (VOCs)	CCV	Daily. Before sample analysis and every 12 hours of analysis time.	SPCCs: Minimum RF same as ICAL. CCCs %Diff ≤ (when using RFs) or drift (when using least squares regression or non-linear calibration).	If SPCC is non-compliant it could be due to standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant it could be due to system leaks, reactive column sites, or standard degradation. Correct the problem and recalibrate.	EMAX Analyst	EMAX-8260

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (SVOCs)	ICAL	ICAL prior to sample analysis	SPCCs average RF ± 0.050 and and one option below (1) linear – mean RSD for all analytes ≤20% (2) linear – least squares regression r ≥ 0.995, when RSD >20% (3) non-linear – COD r^2 > 0.990 (6 points shall be used for second order, 7 points shall be used for third	Locate the source of the problem. If expected RFs are not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat ICAL. If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant, it could be a result of system leaks, reactive column sites, or standard degradation. Correct the problem and recalibrate. If RSD is non-compliant, check for outlier and repeat that ICAL point; otherwise perform instrument troubleshooting and repeat calibration.	Analyst	EMAX-8270

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (SVOCs)	Second source calibration verification	Once after each ICAL	Value of second source for all analytes within ±25% of expected value (initial source).	Prepare fresh standard and reanalyze second source to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance, and rerun ICAL and second source verification standard. If problem continues, new standards may need to be purchased, prepared, and analyzed.	Analyst	EMAX-8270
GC/MS (SVOCs)	Calibration Verification	Daily, before sample analysis, and every 12 hours of analysis time	RRF ≥ 0.050; and target analytes ≤ 20% difference (when using RFs) or drift (when using least squares regression or non-linear calibration).	If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation. Correct the problem and recalibrate	Analyst	EMAX-8270
GC/MS (PAHs)	DFTPP Tune Check	Prior to calibration (ICAL, ICV or CCV)	Criteria listed in Table 4 of U.S. EPA 8270D method.	Retune instrument and verify.	Analyst	EMAX-8270SIM

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (PAHs)	Breakdown check	Prior to calibration (ICAL, ICV or CCV)	Degradation < 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Clean the injection port and repeat breakdown check. If problem persist, cut or replace column.	Analyst	EMAX-8270SIM
GC/MS (PAHs)	ICAL	Initially; as needed	Minimum RF: Refer to Table 6 of EMAX-8270SIM SOP. %RSD < 20% 1) For anlaytes with RSD ≤20% use RRFm 2) For analytes with RSD >20% and r ≥0.990 use either inverse weighting factor or linear least squares with minimum of 6 ICAL points.	Rule out outlier(s)/bad injection/standard degradation, leak, etc. Correct as necessary, otherwise repeat the ICAL.	Analyst	EMAX-8270SIM
GC/MS (PAHs)	Second source calibration verification	Once after each ICAL	Minimum RF: Refer to Table 6 of EMAX-8270SIM SOP. All analytes within ±30% of expected value.	Rule out bad injection/standard degradation, leak, etc. Correct as necessary, otherwise repeat the ICAL.	Analyst	EMAX-8270SIM

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (PAHs)	Calibration Verification	Daily, before sample analysis, and every 12 hours of analysis time	Minimum RF: Refer to Table 6 of EMAX-8270SIM SOP. All analytes ≤ 20% difference.	Rule out bad injection/standard degradation, leak, etc. Correct as necessary, otherwise repeat the ICAL.	Analyst	EMAX-8270SIM
GC (PCBs)	ICAL For PCB 1016 and 1260	Initially, as needed	RSD for all analytes ≤20%. Linear – Least square regression r ≥ 0.995	Correct the problem then repeat initial calibration.	Analyst	EMAX-8082
GC (PCBs)	Second source calibration verification	Once after each ICAL	All analytes within ± 20% of expected value from the ICAL.	Correct the problem. If problem persists, repeat initial calibration.	Analyst	EMAX-8082
GC (PCBs)	ICV	Daily before sample analysis	All analytes within ± 20%	Correct the problem. If problem persists, repeat initial calibration.	Analyst	EMAX-8082
GC (PCBs)	Calibration verification	After every 12 hours and at the end of the analytical sequence	All analytes within ± 20% of expected value	Correct the problem then repeat initial calibration verification and re-analyze all samples since last successful calibration verification.	Analyst	EMAX-8082
GC (Pesticides)	ICAL	Initially, as needed	RSD for all analytes ≤ 20% or linear – least squares or inverse weighting factor: r ≥ 0.995	Correct the problem then repeat initial calibration.	Analyst	EMAX-8081
GC (Pesticides)	Second source calibration verification	Once after each ICAL	All analytes within ± 20% of expected value from the ICAL.	Repeat injection of ICV. If the problem persists, perform troubleshooting and repeat the ICAL.	Analyst	EMAX-8081

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC (Pesticides)	ICV	Daily before sample analysis	All analytes within ± 20%	Correct the problem. If problem persists, repeat initial calibration.	Analyst	EMAX-8081
GC (Pesticides)	Calibration verification	After every 12 hours and at the end of the analytical sequence	All analytes within ± 20% of expected value	Correct the problem then repeat initial calibration verification and re-analyze all samples since last successful calibration verification.	Analyst	EMAX-8081
GC (Pesticides)	Breakdown check (Endrin and DDT)	Every 12-hour	Degradation ≤ 15% of each analyte.	Repeat breakdown check	Analyst	EMAX-8081
ICP/MS (Metals)	Tune Check	Daily before ICAL.	±0.10 AMU (mass of isotope) <0.9 AMU full width resolution RSD of 4 replicates: ≤ 5%	Correct problem and repeat tune check	Analyst	EMAX-6020
ICP/MS (Metals)	ICAL	Daily initial calibration prior to sample analysis	r≥0.995	Correct the problem and repeat the initial calibration	Analyst	EMAX-6020
ICP/MS (Metals)	ICV	Daily after the initial calibration.	All analytes within ±10% of expected value RSD of replicate integrations: <5%	Correct the problem and repeat the initial calibration	Analyst	EMAX-6020

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP/MS (Metals)	Low level Calibration Verification (LLICV/LLCCV)	LLICV: Daily after initial calibration LLCCV: At the end of the analysis sequence	All analytes with ±30% of expected value	Correct the problem and repeat the initial calibration	Analyst	EMAX-6020
ICP/MS (Metals)	CCV	Daily before sample analysis, after every 10 samples and at the end of the analysis sequence.	All analytes within ±10% of expected value. RSD of replicate integrations <5%	Repeat calibration and reanalyze all samples since last successful calibration.	Analyst	EMAX-6020
ICP/MS (Metals)	ICB/CCB	After every calibration verification	All target analytes <LOQ	Correct problem then reanalyze calibration blank and previous samples.	Analyst	EMAX-6020
ICP/MS (Metals)	Interference Check Sample (ICSA/ICSAB)	Analyze at the beginning of each analytical run or once every 12 hours, whichever is more frequent	Within ±20% of expected value	Terminate analysis, correct the problem, reanalyze ICS, and reanalyze all affected samples.	Analyst	EMAX-6020

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
CVAA (Mercury)	ICAL	Daily initial calibration prior to sample analysis	Correlation coefficient r $\geq$ 0.995 for linear regression	Correct the problem then repeat ICAL	Analyst	EMAX-7470 EMAX-7471
CVAA (Mercury)	ICV	Once after each ICAL, prior to beginning a sample run	Analyte within $\pm$ 10% of true value	Repeat ICV once; repeat ICAL if second ICV fails	Analyst	EMAX-7470 EMAX-7471
CVAA (Mercury)	CCV	Daily, before sample analysis, every 10 samples, and at the end of analysis sequence	Analyte within $\pm$ 20% of true value	Repeat CCV once; repeat ICAL if second CCV fails, and reanalyze all samples since last successful calibration	Analyst	EMAX-7470 EMAX-7471
CVAA (Mercury)	Calibration blank (CCB)	After every calibration verification	No analyte detected > LOD	Correct the problem then re-analyze calibration blank and previous samples	Analyst	EMAX-7470 EMAX-7471
HRGC/HRMS (Dioxins/Furans)	Tune / Mass Resolution Check	At the beginning and the end of each 12-hour period of analysis.	Resolving power $\geq$10,000 at mass to charge ratio (m/z)=304.9824 and m/z=380.9760 + 5 parts per million (ppm) of expected mass	Retune instrument and verify. Access data for impact if resolution is less than 10,000 and narrate or re-inject as necessary	Analyst	HE-HMS001

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS (Dioxins/Furans)	Column performance check solution (CPSM). Solution includes the window defining mix	Prior to ICAL or CCV	Peak separation between 2,3,7,8-TCDD and other TCDD isomers result in a valley of ≤ 25%; and identification of all first and last eluters of the eight homologue retention time windows and documentation by labeling (F/L) on the chromatogram; and absolute retention times for switching from one homologous series to the next ≥ 10 seconds for all components of the mixture	Readjust windows Evaluate system Perform maintenance Reanalyze CPSM No corrective action is necessary if 2,3,7,8-TCDD is not detected and the % valley is greater than 25%	Analyst	HE-HMS001

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS (Dioxins/Furans)	Five point ICAL (Lowest concentration standard at or near the reporting limit)	ICAL prior to sample analysis, as needed by the failure of calibration verification, and when a new lot is used as a standard source for calibration verification, internal standard or recovery standard solutions	Ion abundance ratios must be within method acceptance limits. S/N ratio: ≥10 RSD for each native compound ≤ 20%	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc) or standards, correct as appropriate, then repeat initial calibration.	Analyst	HE-HMS001
HRGC/HRMS (Dioxins/Furans)	Second-source calibration verification (ICV)	Immediately following ICAL	Ion abundance ratios must be within method acceptance limits. S/N ratio: ≥10 Native compounds: 80-130% Labeled compounds: 70-130%	Evaluate standards and instrument response. If standard issue, repeat or remake then repeat standard as appropriate. If still fails, repeat ICAL	Analyst	HE-HMS001

SAP Worksheet 24 (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HRGC/HRMS (Dioxins/Furans)	CCV	At the beginning of each 12-hour period, and at the end of each analytical sequence	Ion abundance ratios must be within method acceptance limits: S/N ratio: ≥10% Native compounds: 80-130% Labeled compounds: 70-130%	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV. End-of-run CCV: If the RF for unlabeled standards ≤ 25% RPD and the RF for labeled standards ≤ 35% RPD (relative to the RF established in the ICAL), the mean RF from the two daily CCVs must be used for quantitation of impacted samples instead of the ICAL mean RF value. If the starting and ending CCV RFs differ by more than 25% RPD for unlabeled compounds or 35% RPD for labeled compounds, the sample may be quantitated against a new initial calibration if it is analyzed within two hours. Otherwise reanalyze samples with positive detections if necessary.	Analyst	HE-HMS001
Titration (TOC)	Standard Check	Daily before sample analysis	All analytes within +10% of expected value	Discard the standard and use a new standard lot.	Analyst	EMAX-TOCWB

± - plus or minus
> - greater than
≥ – greater than or equal to
≤ – less than or equal to
CCC – criteria continuing compounds
CCV – continuing calibration verification
IC – ion chromatography
ICAL – initial calibration
ICV – initial calibration verification
LLCCV – low level continuing calibration verification
LLICV – low level initial calibration verification
LOD – limit of detection
r – linear regression
RF – response factor
RSD – relative standard deviation
S/N – signal to noise ratio
SPCC – system performance check compound
SVOCs – semivolatile organic compounds

SAP Worksheet 24 (continued)

COD – coefficient of determination
CPSM – column performance check solution
GC – gas chromatography
HRGC – high resolution gas chromatography
HRMS – high resolution mass spectrometry
LOQ – limit of quantitation
MS – mass spectrometry
m/z – mass to charge ratio
PAHs – polyaromatic hydrocarbons
PCBs – polychlorinated biphenyls
ppm – parts per million
TCDD – tetrachlorodibenzo-p-dioxin
TOC – total organic carbon
VOCs – volatile organic compounds

SAP Worksheet 24 (continued)

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SAP Worksheet #25 — Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS GC HRGC/HRMS	Parameter setup	Physical check	Physical check	Initially; prior to DCC	Predetermined optimum parameter settings	Reset if incorrect.	EMAX Analyst	EMAX-8260 EMAX-8270 EMAX-8270SIM EMAX-8082 EMAX-8081 HE-HMS001
GC/MS HRGC/HRMS	Tune check	Instrument performance	Conformance to instrument tuning	Initially; prior to DCC	Compliance to ion abundance criteria	Repeat tune check to rule out standard degradation or inaccurate injection. If problem persists, retune the instrument and repeat tune check.	EMAX Analyst	EMAX-8260 EMAX-8270 EMAX-8270SIM HE-HMS001
ICP/MS	Tune check	Instrument performance	Conformance to instrument tuning	Initially; prior to DCC	Compliance to ion abundance criteria as specified by the method.	Repeat tune check to rule out standard degradation or inaccurate injection. If problem persists, retune instrument and repeat tune check.	EMAX Chemist	EMAX-6020
ICP	Injector Maintenance	Preventative maintenance	Change injector and torch	Daily to every other day	Intensity of 1 ppm manganese standard within criteria	Replace, investigate injector, reanalyze	EMAX Chemist	EMAX-6020

DCC – daily calibration check
GC – gas chromatograph
HRGC – high resolution gas chromatograph
HRMS – high resolution mass spectrometry
ICP – inductively coupled plasma
MS – mass spectrometry
ppm – parts per million

SAP Worksheet #25 – continued

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SAP Worksheet #26 — Sample Handling System

Sample Handling System

Sample Collection, Packaging, and Shipment
Sample Collection (Personnel/Organization): Trevet Field Technician
Sample Packaging (Personnel/Organization): Trevet Field Technician
Coordination of Shipment (Personnel/Organization): Trevet Chemist
Type of Shipment/Carrier: EMAX courier or commercial carrier
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): EMAX sample custodian
Sample Custody and Storage (Personnel/Organization): EMAX sample custodian
Sample Preparation (Personnel/Organization): EMAX sample preparation group
Sample Determinative Analysis (Personnel/Organization): EMAX bench chemist
Sample Archiving
Field Sample Storage (No. of days from sample collection): 6 months
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 120 days
Sample Disposal
Personnel/Organization: EMAX sample custodian
Number of Days from Analysis: 6 months for metals and 3 months for all other analyses (as per EMAX-SM03)

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SAP Worksheet #27 — Sample Custody Requirements Table

27.1 Sample Number

All samples (including field QC samples) submitted to the off-site analytical laboratory will be identified per the location identification, as shown on Worksheet #18. For example, location ID XX-TP-01 will be labeled with a sample identification of XX-TP-01. Duplicate samples will be identified with "Dup" following the sample identification.

Trip blanks, equipment rinsates, and source blank samples will be identified as "TB" for trip blank, "ER" for equipment rinsate, and "SB" for source blank. These identifiers will be followed by the date in month/day/year format for the sample identification. For example, a trip blank collected on December 2, 2014 would have the identifier "TB-120214."

The sample identifications will be recorded in the field logbook and on the chain-of-custody form. A description of the sample (including the sample number, well identification number, sample depth, sample date, and time) will be recorded in the field logbook or on field log forms.

27.2 Sample Labeling

Sample labels are necessary to prevent misidentification of samples. Sample labels will be completed in indelible ink, affixed to sample containers when the sample is collected, and then covered with clear tape. Each sample label will contain the following information, at a minimum:

- Company name
- Project name/number
- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Sampler's initials
- Analyses required
- Preservative (if any)

The following is an example of a sample label.

TREVET	Project:
Sampler:	
Date:	Time:
Sample ID:	
Analysis: VOCs by U.S. EPA 8260B,	
Preservative: HCl	

SAP Worksheet #27 – continued

27.3 Sample Handling and Shipping

Immediately after samples are collected and labeled, each sample will be wrapped in shock-absorbent material, such as bubble wrap, to prevent breakage of the sample containers. After wrapping in shock-absorbent material, the sample will be placed in a resealable plastic bag. The samples then will be stored and shipped in a cooler with ice to maintain a temperature of 4±2 ºC.

27.4 Field Documentation

All information pertinent to field sampling will be recorded in a field logbook in indelible ink to maintain the integrity and traceability of the samples. All samples will be properly labeled and custody sealed before they are transported to the laboratory. Completed chain-of-custody documentation will accompany the samples.

27.4.1 Chain of Custody

The field sampler is responsible for creating a chain-of-custody record where information about each sample collected in the field shall be entered. The chain-of-custody record is necessary to physically trace sample possession from the time of collection to ultimate disposition. Each chain-of-custody record will be signed as relinquished or received with each change of possession. The following information must be contained in the chain-of-custody:

- Project name and number
- Names of field samplers
- Sample identification number
- Date of sampling
- Local standard time of sample collection, using 24-hour clock notation
- Sample matrix
- Number and type of containers for each sample aliquot
- Type of analysis requested
- Preservation of sample containers (if applicable)
- Means of transmittal to the analytical laboratory or unusual circumstances
- Special handling instructions
- Destination of samples
- Name, date, time, and signature of each individual releasing the shipping container
- Name, address, and individual to receive results

SAP Worksheet #27 – continued

The "Laboratory Instructions/Comments" box in the chain-of-custody record will be used to communicate specific instructions to the analytical laboratory. Additional information relating to a specific sample may also be noted in the "Comments" line. In the event that more than one analytical laboratory will be used, different chain-of-custody forms will be made for each lab. The number of containers (i.e., coolers) intended to go to a specific analytical laboratory will be made clear on the chain-of-custody form under the block, "No. of Coolers Shipped." A copy of the chain-of-custody form is provided in Attachment 1.

27.4.2 Field Logbooks

A logbook will be maintained by the field sampler to summarize chronologically all field activities performed during the course of a given workday. The logbook is intended to provide interested parties, not present in the field at the time of data entry, with all the necessary information about field conditions in order to recreate the event that occurred during fieldwork. Logbooks are to be pre-bound with numbered pages and all entries must be made in indelible ink. To avoid tampering, the user shall draw a line across any unused space and initial to signify that no entries were made in those blank pages or spaces by the authorized user. Logbooks shall contain at least the following information:

- Date of entry and recorder's name
- Site location
- Sample location including distances to nearest fixed point(s) of reference
- Sample depth (bgs, if applicable)
- Sample matrix
- Sample appearance
- Volume of sample collected
- Field measurements (if applicable)
- Type of sampling equipment used
- Names of all individuals present during sampling
- Sample collection date and times, using 24-hour clock notation
- Sample identification numbers
- Type and number of sample containers used per sampling site
- Designation of QC samples (e.g., blanks, splits, or duplicates)

A logbook is considered a legal document and is admissible as evidence in legal proceedings; therefore, entries made should be factual, detailed, and objective.

SAP Worksheet #27 – continued

27.4.3 Document Corrections

Changes or corrections on any project documentation will be made by crossing out the erroneous item with a single line and initialing (by the person performing the correction) and dating the correction. The original item, although erroneous, must remain legible beneath the cross-out line. The new information should be written clearly above the crossed-out item.

SAP Worksheet #28 — Laboratory Quality Control Samples Table

Matrix:	Aqueous/Solid
Analytical Group:	VOCs
Analytical Method/SOP Reference:	U.S. EPA Method 8260B / EMAX-8260

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ. For common laboratory contaminants, no analytes detected > LOQ	Reprepare and reanalyze method blank and all samples processed with the contaminated blank.	EMAX Analyst	Bias	No analytes detected > ½ LOQ. For common laboratory contaminants, no analytes detected > LOQ
LCS	One per preparation	See table below.	Reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	EMAX Analyst	Accuracy	See table below
Matrix Spike/Matrix Spike Duplicate	One per preparation batch per 20 project samples	See table below. RPD ≤ 30%	Check if sample was properly spiked. If indicative of matrix interference, discuss in case narrative, otherwise re-prep and re-analyze the sample	EMAX Analyst	Bias	See table below. RPD ≤ 30%

≤ - less than or equal to
LCS – laboratory control sample
LOQ – limit of quantitation
RPD – relative percent difference

SAP Worksheet #28 – continued

EPA 8260 Surrogate Recovery

Analyte	Aqueous	Solid
1,2-Dichloroethane-d4	70-120	NA
4-Bromofluorobenzene	75-120	85-120
Dibromofluoromethane	85-115	NA
Toluene-d8	85-120	85-115

EPA 8260 QC Limits

Analyte	LCS (Aqueous)	LCS (Solid)	RPD
1,1,1-Trichloroethane	65-130	70-135	< 30
1,1,2,2-Tetrachloroethane	65-130	55-130	< 30
1,1,2-Trichloroethane	75-125	60-125	< 30
1,1-Dichloroethane	70-135	75-125	< 30
1,1-Dichloroethene	70-130	65-135	< 30
1,2,4-Trimethylbenzene	75-130	65-135	< 30
1,2-Dichloroethane	70-130	70-125	< 30
1,2-Dichloropropane	75-125	70-120	< 30
1,3,5-Trimethylbenzene	75-130	65-135	< 30
2,2-Dichloropropane	70-135	65-135	< 30
2-Butanone	30-150	30-160	< 30
2-Hexanone	55-130	45-145	< 30
4-Methyl-2-pentanone	60-135	45-145	< 30
Acetone	40-140	20-160	< 30
Benzene	80-120	75-125	< 30
Bromodichloromethane	75-120	70-130	< 30
Bromoform	70-130	55-135	< 30
Bromomethane	30-145	30-160	< 30
Carbon disulfide	35-160	45-160	< 30
Carbon tetrachloride	65-140	65-135	< 30

SAP Worksheet #28 – continued

EPA 8260 QC Limits

Analyte	LCS (Aqueous)	LCS (Solid)	RPD
Chlorobenzene	80-120	75-125	< 30
Chlorodibromomethane	60-135	65-130	< 30
Chloroethane	60-135	40-155	< 30
Chloroform	65-135	70-125	< 30
Chloromethane	40-125	50-130	< 30
cis-1,2-Dichloroethene	70-125	65-125	< 30
cis-1,3-Dichloropropene	70-130	70-125	< 30
Ethylbenzene	75-125	75-125	< 30
Isopropylbenzene	75-125	75-130	< 30
m,p-Xylene	75-130	80-125	< 30
Methyl tert-butyl ether	65-125	NA	< 30
Methylene chloride	55-140	55-140	< 30
n-Butylbenzene	70-135	65-140	< 30
n-Propylbenzene	70-130	65-135	< 30
o-Xylene	80-120	75-125	< 30
p-Isopropyltoluene	75-130	75-135	< 30
sec-Butylbenzene	70-125	65-130	< 30
Styrene	65-135	75-125	< 30
tert-Butylbenzene	70-130	65-130	< 30
Tetrachloroethene	45-150	65-140	< 30
Toluene	75-120	70-125	< 30
trans-1,2-Dichloroethene	60-140	65-135	< 30
trans-1,3-Dichloropropene	55-140	65-125	< 30
Trichloroethene	70-125	75-125	< 30
Vinyl chloride	50-145	60-125	< 30

LCS – laboratory control sample
MS/MSD – matrix spike/matrix spike duplicate
N/A – not applicable
RPD – relative percent difference

SAP Worksheet #28 – continued

Matrix:	Aqueous/Solid
Analytical Group:	SVOCs
Analytical Method/SOP Reference:	U.S. EPA Method 8270C EMAX-8270

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ. For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination, then re-prepare and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Analyst	Accuracy Bias	No analytes detected > ½ LOQ. For common laboratory contaminants, no analytes detected > LOQ Blank result must not otherwise affect sample results.
Surrogate	Every analytical sample	2 out of 3 acid and 2 out of 3 base neutral surrogates within QC Limit (Table below)	Correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	EMAX Analyst	Accuracy Bias	2 out of 3 acid and 2 out of 3 base neutral surrogates within QC limit (Table below)
LCS	One per sample preparation batch	SeeTable below	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Analyst	Accuracy/Bias	SeeTable below
Matrix	Project	SeeTable below	If result is indicative of matrix	EMAX Analyst	Interferences:	SeeTable below

SAP Worksheet #28 – continued

Matrix:	Aqueous/Solid
Analytical Group:	SVOCs
Analytical Method/SOP Reference:	U.S. EPA Method 8270C EMAX-8270

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Spike/Matrix Spike Duplicate	designated sample matrix QC		interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy Bias Precision	

LCS – laboratory control sample
LOQ – limit of quantitation
QC – quality control

EPA 8270 Surrogate Recovery

Analyte	Aqueous	Solid
2-Fluorobiphenyl	50-110	45-105
Terphenyl-d_{14}	50-135	30-125
2,4,6-Tribromophenol	40-125	35-125
2-Fluorophenol	20-110	35-105
Nitrobenzene-d_5	40-110	40-100
Phenol-d_5/d_6	NA	35-100

U.S. EPA 8270 QC Limit Table

Analyte	LCS, MS/MSD (Aqueous)	LCS, MS/MSD (Solid)	RPD
1,2,4-Trichlorobenzene	35-110	45-110	< 30
1,2-Dichlorobenzene	35-100	45-110	< 30
1,3-Dichlorobenzene	30-100	40-100	< 30

SAP Worksheet #28 – continued

U.S. EPA 8270 QC Limit Table

Analyte	LCS, MS/MSD (Aqueous)	LCS, MS/MSD (Solid)	RPD
1,4-Dichlorobenzene	30-100	35-105	< 30
2,4,5-Trichlorophenol	50-110	50-110	< 30
2,4,6-Trichlorophenol	50-115	45-110	< 30
2,4-Dichlorophenol	50-105	45-110	< 30
2,4-Dimethylphenol	30-110	30-105	< 30
2,4-Dinitrophenol	15-140	15-130	< 30
2,4-Dinitrotoluene	50-120	50-115	< 30
2-Chloronaphthalene	50-105	45-105	< 30
2-Methylphenol	40-110	40-105	< 30
2-Nitroaniline	20-125	25-110	< 30
2-Nitrophenol	40-115	40-110	< 30
3,3'-Dichlorobenzidine	20-110	NA	< 30
3.4-Methylphenol	30-110	40-105	< 30
3-Nitroaniline	20-125	25-110	< 30
4,6-Dinitro-2-methylphenol	40-130	30-135	< 30
4-Bromophenyl-phenyl ether	50-115	45-110	< 30
4-Chloro-3-methylphenol	45-110	45-115	< 30
4-Chloroaniline	15-110	NA	< 30
4-Chlorophenyl-phenyl ether	50-110	45-110	< 30
4-Nitroaniline	35-120	45-120	< 30
4-Nitrophenol	NA	15-140	< 30
Acenaphthene	45-110	45-110	< 30
Benzo(a)anthracene	55-110	50-110	< 30
Benzo(a)pyrene	55-110	50-110	< 30
Benzo(b)fluoranthene	45-120	45-115	< 30
Benzo(g,h,i)perylene	40-125	40-125	< 30
Benzo(k)fluoranthene	45-125	45-125	< 30

SAP Worksheet #28 – continued

U.S. EPA 8270 QC Limit Table

Analyte	LCS, MS/MSD (Aqueous)	LCS, MS/MSD (Solid)	RPD
Benzyl alcohol	30-110	20-125	< 30
bis(2-Chloroethoxy)methane	45-105	45-110	< 30
bis(2-Chloroethyl)ether	35-110	40-105	< 30
Bis(2-ethylhexyl)phthalate	40-125	45-125	< 30
Butylbenzylphthalate	45-115	50-125	< 30
Chrysene	55-110	55-110	< 30
Dibenzo(a,h)anthracene	40-125	40-125	< 30
Diethylphthalate	40-120	50-115	< 30
Dimethylphthalate	25-125	50-110	< 30
Di-n-butylphthalate	35-125	55-110	< 30
Di-n-octylphthalate	35-135	40-130	< 30
Fluoranthene	55-115	55-115	< 30
Fluorene	50-110	50-110	< 30
Hexachlorobenzene	50-110	45-120	< 30
Hexachlorobutadiene	25-105	40-115	< 30
Hexachloroethane	30-100	35-110	< 30
Indeno(1,2,3-cd)pyrene	45-125	40-120	< 30
Isophorone	50-110	45-110	< 30
Naphthalene	40-100	40-105	< 30
N-Nitrosodimethylamine	25-110	20-115	< 30
N-Nitroso-di-n-propylamine	35-130	40-115	< 30
Pentachlorophenol	40-115	25-120	< 30
Phenanthrene	50-115	50-110	< 30
Pyrene	50-130	45-125	< 30

LCS – laboratory control sample
MS/MSD – matrix spike/matrix spike duplicate
N/A – not applicable
RPD – relative percent difference

SAP Worksheet #28 – continued

Matrix:	Solid
Analytical Group:	PAHs
Analytical Method/SOP Reference:	U.S. EPA Method 8270C EMAX-8270SIM

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Internal Standard	Every sample, spiked sample, standard, and method blank	Retention time ±20 seconds from retention time of them midpoint standard in the ICAL. EICP area within -50% to +100% of ICAL midpoint standard.	Inspect MS and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	EMAX Analyst	Accuracy Bias	Retention time ±20 seconds from retention time of them midpoint standard in the ICAL. EICP area within -50% to +100% of ICAL midpoint standard.
Method Blank	One per preparation batch	No analytes detected > ½ LOQ. For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination, then re-prepare and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Analyst	Accuracy Bias	No analytes detected > ½ LOQ. For common laboratory contaminants, no analytes detected > LOQ Blank result must not otherwise affect sample results.
Surrogate	Every analytical sample	Terphenyl-D14: 58-133% 2-Fluorobiphenyl: 53-106% Nitrobenzene-d5: 44-125%	If non-compliant and no apparent matrix interference is observed, re-extract and analyze sample. Otherwise, inform the Project Chemist for	EMAX Analyst	Accuracy Bias	Terphenyl-D14: 58-133% 2-Fluorobiphenyl: 53-106% Nitrobenzene-d5: 44-125%

SAP Worksheet #28 – continued

Matrix:	Solid
Analytical Group:	PAHs
Analytical Method/SOP Reference:	U.S. EPA Method 8270C EMAX-8270SIM

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
			further instruction.			
LCS	One per sample preparation batch	SeeTable below	Cure probable source of LCS failure, re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Analyst	Accuracy/Bias	SeeTable below
Matrix Spike/Matrix Spike Duplicate	Project designated sample matrix QC	SeeTable below	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.	EMAX Analyst	Interferences: Accuracy Bias Precision	SeeTable below

SAP Worksheet #28 – continued

U.S. EPA 8270 QC Limit Table

Analyte	LCS, MS/MSD (Solid)	RPD
2-Methylnaphthalene	39-114	< 30
Acenaphthene	44-111	< 30
Acenaphthylene	39-116	< 30
Anthracene	50-114	< 30
Benzo[a]anthracene	54-122	< 30
Benzo[b]fluoranthene	53-128	< 30
Benzo[k]fluoranthene	56-123	< 30
Benzo[g,h,i]perylene	49-127	< 30
Benzo[a]pyrene	50-125	< 30
Chrysene	57-118	< 30
Dibenz(a,h)anthracene	50-129	< 30
Fluoranthene	55-119	< 30
Fluorene	47-114	< 30
Indeno[1,2,3-cd]pyrene	49-130	< 30
Naphthalene	38-111	< 30
Phenanthrene	49-113	< 30
Pyrene	55-117	< 30

SAP Worksheet #28 – continued

Matrix:	Solid/Aqueous
Analytical Group:	Mercury
Analytical Method/SOP Reference:	U.S. EPA Method 7471B/ EMAX-7471 U.S. EPA Method 7470A EMAX-7470

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ.	Reprepare and reanalyze method blank and all samples processed with the contaminated blank.	EMAX Analyst	Bias	No analyte detected > ½ LOQ
LCS	One per preparation batch	%R: 80-120%	Reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	EMAX Analyst	Accuracy	%R: 80-120%
MS/MSD or MS/Dup	One set of MS/MSD or MS/Dup in every preparatory batch	%R: 80-120%, RPD $\leq$ 20%	Perform post-digestion spike	EMAX Analyst	Accuracy Bias	%R: 80-120%, RPD $\leq$ 20%
Post-digestion Spike	When MS/MSD fails	%R: 85-115%	Perform dilution test if analyte concentration is sufficiently high (approximately 5 times the LOQ after dilution), otherwise perform MSA	EMAX Analyst	Accuracy Bias	%R: 85-115%

SAP Worksheet #28 – continued

Matrix:	Solid/Aqueous
Analytical Group:	Mercury
Analytical Method/SOP Reference:	U.S. EPA Method 7471B/ EMAX-7471 U.S. EPA Method 7470A EMAX-7470

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Dilution Test	When post-digestion spike fails and analyte concentration is sufficiently high (approximately 5 times the LOQ after dilution)	Within ± 10% of the parent sample result	Perform MSA	EMAX Analyst	Bias	Within ± 10% of the parent sample result

± - plus or minus
% R – percent recovery
LCS – laboratory control sample
LOQ – limit of quantitation
MS/MSD – matrix spike/matrix spike duplicate
RPD – relative percent difference

SAP Worksheet #28 – continued

Matrix:	Aqueous/Solid
Analytical Group:	Metals
Analytical Method/SOP Reference:	U.S. EPA Method 6020 / EMAX-6020

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination, then re-prepare and reanalyze method blank and all samples processed with the nonconforming method blank.	EMAX Analyst	Bias	No analytes detected > ½ LOQ
Interference Check Solution (ICS-A and ICS-AB)	At the beginning of an analytical run and every 12 hours	Within ± 20% of true value	Terminate analysis, correct the problem, reanalyze ICS, and all affected samples	EMAX Analyst	Accuracy	Within ± 20% of true value
Internal Standard (IS)	ICV, LLICV, CCV, LLCCV, CCBs, MB, LCS, every sample	IS intensities > 70% from initial calibration blank IS intensity	Correct problem then reanalyze	EMAX Analyst	Accuracy	IS intensities > 70% from initial calibration blank IS intensity
LCS	One per preparation batch	Recovery of 80-120%	Re-prepare and reanalyze LCS and all samples processed with the nonconforming LCS.	EMAX Analyst	Accuracy	Recovery of 80-120%
MS/MSD	Project designated sample in matrix QC. In general, one per 20 project samples per matrix	Recovery of 75-125%; RPD 20%.	Evaluate post spike and dilution test: • If parent sample result is "ND", evaluate post spike. • If parent sample result is high (i.e., 4 times of spike concentrations) and post spike failed, evaluate dilution test	EMAX Analyst	Accuracy	Recovery of 75-125%; RPD 20%.

SAP Worksheet #28 – continued

Matrix:	Aqueous/Solid
Analytical Group:	Metals
Analytical Method/SOP Reference:	U.S. EPA Method 6020 / EMAX-6020

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Dilution Test	When MS fails	1:5 dilution must agree within ±10% of the original determination.	Evaluate. Discuss in case narrative.	Analyst	Accuracy	1:5 dilution must agree within ±10% of the original determination.
Post-digestion Spike	when MS recovery fails	%R within 80-120% of expected value	Correct the problem then reanalyze post digestion spike addition	Analyst	Accuracy	%R within 80-120% of expected value

± - plus or minus
% R – percent recovery
CCB – continuing calibration blank
CCV – continuing calibration verification
ICS – interference check solution
ICV – initial calibration verification
IS – internal standard
LCS – laboratory control sample
LLCCV – low level continuing calibration verification
LLICV – low level initial calibration verification
LOQ – limit of quantitation
MB – method blank
MS/MSD – matrix spike/matrix spike duplicate
QC – quality control
RPD – relative percent difference

SAP Worksheet #28 – continued

Matrix:	Aqueous/Solid
Analytical Group:	Dioxins/Furans
Analytical Method/SOP Reference:	U.S. EPA Method 8290A / HE-HMS001

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator	Measurement Performance Criteria
Labeled Analytes	Every field sample, standard, and QC sample	%R: 40-135%	Identify and correct the problem, if possible re-extract and re-analyze field samples with a smaller sample size	ALS Analyst	Accuracy Bias	%R: 40-135%
Method Blank	One per each batch of 20 field samples	< 1/2 LOQ and <1/10 any amount reported in a related sample	Identify and correct the problem, evaluate whether affected samples require re-extraction/re-analysis.	ALS Analyst	Accuracy Bias	< 1/2 LOQ and <1/10 any amount reported in a related sample
MS	One per each batch of 20 field samples	%R: 50-150%	Evaluate parent sample, and determine whether re-extraction is warranted	ALS Analyst	Accuracy Bias	%R: 50-150%
MSD	One per each batch of 20 field samples	%R: 50-150% RPD < 20%	Evaluate parent sample, and determine whether re-extraction is warranted	ALS Analyst	Accuracy Bias	%R: 50-150% RPD < 20%
LCS	One per each batch of 20 field samples	%R: 50-150%	Identify and correct the problem, if possible re-extract and re-analyze QC and related samples.	ALS Analyst	Accuracy	%R: 50-150%

% R – percent recovery
LCS – laboratory control sample
LOQ – limit of quantitation
MS/MSD – matrix spike/matrix spike duplicate
QC – quality control
RPD – relative percent difference

SAP Worksheet #28 – continued

U.S. EPA 8290 QC Limit Table

Analyte	LCS, MS/MSD (Aqueous)	LCS, MS/MSD (Solid)	Relative Percent Difference
2378-TCDD	67-158	67-158	20
12378-PeCDD	70-142	70-142	20
123478-HxCDD	70-164	70-164	20
123678-HxCDD	76-134	76-134	20
123789-HxCDD	64-162	64-162	20
1234678-HpCDD	70-140	70-140	20
OCDD	78-144	78-144	20
2378-TCDF	75-158	75-158	20
12378-PeCDF	80-134	80-134	20
23478-PeCDF	68-160	68-160	20
123478-HxCDF	72-134	72-134	20
123678-HxCDF	84-130	84-130	20
123789-HxCDF	78-130	78-130	20
234678-HxCDF	70-156	70-156	20
1234678-HpCDF	82-122	82-122	20
1234789-HpCDF	78-138	78-138	20
OCDF	63-170	63-170	20

HpCDD – heptachloro dibenzo-p-dioxin
HxCDD – hexachloro dibenzo-p-dioxin
HpCDF – heptachloro dibenzo-p-furan
HxCDF – hexachloro dibenzo-p-furan
± - plus or minus

LCS – laboratory control sample
MS/MSD – matrix spike/matrix spike duplicate
OCDD – octachloro dibenzo-p-dioxin
OCDF – octachloro dibenzo-p-furan

PeCDD – pentachloro dibenzo-p-dioxin
PeCDF – pentachloro dibenzo-p-furan
TCDD – tetrachloro dibenzo-p-dioxin
TCDF – tetrachloro dibenzo-p-furan

SAP Worksheet #28 – continued

Matrix:	Aqueous
Analytical Group:	Hardness
Analytical Method/SOP Reference:	SM-2340C/ EMAX-2340C

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ.	Reprepare and reanalyze method blank and all samples processed with the contaminated blank.	EMAX Analyst	Bias	No analyte detected > ½ LOQ
LCS	One per preparation batch	%R: 80-120%	Reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	EMAX Analyst	Accuracy	%R: 80-120%
Duplicate sample	One per preparation batch	RPD ≤ 20%	Discuss in case narrative	EMAX Analyst	Bias	RPD ≤ 20%

≤ - less than or equal to
% R – percent recovery
LCS – laboratory control sample
LOQ – limit of quantitation
RPD – relative percent difference

SAP Worksheet #28 – continued

Matrix:	Solid
Analytical Group:	TOC
Analytical Method/SOP Reference:	Walkley Black/ EMAX-TOCWB

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ.	If results are ND or result is > 10 times of method blank, sample result may be reported, otherwise re-analyze all associated samples	EMAX Analyst	Bias	No analyte detected > ½ LOQ
LCS	One per preparation batch	%R: 80-120%	Reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	EMAX Analyst	Accuracy	%R: 80-120%
Duplicate sample	One per preparation batch	RPD ≤ 20%	If method blank and LCS is under control, matrix interference is suspected, discuss in case narrative.	EMAX Analyst	Bias	RPD ≤ 20%

≤ - less than or equal to
% R – percent recovery
LCS – laboratory control sample
LOQ – limit of quantitation
ND – not detected
RPD – relative percent difference

SAP Worksheet #28 – continued

Matrix:	Solid
Analytical Group:	Pesticides
Analytical Method/SOP Reference:	U.S. EPA Method 8081A EMAX-8081

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ or > 1/10 the amount measured in any samples or 1/10 the requlatory limit, whichever is greater.	Re-prepare and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Analyst	Accuracy Bias	No analytes detected > ½ LOQ or > 1/10 the amount measured in any samples or 1/10 the requlatory limit, whichever is greater.
Surrogate	Every analytical sample	Tetrachloro-m-xylene: 42-129%	Re-prep and re-analyze the LCS and all associated samples	EMAX Analyst	Accuracy Bias	Tetrachloro-m-xylene: 42-129%
LCS	One per sample preparation batch	See Table below	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Analyst	Accuracy/Bias	SeeTable below
MS/MSD	Project designated sample matrix QC	See Table below	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and perform corrective action as necessary	EMAX Analyst	Interferences: Accuracy Bias Precision	See Table below

SAP Worksheet #28 – continued

Matrix:	Solid
Analytical Group:	Pesticides
Analytical Method/SOP Reference:	U.S. EPA Method 8081A EMAX-8081

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Confirmation	100% of all positive results	Same as primary column	If quantitation criteria are not met, use confirmation for qualitative identification only.	EMAX Analyst	Accuracy	Same as primary column

LCS – laboratory control sample
LOQ – limit of quantitation
MS/MSD – matrix spike/matrix spike duplicate
QC – quality control

U.S. EPA 8081A QC Limit Table

Analyte	LCS, MS/MSD (Solid)	RPD
4,4'-DDD	56-139	< 30
4,4'-DDE	56-134	< 30
4,4'-DDT	50-141	< 30
Aldrin	45-136	< 30
alpha-BHC	45-137	< 30
alpha-Chlordane	54-133	< 30
beta-BHC	50-136	< 30
delta-BHC	47-139	< 30

SAP Worksheet #28 – continued

Analyte	LCS, MS/MSD (Solid)	RPD
Dieldrin	56-136	< 30
Endosulfan I	53-132	< 30
Endosulfan II	53-134	< 30
Endosulfan sulfate	55-136	< 30
Endrin	57-140	< 30
Endrin aldehyde	35-137	< 30
Endrin ketone	55-136	< 30
gamma-BHC (Lindane)	49-135	< 30
gamma-Chlordane	53-135	< 30
Heptachlor	47-136	< 30
Heptachlor epoxide	52-136	< 30
Methoxychlor	52-143	< 30
Toxaphene	33-141	< 30

SAP Worksheet #28 – continued

Matrix:	Solid
Analytical Group:	PCBs
Analytical Method/SOP Reference:	U.S. EPA Method 8082 EMAX-8082

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ LOQ or > 1/10 the amount measured in any samples or 1/10 the regulatory limit, whichever is greater.	Re-prepare and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Analyst	Accuracy Bias	No analytes detected > ½ LOQ or > 1/10 the amount measured in any samples or 1/10 the regulatory limit, whichever is greater.
Surrogate	Every analytical sample	Tetrachloro-m-xylene: 44-130%	Re-prep and re-analyze the LCS and all associated samples	EMAX Analyst	Accuracy Bias	Tetrachloro-m-xylene: 44-130%
LCS	One per sample preparation batch	SeeTable below	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Analyst	Accuracy/Bias	SeeTable below
MS/MSD	Project designated sample matrix QC	SeeTable below	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and perform corrective action as necessary	EMAX Analyst	Interferences: Accuracy Bias Precision	SeeTable below

SAP Worksheet #28 – continued

Matrix:	Solid
Analytical Group:	PCBs
Analytical Method/SOP Reference:	U.S. EPA Method 8082 EMAX-8082

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Confirmation	100% of all positive results	Same as primary column	If quantitation criteria are not met, use confirmation for qualitative identification only.	EMAX Analyst	Accuracy	Same as primary column

LCS – laboratory control sample
LOQ – limit of quantitation
MS/MSD – matrix spike/matrix spike duplicate
QC – quality control

U.S. EPA 8082 QC Limit Table

Analyte	LCS, MS/MSD (Solid)	RPD
PCB-1016	47-134	< 30
PCB-1254	67-135	< 30
PCB-1260	53-140	< 30

SAP Worksheet #28 – continued

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SAP Worksheet #29 — Project Documents and Records Table

Document	Where Maintained
SAP Worksheet #4 – Project Personnel Sign-Off Sheet	Trevet project file*
Field logbook	Trevet project file
Field forms	Trevet project file
Sample labels	EMAX**
chain-of-custody form	Trevet project file and EMAX
Supplies certification	Trevet project file
Shipping records	Trevet project file
Field audit and nonconformance reports	Trevet project file
Laboratory data package including:*** • Sample receipt and login • Laboratory internal chain-of-custody • Instrument calibration logs • Sample preparation logs • Sample analysis/run logs • Nonconformance reports including corrective actions	EMAX, Trevet project file, and NAVFAC SW Administrative Record
Data validation report***	Validator- LDC, Trevet project file, and NAVFAC SW Administrative Record

* Project files are maintained at Trevet's San Diego office located at 9888 Carroll Centre Road, Suite 228, San Diego, California 92126

** EMAX is located at 1835 W. 205th Street, Torrance, California 90501

*** Laboratory analytical data and field measurements (such as groundwater quality measurements including temperature, pH, conductivity, dissolved oxygen, oxidation/reduction potential, and turbidity) will be uploaded to NIRIS in accordance with EWI EVR.6, *Environmental Data Management and Required Electronic Delivery Standards* (NAVFAC SW 2005).

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SAP Worksheet #30 — Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Aqueous	VOCs	See Worksheet #18	U.S. EPA 8260B	21 days	EMAX Laboratories 1835 W. 205th Street, Torrance, CA 90501 Contact: Ye Myint (310) 618-8889	Columbia Analytical Services 1317 S. 13th Avenue Kelso, WA 98626 Contact: Greg Salata (360) 577-7222
	SVOC	See Worksheet #18	U.S. EPA 8270C			
	Metals	See Worksheet #18	U.S. EPA 6020A			
	Mercury	See Worksheet #18	U.S. EPA 7471B			
	Hardness	See Worksheet #18	SM 2340C			
Solid	VOCs	See Worksheet #18	U.S. EPA 8260B			
	SVOC	See Worksheet #18	U.S. EPA 8270C			
	PAHs	See Worksheet #18	U.S. EPA 8270C SIM			
	Pesticides	See Worksheet #18	U.S. EPA 8081A			
	PCBs	See Worksheet #18	U.S. EPA 8082			
	Metals	See Worksheet #18	U.S. EPA 6020A			
	Mercury	See Worksheet #18	U.S. EPA 7471B			
	TOC	See Worksheet #18	Walkley-Black			

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Solid	Dioxins /Furans	See Worksheet #18	U.S. EPA 8290	30 days	ALS Environmental 10450 Stancliff Rd. Suite 210 Houston, Texas 77099 281-530-5656	TestAmerica West Sacramento 880 Riverside Pkwy Sacramento, CA 95605

SM – Standard Methods
SVOCs – semi-volatile organic compounds
PAHs – polyaromatic hydrocarbons
PCBs – polychlorinated biphenyls
TOC – total organic carbon
U.S. EPA – United States Environmental Protection Agency
VOCs – volatile organic compounds

SAP Worksheet #31 — Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
Field Readiness Review	Before mobilization for the project and before major phases of work are initiated	Internal	Trevet	PM, Trevet	PM, Trevet	PM, Trevet	QCM, Trevet
Field Sampling Surveillance	Once at the beginning of field sampling	Internal	Trevet	Chemist, Trevet	PM, Trevet	PM, Trevet	QCM and Chemist, Trevet
Data Review Surveillance	Once for project when duration less than 6 months	Internal	Trevet	Chemist, Trevet	Chemist, Trevet	Chemist, Trevet	QCM, Trevet
Management Review	Once	Internal	Trevet	QCM, Trevet	PM, Trevet	PM, Trevet	QCM, Trevet

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SAP Worksheet #32 — Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Sampling Surveillance	Surveillance Report	Trevet PM	7 days after the inspection is complete	Corrective Action Report	PM and QCM, Trevet	5 days after notification
Data Review Surveillance	Surveillance Report	Trevet PM	7 days after the inspection is complete	Corrective Action Report	PM and QCM, Trevet	14 days after notification
Management Review	Surveillance Report	Trevet PM	7 days after the inspection is complete	Corrective Action Report	QCM, Trevet	14 days after notification

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SAP Worksheet #33 — QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Persons Responsible for Report Preparation	Report Recipient(s)
Field Sampling Surveillance Report	Once at start up of sampling	Within 7 days of first day of sampling.	Trevet Chemist	Trevet PM, Trevet QCM, and Trevet Project File
Data Review Surveillance Report	Once after all data generated and reviewed	Within 7 days of receipt of final validation report.	Trevet Chemist	Trevet PM, Trevet QCM, and Trevet Project File
Management Review Report	Once after management review is completed	Within 7 days of receipt of completion of field effort.	Trevet QCM	Trevet PM and Trevet Project File
Final Project Report	Following Agency concurrence with draft report	February 2016	Trevet QCM	Trevet PM and Trevet Project File

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SAP Worksheet #34 — Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Field logbook	Field logbooks will be reviewed weekly and verified that the information is complete. The inspection will be documented in daily QC reports.	Internal	Field Team Lead, Trevet
chain-of-custody forms	Completed chain-of-custody forms will be reviewed daily and verified for completeness.	Internal	Field Team Lead, Trevet
Sample receipt	Receipt of samples by the laboratory will be verified the day following shipment for samples shipped via courier or commercial carrier.	Internal	Chemist, Trevet
Sample logins	Sample login information will be reviewed and verified for completeness in accordance with chain-of-custody forms.	Internal External	Chemist, Trevet Laboratory PM, EMAX
Laboratory data prior to release	Laboratory data will be reviewed and verified for completeness against analyses requested on chain-of-custody forms.	External	Laboratory PM, EMAX
Laboratory data due at turnaround time listed on chain-of-custody	Laboratory data will be verified that the analyses reported are consistent with the analytical suite requested on the chain-of-custody forms.	Internal	Chemist, Trevet
Laboratory data packages	All laboratory data packages will be verified for completeness by the laboratory performing the work. Data packages will then be reviewed by the project chemist for completeness. Subsequently, data packages will be evaluated externally by undergoing data validation.	External Internal External	Laboratory PM, EMAX Chemist, Trevet Third-party data validators, LDC
Field and electronic data	100% of manual entries will be reviewed against the hardcopy information and 10% of electronic uploads will be checked against the hardcopy.	Internal	Chemist, Trevet

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SAP Worksheet #35 — Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field logbook	Field logbooks will be reviewed weekly for accuracy associated with each sampling event. The inspection will be documented in daily QC reports.	PM, Trevet
IIa	chain-of-custody forms	chain-of-custody forms will be reviewed daily to ensure that project information, sample analyses requested, number of field QC samples collected, and percent level III or IV validation chosen is accurate and in accordance with the requirements in this SAP.	Chemist, Trevet
IIa	Sample receipt	Sample cooler will be checked for compliance with temperature and packaging requirements.	Laboratory sample custodian, EMAX
IIa	Sample logins	Sample login will be reviewed for accuracy against the chain-of-custody form.	Chemist, Trevet Laboratory PM, EMAX
IIa	Holding times	Analytical results will be reviewed to ensure analysis occurred within stated holding times.	Chemist, Trevet Laboratory PM, EMAX
IIa	Laboratory data prior to release	Laboratory data will be reviewed to ensure that the data is accurate and meets the requirements in this SAP.	Laboratory PM, EMAX
IIa	Laboratory data prior to release	100% of the data will comply with the method- and project-specific requirements; any deviations or failure to meet criteria will be documented for the project file.	Laboratory Analyst, EMAX
IIa	Laboratory data prior to release	100% of manual entries are free of transcription errors and manual calculations are accurate; computer calculations are spot-checked to verify program validity; data reported are compliant with method- and project-specific QC requirements; raw data and supporting materials are complete; spectral assignments are confirmed; descriptions of deviations from method or project requirements are documented; significant figures and rounding have been appropriately used; reported values include dilution factors; and results are reasonable.	Laboratory Peer Analyst, EMAX
IIa	Laboratory data prior to release	Data reported comply with method- and project-specific QC requirements; the reported information is complete; the information in the report narrative is complete and accurate; and results are reasonable.	Laboratory Supervisor, EMAX

SAP Worksheet #35 – continued

Step IIa/IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Laboratory data prior to release	Data reported comply with method- and project-specific QC; analytical methods are performed in compliance with approved SOPs. This review may be conducted after release of data since performed only on 10% of data.	Laboratory QA Manager, EMAX
IIa	Laboratory data due at turnaround time listed on chain-of-custody	Laboratory data will be reviewed to ensure that the data reported met the analyte list and limits listed in Worksheet #15.	Chemist, Trevet
IIa	Laboratory data packages	All laboratory data packages will be validated by the laboratory performing the work for technical accuracy before it is submitted.	Laboratory PM, EMAX
IIa	Laboratory data packages	Data packages will be reviewed for accuracy against the laboratory data that was faxed or e-mailed at the turnaround time listed on the chain-of-custody.	Chemist, Trevet
IIa	Laboratory data packages	Data packages will be evaluated externally by undergoing data validation.	Third-party data validator, LDC
IIb	Data validation reports	Data validation reports will be reviewed in conjunction with the project DQOs and data quality indicators.	Chemist, Trevet

SAP Worksheet #36 — Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Aqueous	VOCs / U.S. EPA 8260B SVOCs / U.S. EPA 8270C Metals / U.S. EPA 6020 Mercury / U.S. EPA 7470A Hardness / SM 2340C	CLP NFG*, U.S. EPA SW 846**, and this UFP-QAPP. U.S. EPA Level III for 90% of data and U.S. EPA Level IV for 10% of data	PM, LDC
IIb	Solid	VOCs / U.S. EPA 8260B SVOCs / U.S. EPA 8270C Metals / U.S. EPA 6020 Mercury / U.S. EPA 7471B Pesticides / U.S. EPA 8081A PCBs / U.S. EPA 8082 PAHs / EPA EPA 8270C SIM TOC / Walkley Black Dioxins/Furans / U.S. EPA 8290	CLP NFG*, U.S. EPA SW 846**, and this UFP-QAPP. U.S. EPA Level III for 90% of data and U.S. EPA Level IV for 10% of data	PM, LDC

*U.S. EPA Contract Laboratory Program (CLP) National Functional Guidelines (NFG) for Organic Data Review, June 2008; and U.S. EPA CLP NFG for Inorganic Data Review, January 2010.

**U.S. EPA SW 846, Third Edition, Test Methods for Evaluation Solid Waste, update 1, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996; update IIIA, April 1998; update IV, January 2008.

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SAP Worksheet #37 — Usability Assessment

37.1 Measurement Quality Objectives for Chemical Data

The primary measurement quality objectives for this investigation relate to precision and accuracy, including detections and quantitation limits, for the analytical methods performed. All analytical results will be evaluated in accordance with precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters to document the quality of the data and to ensure that the data are of sufficient quality to meet the project objectives. The following subsections describe each of the PARCC parameters and how they will be assessed within this project.

37.1.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Usually, combined field and laboratory precision is evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as a relative percent difference (RPD).

$$RPD = \frac{|A - B|}{\frac{(A + B)}{2}} \text{ X } 100\%$$

where:

A = First duplicate concentration
B = Second duplicate concentration

Laboratory analytical precision is evaluated by analyzing laboratory duplicates or matrix spikes and matrix spike duplicates. Matrix spike and matrix spike duplicate samples will be generated for all analytes for this project. The results of the analysis of each matrix spike and matrix spike duplicate pair will be used to calculate an RPD for evaluating precision.

37.1.2 Accuracy

Field accuracy will be assessed by collecting and analyzing equipment rinsate, trip blank, and source water blank QC samples as appropriate. These QC samples will be used to evaluate the potential for target analytes to enter samples because of sampling processes.

A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the matrix spikes and matrix spike duplicate samples, laboratory control samples (LCS), surrogate standards, and method blanks. Matrix spikes and matrix spike duplicate and LCS samples will be prepared and analyzed at a frequency of 5 percent for soil samples. Surrogate standards, where applicable, are added to every sample analyzed for organic

SAP Worksheet #37 – continued

constituents. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

$$\text{Percent Recovery} = \frac{S - C}{T} \text{ x } 100$$

where:

S = Measured spike sample concentration
C = Sample concentration
T = True or actual concentration of the spike

Results that fall outside of the accuracy goals will be further evaluated based on the results of other QC samples.

37.1.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition. Representative data will be obtained for this project through careful selection of sampling locations and analytical parameters. Representative data will also be obtained through proper collection and handling of samples to avoid interference and minimize contamination.

Representativeness of data will be ensured through the consistent application of established field and laboratory procedures. Field blanks (if appropriate) and LCS will be evaluated for the presence of contaminants to aid in evaluating the representativeness of sample results. Data determined to be nonrepresentative, by comparison with existing data, will be used only if accompanied by appropriate qualifiers and limits of uncertainty.

37.1.4 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this SAP and when none of the QC criteria that affect data usability is exceeded. When all data validation is complete, the percent completeness value will be calculated by dividing the number of useable sample results by the total number of sample results planned for this investigation and multiplied by 100.

Completeness will also be evaluated as part of the data quality assessment process. This evaluation will help determine whether any limitations are associated with the decisions to be made based on the data collected. The completeness goal for this project is 90 percent.

SAP Worksheet #37 – continued

37.1.5 Comparability

Comparability expresses the confidence with which one data set can be compared with another. Comparability of data will be achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data.

37.1.6 Detection and Quantitation Limits

The method detection limit is the minimum concentration of an analyte that can be reliably distinguished from background noise for a specific analytical method. The quantitation limit (QL) represents the lowest concentration of an analyte that can be accurately and reproducibly quantified in a sample matrix. The QLs are typically several times the method detection limit to allow for matrix effects. Analytical methods for this project have been selected so that the QLs for each target analyte are below the project action limits listed in Worksheet #15, wherever practical.

37.2 Data Quality Assessment

After data are validated, the project chemist will review and assess field and laboratory quality control. The PARCC parameters will be determined as described in Section 37.1. Data validation reports will be reviewed and assessed for meeting DQOs. The project chemist will review the data validation reports for any deviations and qualify data. The following data qualifiers will be used:

J	-	Result is estimated
U	-	Analyte is not detected at or above the stated QL
R	-	Data are rejected
UJ	-	Analyte is not detected, but there is an uncertainty about the QL

Data qualifiers are used to indicate uncertainties associated with the data. The assigned qualifiers will be entered into the validation code field in the database. In addition, data will be assessed through the evaluation of the PARCC parameters.

The project chemist will prepare a data quality assessment report that will summarize the findings of the data assessment and discuss the usability of the data to be included in the report.

Data will be reported in tabular format to be included in the report. The electronic data in NEDD (i.e., NIRIS Electronic Data Deliverable) format will be submitted to the NIRIS database within 30 days of completion of validation, as described in Environmental Work Instruction #6, *Environmental Data Management and Required Electronic Delivery Standards* (NAVFAC SW

SAP Worksheet #37 – continued

2005). An e-mail confirmation received by Trevet will be forwarded to the project file. The DOD ELAP certification for EMAX Laboratories is included in Attachment 3.

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Figures

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Figure 2. IR Site 34b Site Plan
Figure 3. IR Site 34d Site Plan
Figure 4. Site Geology and Hydrogeology
Figure 5. Proposed Test Pit Locations at IR Site 34b
Figure 6. Proposed Test Pit Locations at IR Site 34d

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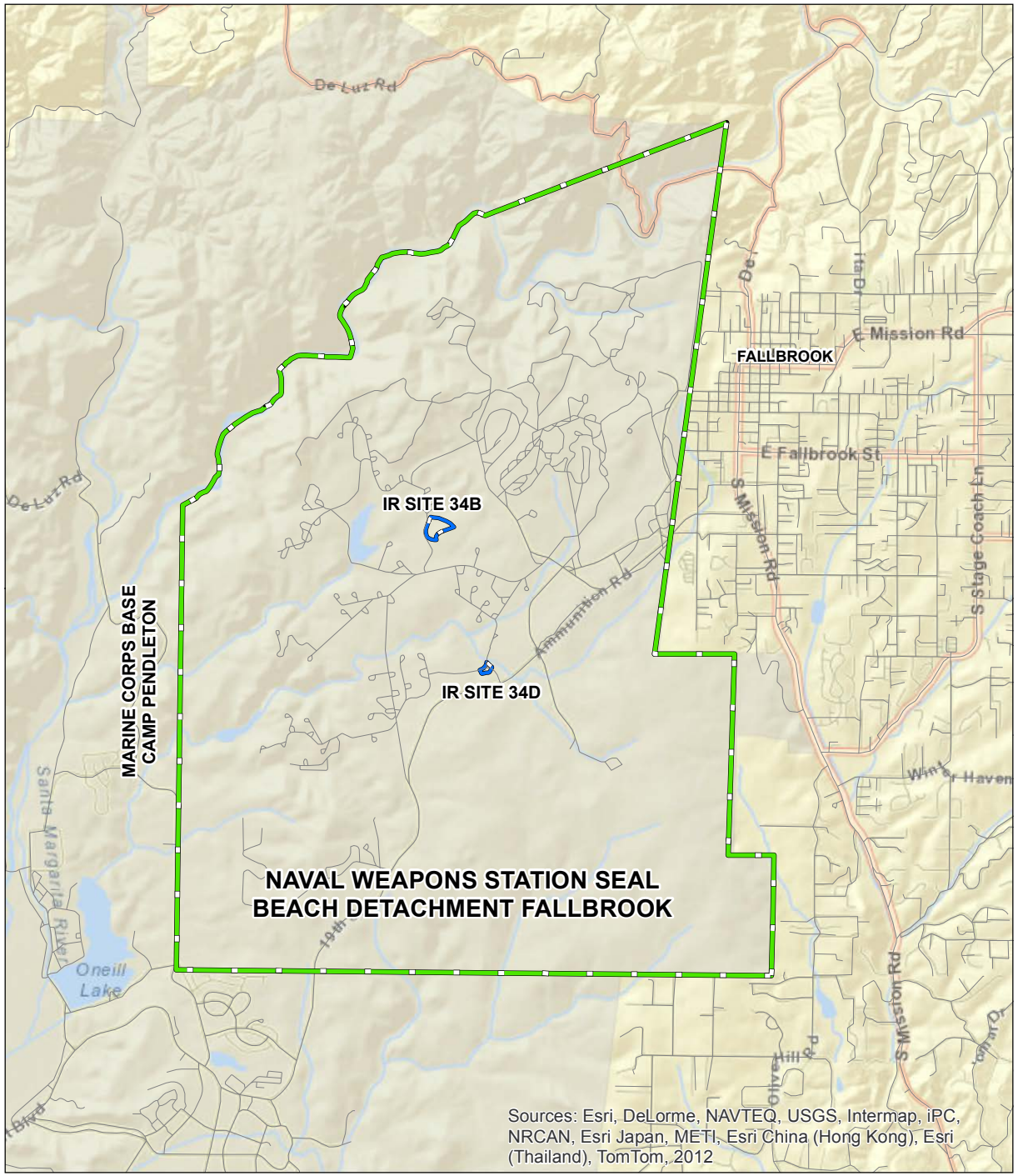
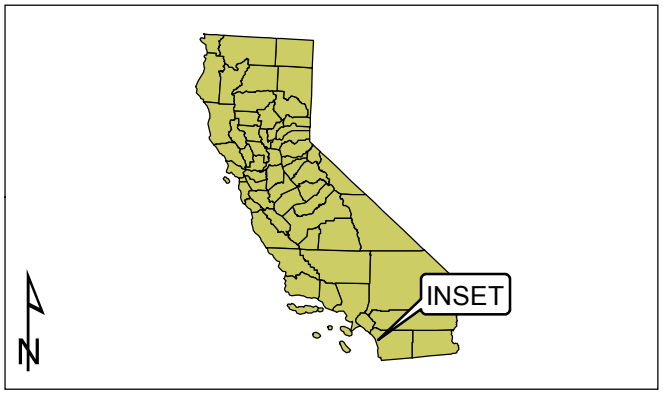
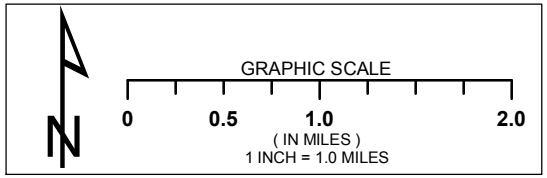




LEGEND

IR SITE BOUNDARY

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT FALLBROOK



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FALLBROOK, CALIFORNIA

FIGURE 1

SITE LOCATION MAP

TREVET

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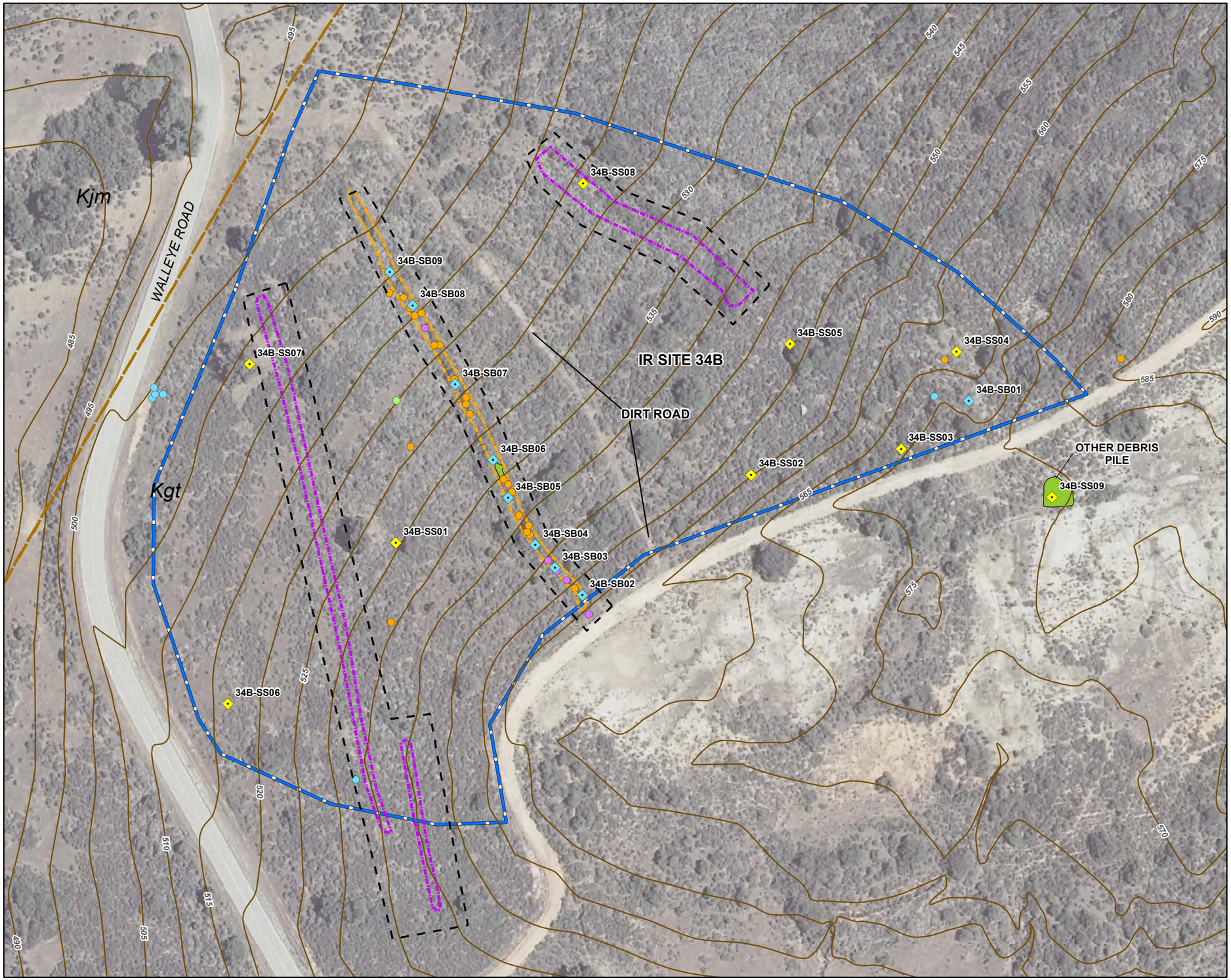

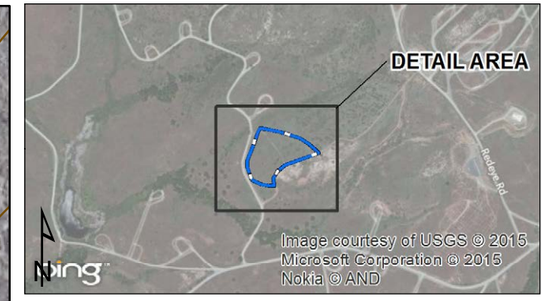

LEGEND

- MAGNETIC ANOMALIES
- METAL DEBRIS
- CONSTRUCTION DEBRIS
- OTHER DEBRIS
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- WASTE DISPOSAL TRENCH
- GEOLOGIC CONTACT
- TOPOGRAPHIC CONTOUR
- PREVIOUSLY SUSPECTED TRENCH AREA
- GEOPHYSICAL INVESTIGATION AREA
- IR SITE 34B BOUNDARY

NOTES::
Kjm - METAVOLCANICS
Kgt - TONALITE

SOURCE:
GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

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FIGURE 2

IR SITE 34B SITE PLAN

TREVET

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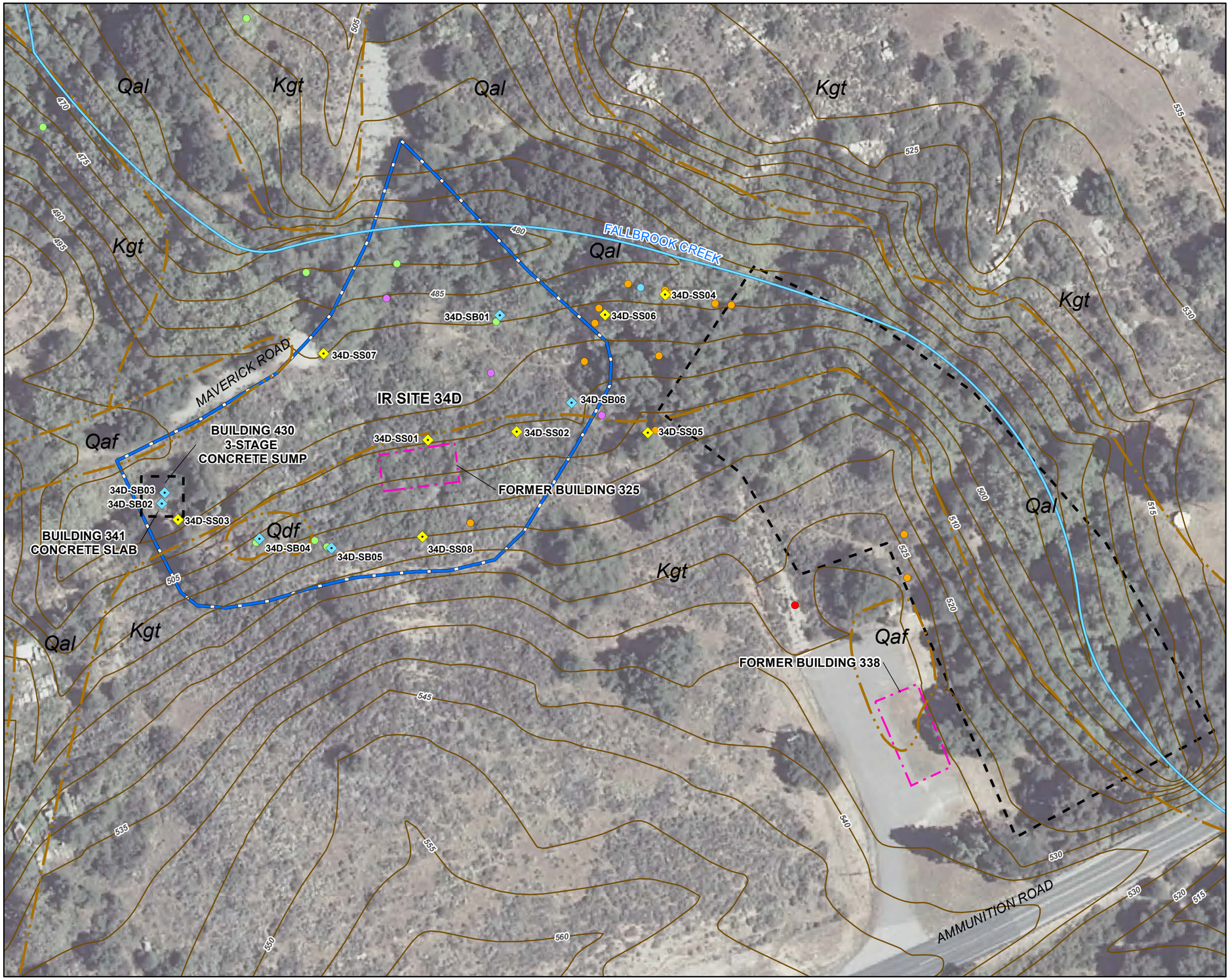

LEGEND

- MAGNETIC ANOMALIES
- 5.56-MM BLANK CASING
- METAL DEBRIS
- CONSTRUCTION DEBRIS
- OTHER DEBRIS
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- GEOLOGIC CONTACT (CHADUXTT 2010)
- TOPOGRAPHIC CONTOUR
- FORMER BUILDING
- OFFSITE INVESTIGATION AREA
- IR SITE34D BOUNDARY

NOTES:
Qdf - DEBRIS FILL
Qaf - ARTIFICIAL FILL
Qal - ALLUVIUM
Kgt - TONALITE

SOURCE:
GOOGLE MAPS AERIAL IMAGE

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GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

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FIGURE 3

IR SITE 34D SITE PLAN

TREVET

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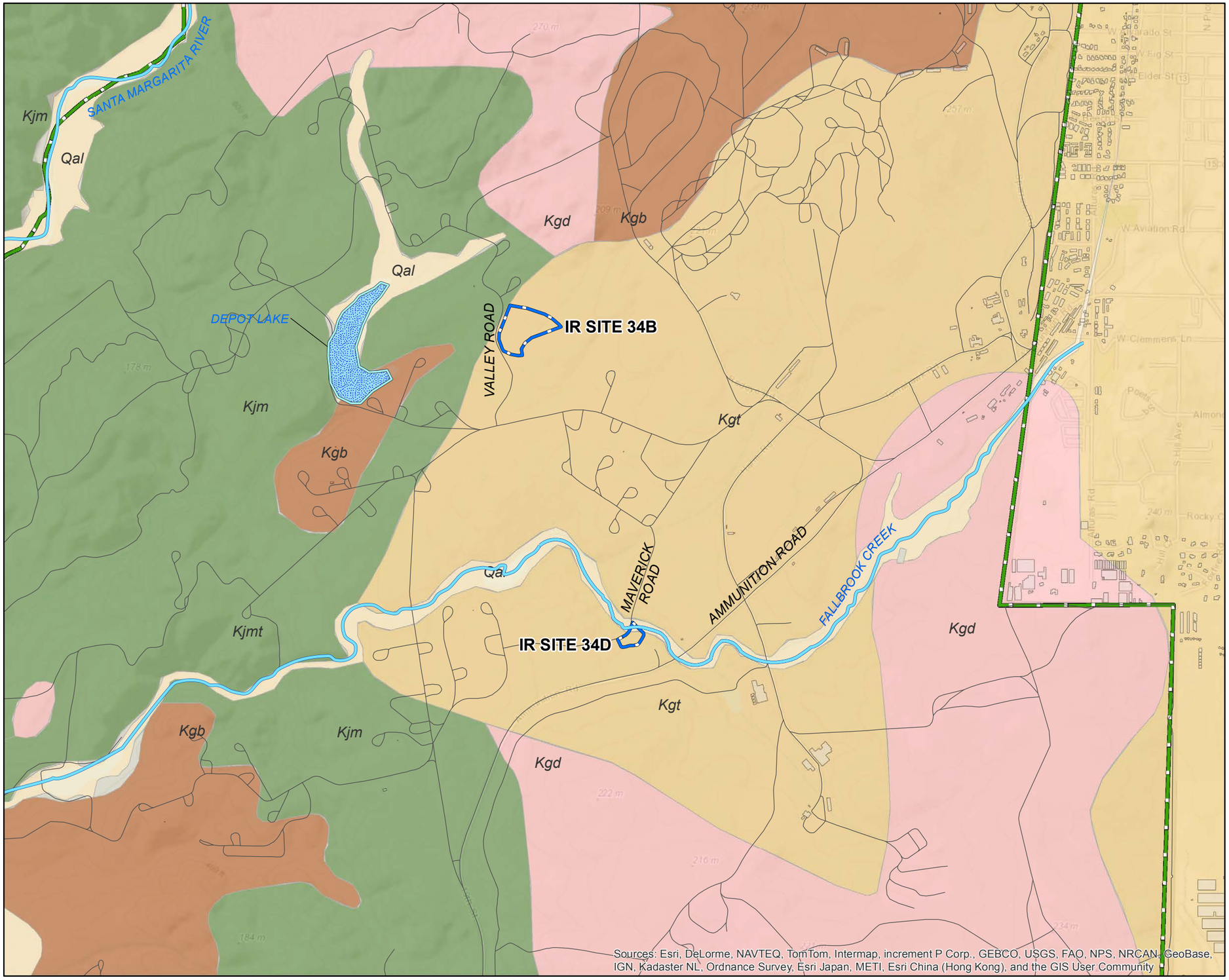

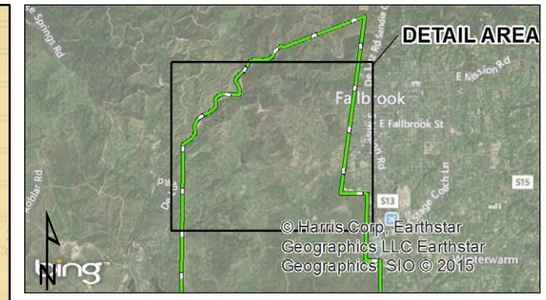

LEGEND

- Kjm - METAVOLCANICS
- Kgb - DIORITE/GABBRO
- Kgt - TONALITE
- Kgd - GRANODIORITE
- Qal - ALLUVIUM
- IR SITE BOUNDARY
- NAVAL WEAPONS STATION SEAL BEACH DETACHMENT FALLBROOK

GRAPHIC SCALE

0 750 1500 3000

(IN FEET)
1 INCH = 1500 FEET

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FIGURE 4

SITE GEOLOGY AND HYDROGEOLOGY

TREVET

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DELIVERY ORDER: 0096

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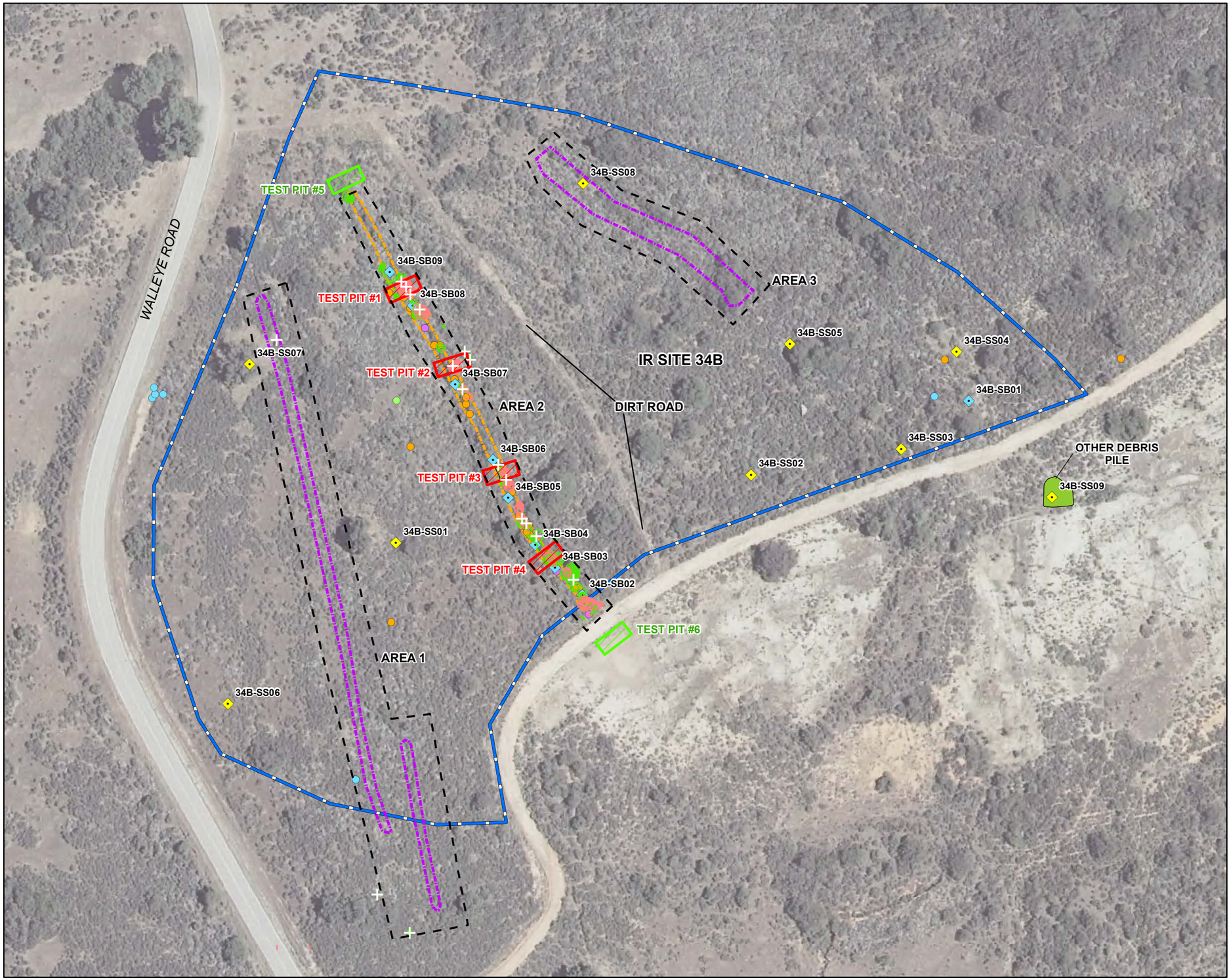

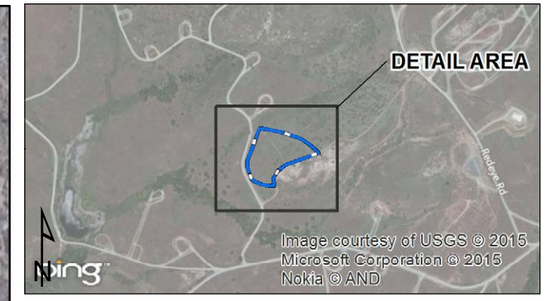

LEGEND

- METAL JUNK AT SURFACE (GEOPHYSICAL)
- MAGNETIC ANOMALIES (IDENTIFIED IN SI)
- METAL DEBRIS (IDENTIFIED IN SI)
- CONSTRUCTION DEBRIS (IDENTIFIED IN SI)
- OTHER DEBRIS (IDENTIFIED IN SI)
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PROPOSED WASTE TEST PIT
- PROPOSED EXPLORATORY TEST PIT
- WASTE DISPOSAL TRENCH
- MAGNETIC ANOMALIES (GEOPHYSICAL)
- EM ANOMALIES (GEOPHYSICAL)
- PREVIOUSLY SUSPECTED TRENCH AREA
- GEOPHYSICAL INVESTIGATION AREA
- IR SITE 34B BOUNDARY

SOURCE:
GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

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FIGURE 5

PROPOSED TEST PIT LOCATIONS AT IR SITE 34B

TREVET

DATE: APRIL 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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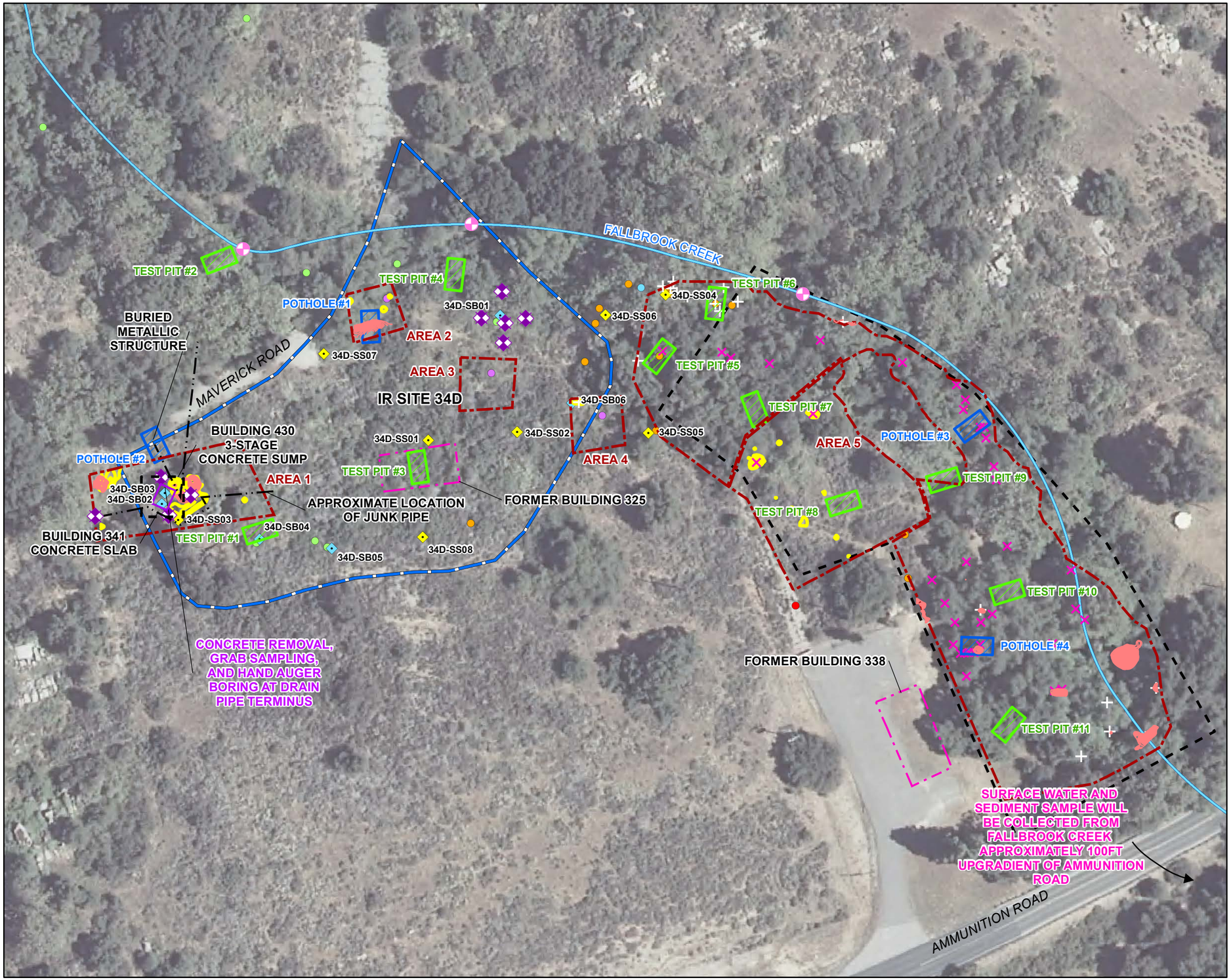

LEGEND

- METAL JUNK SUBSURFACE (GEOPHYSICAL)
- METAL JUNK AT SURFACE (GEOPHYSICAL)
- MAGNETIC ANOMALIES (IDENTIFIED IN SI)
- 5.56-MM BLANK CASING (IDENTIFIED IN SI)
- METAL DEBRIS (IDENTIFIED IN SI)
- CONSTRUCTION DEBRIS (IDENTIFIED IN SI)
- OTHER DEBRIS (IDENTIFIED IN SI)
- PROPOSED HAND AUGER BORING
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATION
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PROPOSED EXPLORATORY TEST PIT
- PROPOSED POTHOLE TEST PIT
- MAGNETIC ANOMALIES (GEOPHYSICAL)
- EM ANOMALIES (GEOPHYSICAL)
- GEOPHYSICAL SURVEY AREA
- FORMER BUILDING
- OFFSITE INVESTIGATION AREA
- IR SITE34D BOUNDARY

SOURCE: GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE

0 50 100 200

(IN FEET)
1 INCH = 100 FEET

N

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NAVAL WEAPONS STATION SEAL BEACH
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FIGURE 6

PROPOSED TEST PIT LOCATIONS AT IR SITE 34D

TREVET

DATE: APRIL 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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Attachment 1: Field Forms

Borehole Log
Test Pit Log
Field Calibration Form
Chain-of-Custody Form

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TREVET

Borehole Log

Project Name:	**Project Number:**	**Borehole ID:**
Borehole Location:	*Northing:* *Easting:*	Sheet: of
Drilling Company:	**Driller(s):**	
Drilling Equipment:	**Date Started:**	**Total Depth:** feet
Drilling Method:	**Date Finished:**	**Bedrock Depth:** feet
Drilling Fluid:	**Depth to Groundwater During Drilling:** feet	
Completion Information:	**Static Depth to Groundwater:** feet	
	Ground Elev.: feet (amsl)	**TOC Elevation:** feet (amsl)
	Logged By:	**Checked By:**

Depth (feet)	Samples				Field Analyses			Log		Lithologic Description	Remarks
	Location	Number	Type	Time	PID Sample (ppm)	PID Breathing Zone (ppm)	Additional Tests	Graphic	USCS		
2											
4											
6											
8											
10											
12											
14											
16											
18											
20											
22											
24											

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TEST PIT STRATIGRAPHY LOG

Page ___ of ___

Project Name:	**Contractor:**	**Test Pit Designation:**
Project Number:		**Date Started:**
Client:	**Surface Elevation:**	**Date Completed:**
Location:	**Test Pit Method:**	**CRA Supervisor:**

Depth (m/ft)			***Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors***	***Sample No.***	***Sample Interval***	***PID***	***Location:***
From	***At***	***To***					***Geologic Profile***

Completed by: _____ Date: _____

CRA

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Daily Calibration Log - PID

Job Number/Name: _____

Calibration gas/standard (ppm): ____Isobutylene 100 ppm_____

PID Serial Number	Date	Background (ppm)	Adjusted Background (ppm)	Initial Gas (ppm)	Cal'd Gas (ppm)	Initials

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TREVET
9888 Carroll Centre Road, Suite 228
San Diego, CA 92126

CHAIN-OF-CUSTODY RECORD

COC NUMBER _____-_____
mmdd

PROJECT NAME	PURCHASE ORDER NO.
PROJECT LOCATION	PROJECT NO.
SAMPLER NAME	AIRBILL NUMBER
	PROJECT CONTACT PHONE NUMBER

ANALYSES REQUIRED

LABORATORY NAME
EMAX
(310) 618-8889

LABORATORY ID
(FOR LABORATORY)

SAMPLE ID	DATE COLLECTED	TIME COLLECTED	NO. OF CONTAINER	LEVEL 3	LEVEL 4	TYPE	TAT															**COMMENTS**

RELINQUISHED BY (Signature)	DATE	RECEIVED BY (Signature)
COMPANY	TIME	COMPANY
RELINQUISHED BY (Signature)	DATE	RECEIVED BY (Signature)
COMPANY	TIME	COMPANY
RELINQUISHED BY (Signature)	DATE	RECEIVED BY (Signature)
COMPANY	TIME	COMPANY

SAMPLE CONDITION UPON RECEIPT (FOR LABORATORY)
TEMPERATURE: _____ SAMPLE CONDITION: ☐INTACT ☐BROKEN
COOLER SEAL: ☐INTACT ☐BROKEN

SAMPLING COMMENT:

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Attachment 2: Analytical Laboratory Standard Operating Procedures

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STANDARD OPERATING PROCEDURES

VOLATILE ORGANICS BY GC/MS

SOP No.:	EMAX-8260	Revision No.	10	Effective Date:	06-Jun-14
Prepared By:	Souzan Greas			Date:	06-04-14
Approved By:	Kenette Pimentel QA Manager			Date:	06.04.14
Approved By:	Caspar Pang Laboratory Director			Date:	06-04-14

Control Number: 8260-10-

1.0 SCOPE AND APPLICATION

1.1. This analytical method is used to determine the concentration of volatile organic compounds whose boiling points are below 200°C and are water insoluble or slightly water-soluble found in solid or liquid samples. The list of compounds is summarized in Tables 6 and 7. Additional analytes may be added after verification.

1.2. This SOP is an adaptation of SW846 Method 8260B.

2.0 SUMMARY OF METHOD

2.1. A measured sample is extracted using a purge and trap concentrator system. The extract is introduced to a temperature-programmed GC. The analytes are eluted through the GC column separating each analyte relative to its volatility. These analytes are captured and ionized by the mass spectrometer. The ionized fragments are measured by mass to charge ratio. Analyte qualitative identification is based on the characteristic electron impact mass spectra. Analyte quantitative identification is based on the response of the major ion relative to an internal standard using a multi-point calibration curve.

2.2. **Interferences**

2.2.1. Contamination may occur by diffusion of volatile organics (particularly chlorofluorocarbons and methylene chloride) through sample container septum during shipment and storage. Trip blanks and storage blanks can serve as means of monitoring.

2.2.2. Glassware and other sample processing materials in which the samples come into contact with are possible sources of contamination. All glassware and other materials used must be purchased pre-cleaned or decontaminated prior to use.

2.2.3. Solvents and reagents are possible sources of contamination. All solvents and reagents must be GC grade and must pass the QC checks prior to use.

2.2.4. Contamination by carry-over can occur whenever high concentration samples are analyzed in sequence with a low concentration sample. To reduce potential carry-over, the concentrator must be thoroughly baked-out between samples and the sample syringe and purging device must be thoroughly rinsed with an appropriate solvent between samples.

2.2.5. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Table 6 and Table 7 for established DL, LOD and LOQ levels.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and requires dilution to properly quantitate.

4.2. The concentration in the diluted sample should be at or above the project reporting limit. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. **Typical Dynamic Range**

4.3.1. Water: 5 µg/L to 200 µg/L (5 ml purge)

1 µg/L to 40 µg/L (25 ml purge)

4.3.2. Soil: 5 µg/kg to 200 µg/kg

5.0 SAMPLE HOLDING TIME & PRESERVATION

5.1. **Aqueous Samples**

5.1.1. Samples received in the laboratory are expected to be contained in 40 ml vials with teflon lined septa with zero headspace.

Note: The size of any bubble caused by degassing upon cooling the sample must not exceed 6 mm.[1]

5.1.2. Samples must be stored at ≤ 6°C without freezing.

5.1.3. Samples preserved in HCL must be analyzed within 14 days from the date of sampling. Samples with no chemical preservative must be analyzed within 7 days from the date of sampling.

5.1.4. If Acrolein and Acrylonitrile are target analytes, samples must be analyzed within 14 days if preserved with $Na_2S_2O_3$ to pH 4-5. Samples received unpreserved must be analyzed with 3 days from sampling date[2].

5.2. **Soil Samples**

5.2.1. Samples received in glass jars or brass tubes must be stored at ≤ 6°C without freezing. Samples for low level and extracted in methanol for high level must be analyzed within 14 days from sampling date.

5.2.2. Samples received in encore tubes may be frozen, preserved with sodium bisulfate or extracted with methanol prior to analysis.

[1] Referenced from SW846 Method 5030B, Section 6.1.
[2] Reference: 40CFR Table 11 Footnote 10

- Encore samples to be frozen must be analyzed within 14 days from sampling date.
- Encore samples to be preserved with sodium bisulfate for low level and extracted with methanol for high level must be done within 48 hours and analyzed within 14 days from sampling date.
- Preserved samples and extracts must be stored at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

6.1. EMAX-5030 Purge and Trap

6.2. EMAX-5035 Closed-System Purge and Trap

6.3. EMAX-DM01 Data Flow and Review

6.4. EMAX-QA04 Detection Limit (DL)

6.5. EMAX-QA05 Training

6.6. EMAX-QA08 Corrective Action

6.7. EMAX-QC01 Quality Control for Chemicals

6.8. EMAX-QC02 Analytical Standard Preparation

6.9. EMAX-QC07 Glassware Cleaning

6.10. EMAX-SM01 Sample Management

6.11. EMAX-SM03 Waste Disposal

6.12. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all SDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of the body, rinse the affected body part thoroughly with copious amounts of water. If irritations or any other discomfort related to the incident persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS & REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	HP 5890 Series II or equivalent
Detector	HP 5971 MSD or equivalent

Column	RTX 502.2 (0.32 mm x 60 m), 1.8 µm thickness or equivalent after verification that the four gases (chloromethane, bromomethene, chloroethane, and vinyl chloride) can be resolved > 90% from each other in the total ion chromatogram
Data Acquisition Software	ChemStation or equivalent
Purge & Trap Device	OI 4560/Encon Evolution/EST or equivalent
Multiple purging module	Archon/Centurion or equivalent
Gases	Ultra-high purity helium/Air
Syringes	5 ml, 25 ml Luerlok gas-tight
Microsyringes	1, 10, 20, 25, 50, 100 and 1000 µl (Hamilton 702N or equivalent)
Volumetric Flasks	2, 5, 10, 50 and 100 ml with ground glass stopper
Heated Sparge	Archon or Automatic sample heating jacket or equivalent

8.2. **Chemicals and Reagents**

Extraction Solvent	Purge & Trap Grade Methanol or equivalent
Reagent Water	Organic-free water
Reagent Soil	Organic-free Ottawa Sand or equivalent
Preservative	Sodium Bisulfate

9.0 STANDARDS

9.1. Standard preparation for VOA is summarized in Tables 1 to 4. Refer to EMAX-QC02 for proper analytical standard preparation and EMAX-SM04 for proper labeling. Other concentration levels may be prepared as long as it complies with the method and/or project requirements.

9.2. **Stock Standard**

9.2.1. Purchase Stock Standards as certified solutions.

9.2.2. Purchase one set of calibration standard (refer to Table 1) for calibration and a secondary source Stock Standard for calibration verification (refer to Table 2).

9.2.3. Purchase Surrogate Mix at 2500 mg/L and Internal Standard at 2500 mg/L (refer to Table 3).

9.2.4. Purchase BromoFluorobenzene (BFB) as Tuning Standard at 5000 mg/L (refer to Table 4).

9.2.5. After opening, transfer in inert vials with minimal headspace and store at -10°C to -20°C.

9.3. **Intermediate Standards**

9.3.1. Using the stock standard solutions, prepare intermediate standards in methanol according to Tables 1 to 4 and store with minimal headspace in an inert vial.

9.4. **Initial Calibration Standards (ICAL)**

9.4.1. ICAL for 5 ml Purge

9.4.1.1. Using intermediate standards (refer to Tables 1 and 3), prepare multi calibration standards (minimum of five different concentrations) in reagent water as suggested below.

Calibration Pt.	VOA (µg/L)*	Surrogate (µg/L)	Internal Std (µg/L)
1	5	5	50
2	10	10	50
3	20	20	50
4	50	50	50
5	100	100	50
6	200	200	50

** Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.*

9.4.2. ICAL for 25 ml Purge

9.4.2.1. Using intermediate standards (refer to Tables 1 and 3), prepare multi calibration standards (minimum of five different concentrations) in reagent water as suggested below:

Calibration Pt.	VOA (µg/L)*	Surrogate (µg/L)	Internal Std (µg/L)
1	0.5	0.5	10
2	1	1	10
3	2	2	10
4	10	10	10
5	20	20	10
6	40	40	10

** Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.*

9.5. **Initial Calibration Verification Standard (ICV)**

9.5.1. Using the Intermediate Standard prepared from the secondary source (refer to Tables 2 and 3), spike into 5 ml or 25 ml purge in reagent water as suggested below.

9.5.1.1. ICV for 5 ml purge

ICV	VOA* (µg/L)	Surrogate (µg/L)	Internal Standard (µg/L)
5 ml	50	50	50

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.5.1.2. ICV for 25 ml purge

ICV	VOA* (µg/L)	Surrogate (µg/L)	Internal Standard (µg/L)
25 ml	10	10	10

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Using the Intermediate Standard prepared from the same source as the ICAL Standard (refer to Tables 1 and 3), spike into 5 ml or 25 ml purge in reagent water as suggested below.

9.6.1.1. DCC for 5 ml purge

DCC	VOA* (µg/L)	Surrogate (µg/L)	Internal Standard (µg/L)
5 ml	50	50	50

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.6.1.2. DCC for 25 ml purge

DCC	VOA* (µg/L)	Surrogate (µg/L)	Internal Standard (µg/L)
25	10	10	10

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.7. **LCS and Matrix Spike Standard**

9.7.1. For spike standards, use the Intermediate Standard prepared from the secondary source (refer to Tables 2 and 3), spike into the 5 ml or 25 ml purge sample as suggested below (unless otherwise specified by the project). Spike 5 ml or 25 ml reagent water for LCS water or 5 g reagent soil in 5 ml reagent water for LCS soil.

9.7.1.1. LCS and Matrix Spike for 5 ml purge

LCS or MS/MSD	VOA* (µg/L)	Surrogate (µg/L)	Internal Standard (µg/L)
5 ml	50	50	50

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.7.1.2. LCS and Matrix Spike for 25 ml purge

LCS or MS/MSD	VOA* (µg/L)	Surrogate (µg/L)	Internal Standard (µg/L)
25 ml	10	10	10

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

10.0 PROCEDURES

10.1. Sample Preparation

10.1.1. For aqueous samples, refer to EMAX-5030.

10.1.1.1. Check the pH and presence of residual chlorine from remaining sample. Record samples with pH ≥ 2 and residual chlorine ≥ 5 mg/L in the analysis log.

10.1.2. For soil samples, refer to EMAX-5035.

10.2. Instrument Parameters

10.2.1. From the main gas supply (gas Tanks) regulate gas pressure at 80 psi.

10.1.1. Fine-tune the instrument guided by the parameter conditions suggested below. Adjust the parameter conditions accordingly to obtain optimum condition. Print the instrument parameter and post it on the instrument for daily routine maintenance check.

10.2.2. Typical GC Parameters

Carrier gas flow (column) helium	1 – 5 ml/min
Initial Temp	35°C; hold for 1 min.
Rate 1	8°C/min. to 160°C/min
Rate 2	30°C/min to 230°C/min; hold for 3 min.
Inject Port	200°C
Interface	250°C

10.2.3. Mass Spectrometer Parameter

Scan Start	0.5 min.
Mass Range	35 to 300
Multiplier	1200 to 2700

10.2.4. Typical Purge and Trap Condition

10.2.4.1. Purge samples at 40°C for 11 minutes, desorbed at 250°C for 2 minutes and then bake the trap at 260°C for 11 minutes.

10.3. Calibration

10.3.1. Set GC/MS operating condition as described in Section 10.2.

10.3.2. Perform Tune Check

10.3.2.1. Introduce a BFB to yield 5 – 50 ng by either direct injection or purge and trap in 5 ml or 25 ml organic-free water (using tuning standard). Refer to table 4.

10.3.2.2. Evaluate the tune check by the highest scan on the peak or the average of at least 3 scans (before, at and after the apex) with a background subtraction using a single scan no more than 20 scans prior to the elution of BFB.

10.3.2.3. Check Table 5 for acceptance criteria or follow the manufacturer's recommendation for tuning. A valid tune check expires after 12 hours.

10.3.2.4. If non-compliant refer to Section 12 for corrective action.

10.3.3. Initial Calibration (ICAL)

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Optimize the instrument condition prior to ICAL

- Ensure that instrument parameters are set up properly
- Ensure that there is no evidence of leak
- Ensure that instrument maintenance is performed on schedule
- Ensure that instrument tune check and column performance is not indicative that it is at the threshold of failing the acceptance criteria

10.3.3.3. Analyze a multi-point initial calibration curve as suggested in Figure 3 after a valid tune check.

10.3.3.4. Base quantitation of identified compounds on the integrated abundance from the EICP of the assigned primary characteristic ion (refer to Tables 6 and 7). For optimum output, assign internal standard to each compound based on the nearest retention time or as suggested on Tables (6 and 7).

10.3.3.5. Evaluate the ICAL Acceptance

10.3.3.5.1. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary

10.3.3.5.2. Evaluate retention time of each analyte with respect to the nearest internal standard. The relative retention time (RRT) of each analyte should agree within ± 0.06 RRT units.

10.3.3.5.3. At a minimum, evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.3.5.4. Check RSD and correlation coefficient. If more than 10% of the compounds included with the initial calibration exceed the 15% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Perform necessary instrument maintenance and repeat calibration. Refer to 10.3.3.2, Section 12 for corrective action.

10.3.3.6. Application of ICAL Curve for Quantitation

10.3.3.6.1. Generate a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRFm), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq.-10.5.1.1, Eq.-10.5.1.2, Eq.-10.5.1.6 and Eq.-10.5.1.7 respectively.

10.3.3.6.2. If RSD is ≤ 15% average response factor may be applied.

10.3.3.6.3. Apply Inverse Weighting Factor ($1/y$ or $1/y^2$; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 15% and correlation coefficient of ≥ 0.995.

10.3.3.6.4. Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 15% and correlation coefficient of ≥ 0.995.

10.3.3.6.5. It may be appropriate to force the regression through zero for specific analytes[3]. When exercising this option [as included in the data acquisition software], make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. Initial Calibration Verification (ICV)

10.3.4.1. Analyze ICV to verify the concentration of the ICAL standards (refer to Section 9.5).

10.3.4.2. Check for completeness of analytes as described in Section 10.4.3.

10.3.4.3. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.4.4. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

[3] SW846 Method 8000B, Section 7.5.3

10.3.4.5. Refer to Appendix 1 for ICV acceptance criteria and/or corrective action.

10.3.4.6. When non-compliant refer to Section 12 for corrective action.

10.3.5. Daily Continuing Calibration (DCC)

10.3.5.1. Analyze DCC to check the validity of the ICAL (refer to 9.6).

10.3.5.2. Check for completeness of analytes as described in Section 10.4.3.

10.3.5.3. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.5.4. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.5.5. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.5.6. Establish RRF of each analyte, calculate %D (Eq.-10.5.2.1) against the ICAL.

10.3.5.7. Refer to Appendix 1 for DCC acceptance criteria and/or corrective action.

10.3.5.8. When non-compliant refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. Analytical Sequence

10.4.1.1. Analyze BFB and evaluate tuning

10.4.1.2. Analyze DCC and check ICAL validity

10.4.1.3. Analyze Lab Control Sample

10.4.1.4. Analyze Lab Control Sample Duplicate (if required)

10.4.1.5. Analyze Method Blank

10.4.1.6. Analyze samples to a maximum number of 12-hours from the time of BFB injection.

10.4.1.7. Analyze a pair of matrix spikes (MS/MSD) for every 20 samples of the same matrix.

10.4.1.8. Record analytical sequence in the analysis log.

10.4.2. Sample Result Evaluation

10.4.2.1. Check the QC criteria as soon as the data is available.

- ✓ Check method blank. If result is non-compliant and analyte in question is not detected in any sample or contamination is < 10X of the sample concentration, results maybe reportable. Verify with the PM if results can be reported.
- ✓ Compare the retention times of each Internal Standards (IS) to the ICAL mid point (must be ± 30 seconds).

- ✓ Compare the area of each IS acquired against the mid point of the ICAL. The Extracted Ion Current Profile (EICP) must be within a factor of two (-50 to +100%).
- ✓ Check concentration of target analytes if calibration range is exceeded.
- ✓ Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 QC limits.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. Note observations on the analysis log. When results arise to questionable result, e.g. inconsistency from the first analysis, consult the Supervisor for further action.

10.4.2.2. Properly fill up the analysis log.

10.4.3. Qualitative Identification

- The intensities of the characteristic ions maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Investigate visible peaks in the chromatogram that were not identified in the data output. Manually integrate the peak if necessary. For manual integration refer to EMAX-DM01.
- Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.[4]

10.4.3.1. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification[5] (TIC). Execute LSC (Chem Station program) to initiate the library search using NIST/EPA/MSDC mass spectral library. Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting following the guidelines below.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within + 20%. Example: for an ion with an abundance of 50% of the standard spectra, the corresponding sample ion abundance must be between 30 and 70%.

[4] SW846 Method 8260B, Section 7.6.1.4

[5] Library search is performed only when indicated in the PSR.

- Molecular ions present in reference spectrum should be present in sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting analytes.
- Ions present in the reference spectrum but not present in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting analytes. Data system library reduction programs can sometimes create these discrepancies.

10.4.3.2. **Reporting TICs**

- If the library search produces a match at or above 85%, report the analyte.
- If the library search produces more than one analyte at or above 85%, report the first analyte (highest).
- If the library search produces no matches at or above 85%, the compound should be reported as unknown.

10.4.4. Quantitation

10.4.4.1. Apply the appropriate quantitation method (Section 10.3.3.6). Calculate the concentration of any positively identified target analyte using Eq.-10.5.3. Apply the dilution factor for diluted samples to calculate for the final concentration of the sample.

10.4.5. Manual Integration

10.4.5.1. Refer to EMAX-DM01, Manual Integration Section.

10.4.6. Dealing with Carryover

10.4.6.1. Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

10.4.6.2. If there is no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.

10.4.6.3. If there is any target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.6.4. To clean-up the autosampler purge line consider purging a 25 ml or 5 ml sample spiked with 100 µl of methanol and let it run like a blank sample. If improved result is noted repeat this process until no evidence of contamination is observed. Otherwise inform the Supervisor for further instruction.

10.5. **Calculations**

10.5.1. Initial Calibration

10.5.1.1. **Calculate for the Relative Response Factor (RRF)**

$$RRF = \frac{A_X C_{IS}}{A_{IS} C_X}$$ Eq.-10.5.1.1

where:

A_X – Area of characteristic ion for the compound being measured
A_{IS} – Area of characteristic ion for the specific internal standard
C_X – Concentration of the compound being measured
C_{IS} – Concentration of the specific internal standard

10.5.1.2. **Calculate for the Average Relative Response Factor (RRF_m)**

$$RRF_m = \frac{\sum RRF}{n}$$ Eq.-10.5.1.2

where:

$\sum RRF$ – Summation of response factors
n – Number of measurements

10.5.1.3. **Calculate for Least Square Linear Regression**

$$y = ax + b$$ Eq.-10.5.1.3

where:

y – Response ratio (A_X/A_{IS})
x – Amount ratio (C_X/C_{IS})
a – x1 = slope of the line

$$a = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$

where:

$\bar{x}$ = average of amount ratios
$\bar{y}$ = average of response ratios

b – x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.5.1.4. **Calculate for Inverse Weighting Factor**

$$y = ax + b$$ Eq.-10.5.1.4

where:

y – Response ratio (A_X/A_{IS})
x – Amount ratio (C_X/C_{IS})
a – x1 = slope of the line

$$a = \frac{\sum (x-x_a)(y-y_a)}{\sum (x-x_a)^2}$$

where:

$$x_a = \sum \left[x(1/x) / \sum (1/x) \right]$$
$$y_a = \sum \left[y(1/x) / \sum (1/x) \right]$$

or $x_a = \sum\left[x(1/x^2)/\sum(1/x^2)\right]$

$y_a = \sum\left[y(1/x^2)/\sum(1/x^2)\right]$

b – x0 = intercept of the line

$b = y_a - a * x_a$

10.5.1.5. **Calculate Inverse Quadratic**

$y = ax^2 + bx + c$

where:

y – Resp_Ratio =**x0** + **x1** * Amt_Ratio + **x2** * (Amt_Ratio)^2

x – Amt_Ratio

c – **x0**=Det 0/Det b

b – **x1**=Det 1/Det b

a – **x2**=Det 2/Det b

$$W_i = \frac{\frac{1}{x_i}}{\sum_{i=1}^{n}\frac{1}{x_i}}$$

where:

X_i = amount ratio= Conc of Std/Conc of IS

Y_i = response ratio=Resp of Std/Resp of IS

Wi= 1/X)/SUM(1/X)

<X>= SUM(W_i*X_i)

<Y>= SUM(W_i*Y_i)

<XX>= SUM(W_i*(X_i)^2)

<XXX>= SUM(W_i*(X_i)^3)

<XXXX>= SUM(W_i*(X_i)^4)

<YY>= SUM(W_i*(Y_i)^2)

<XY>= SUM(W_i*X_i*Y_i)

<XXY>= SUM(W_i*(X_i)^2*Y_i)

<Yd2>= SUM((Y_i-<Y>)^2*W_i)

Ye= x0+x1*X_i+x2*X_i^2-<Y>)

<Ye2>= SUM(Ye^2*W_i)

Det b

1	<X>	<XX>
<X>	<XX>	<XXX>
<XX>	<XXX>	<XXXX>

Det 0

1	<X>	<XX>
<X>	<XX>	<XXX>
<Y>	<XY>	<XXY>

Det 1

1	<X>	<XX>
<Y>	<XY>	<XXY>
<XX>	<XXX>	<XXXX>

Det 2

<Y>	<XY>	<XXY>
<X>	<XX>	<XXX>
<XX>	<XXX>	<XXXX>

r2= <Ye2>/<Yd2>

ccf2= $(r2)^{1/2}$

10.5.1.6. **Calculate the Standard Deviation (SD)**

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \qquad \text{Eq.-10.5.1.6}$$

where:

x_i – Result at i^{th} measurement

$\bar{x}$ – Mean of the n measurements

n – Number of measurements

10.5.1.7. **Calculate the % relative standard deviation (%RSD)**

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \text{Eq.-10.5.1.7}$$

where:

SD – Standard deviation

RRF_m – Average response factor

10.5.1.8. **Calculate the relative retention time (RRT)**

$$\text{RRT} = \frac{\text{Retention Time of the Analyte}}{\text{Retention Time of the Internal Standard}} \qquad \text{Eq.-10.5.1.8}$$

10.5.2. Calibration Check/Continuing Calibration

10.5.2.1. **Calculate Percent Difference (%D)**

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \text{Eq.-10.5.2.1}$$

where:

RRF_c – Response factor from continuing calibration standard
RRF_m – Average response factor

10.5.2.2. **% Drift**

$$\%Drift = \frac{[found\ Conc. - true\ Conc]}{true\ Conc.} * 100\% \qquad \text{Eq.-10.5.2.2}$$

10.5.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples)

10.5.3.1. When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.5.3.2. **Water Samples**

$$Concentration\ (ug/L) = \frac{(Ax)(Is)}{(Ais)(RRF_m)}\ x\ DF \qquad \text{Eq.-10.5.3.2}$$

where:

A_x – Area of characteristic ion for the compound to be measured
I_s – Concentration of internal standard added in µg/L
A_{is} – Area of characteristic ion for the internal standard
RRF_m – Average response factor
DF – Dilution factor = $\frac{purge\ volume\ in\ ml\ \ (5\ ml\ or\ 25\ ml)}{sample\ \ amount\ \ in\ ml}$

10.5.3.3. **Soil/Sediment Samples (Dry weight basis)**

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad \text{Eq.-10.5.3.3}$$

where:

A_x – Area of characteristic ion for the compound to be measured
I_s – Concentration of internal standard added in µg/L
A_{is} – Area of characteristic ion for the internal standard
RRF_m – Average response factor
DF – Dilution factor = $\frac{5\ g}{(sample\ \ amount\ \ in\ g)}$
DW – % solid = $\frac{100 - \%moisture}{100}$

10.5.3.4. **Extracted Soil/Sediment Samples (Dry weight basis)**

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad \text{Eq.-10.5.3.4}$$

where:

A_x – Area of characteristic ion for the compound to be measured

I_s – Concentration of internal standard added in µg/L

A_{is} – Area of characteristic ion for the internal standard

RRF_m – Average response factor

DF – Dilution factor

$$\frac{(purged\ \ volume\ \ in\ \mu L)(5\,g)}{(extract\ \ aliquot\ \ in\ \mu L)(sample\ \ amount\ \ in\ g)}$$

DW – % solid = $\frac{100 - \%moisture}{100}$

10.5.4. Alternatively, the regression line (area ratio of Ax/Ais versus concentration using first degree) fitted to the initial calibration may be used for determination of the sample concentration when RSD of the analyte is greater than 15% (Section 10.3.3.6) .

10.5.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.5.5.1. The area Ax and Ais are derived from total ion chromatogram. Ais refers to the closest internal standard (IS) free of interference.

10.5.5.2. RRF of the TIC is 1.

10.5.6. Method Proficiency

10.5.6.1. **Percent Recovery**

$$\%\,\mathrm{Re}\,\mathrm{cov}\,ery = \frac{(C_f - C)}{C_s} \times 100 \qquad \text{Eq.-10.5.6.1}$$

where:

C_f – Concentration found

C – Concentration of sample (use 0 for LCS)

C_s – Concentration of spike

10.5.6.2. **Relative Percent Difference (RPD)**

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.6.2}$$

where:

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Make a copy of the analysis log.

10.6.2. Print a copy of the sample weight log (if any).

10.6.3. Highlight the data to be reported.

10.6.4. Print a copy of the raw data and the QC report.

10.6.5. Collate the reportable raw data separating the QC results from the sample results.

10.6.6. Keep all other data generated with the analytical folder marked with "For record only".

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe.

10.7.2. Generate the sample results using F1NV3C.exe or F1NV3C4.exe.

10.7.3. Generate the QC summary using QCV3CN.exe or QCV3CN4.exe.

10.7.4. Generate the Instrument Performance Check (ICAL and DCC) using F5VOA.exe.

10.7.5. Generate the IS and RT summary using F8VC.exe.

10.7.6. Generate Lab Chronicle using LABCHRN1.exe

10.7.7. Generate Case Narrative using CN1.exe

10.7.8. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

10.7.8.1. Case Narrative

10.7.8.2. Lab Chronicle

10.7.8.3. Sample Results

10.7.8.4. Method Blank Results

10.7.8.5. LCS/LCSD Summary

10.7.8.6. MS/MSD Summary

10.7.8.7. Instrument Performance Check (ICAL)

10.7.8.8. ICAL Summary

10.7.8.9. ICV Summary

10.7.8.10. Instrument Performance Check (DCC)

10.7.8.11. IS and RT Summary

10.7.8.12. DCC Summary

10.7.8.13. Analysis Log

10.7.8.14. Sample Weight Log (if any)

10.7.8.15. Non-Conformance Report (If any)

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01and the PSR.

10.8.1.1. If any of the checkpoints below indicates a problem, re-analysis is required.

- ✓ Check internal standard area. They should be within -50 to +100% of ICAL midpoint to be acceptable, otherwise follow PSR.

- ✓ Check retention time of each IS to the ICAL midpoint. They should be within ± 30 seconds to be acceptable, otherwise follow PSR.
- ✓ Check surrogate recoveries against project specific criteria (PSR). In the absence of PSR, default to in-house QC limits.
- ✓ Check concentration of target analytes if calibration range is exceeded.

10.8.1.2. Review the attached logs that they are properly filled.

10.8.1.3. Check the generated reports against the raw data. Check that the analytical data generated indicating positive results are qualitatively and quantitatively correct.

10.8.1.4. Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.2. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Perform instrument routine preventive maintenance and record on instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction that may affect data quality.

10.9.2. The table below list suggested routine maintenance schedule.

Task	Every Day	Every Week	Every Month	Every 3 Months	Every 6 Months	As Needed
Tune Check	✓					
Check gas cylinders pressure	✓					
Check the foreline pump oil level		✓				
Check the calibration vial						✓
Check and if necessary, change injection port liners, septa and O-rings.					✓	
Replace the foreline pump oil					✓	
Replace the diffusion pump fluid					✓	
Replace the traps and filters					✓	
Clean the ion source						✓
Change the carrier gas trap(s) and purifier						✓
Replace column						✓
AutoTune the MSD						✓
Replace the worn out parts						✓

11.0 QUALITY CONTROL

11.1. **Analytical Batch QC**

11.1.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.1.2. Perform initial calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest.

11.1.3. Establish retention time window position for each analyte every after ICAL for proper qualitative identification.

11.1.4. Perform initial continuing calibration verification (ICV) every after ICAL to verify accuracy of ICAL.

11.1.5. Perform continuing calibration verification (CCV) every 12 hours to verify that instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.1.6. Evaluate relative retention time for each analytes in every sample to be within ± 0.06 RRT units.

11.1.7. Verify internal standard (IS) for quantitative accuracy and that its Retention time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -50% to +100% of ICAL midpoint standard.

11.1.8. Evaluate surrogate recovery to monitor instrument response on every sample.

11.2. **Preparation Batch QC**

11.2.1. Reagent water used for IB shall be of the same source for all QC samples and sample dilutions.

11.2.2. Analyze MB, LCS, MS/MSD and < 20 field samples.

11.2.3. Solvents and reagents must undergo quality control check prior to its use. Refer to EMAX-QC01 for details.

11.2.4. Properly treat lab wares used in the sample preparation as specified in EMAX-QC07.

11.3. **Method QC**

11.3.1. All analytes reported must have a valid DL, LOD and LOQ as described in EMAX-QA04.

11.3.2. All analysts conducting this analysis must demonstrate capability (IDOC/DOC) as described in EMAX-QA05.

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency and acceptance criteria.

12.0 CORRECTIVE ACTION

12.1. Corrective action for each Quality Control procedure is summarized in Appendix 1.

12.2. **Analytical Batch QC**

12.2.1. Tune Check – If tune check is non-compliant consider the following suggestion to correct the problem:

- Check the abundance of mass 95 and 174. If it is significantly less than previous tune checks, it is indicative of insufficient amount of BFB injected. Probable causes are:

improper spiking, leaks, standard degradation or low vacuum system. Repeat tune check ensuring that BFB was properly spiked or rule out leaks, prepare a fresh BFB standard and repeat the tune check.

- If problem persist, re-tune the instrument and repeat tune check.
- If problem is unresolved, inform the supervisor for further action.

12.2.2. Initial Calibration

12.2.2.1. If the %RSD is out of acceptance criteria, consider the following suggestions to correct the problem.

- If one of the standards returns a bias low or bias high on all of the analytes then that point is considered an out-liner. Prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias low or bias high response or the peaks are not distinct and sharp, drop the lowest point.

Note : The lowest calibration point identifies the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects where the ICAL will be used.

12.2.2.2. If instrument problem is suspected, consider the following suggestion to correct the problem:

- Check the connection and make sure they are air tight and perform maintenance as needed.
- Check the gas flow.
- Re-tune the MS.
- Prepare a fresh standard and repeat calibration.
- Clean the MS source and repeat calibration.
- If problem is unresolved, inform the supervisor for further action.

12.2.3. Initial Calibration Verification (ICV) – If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Re-analyze ICV to rule out poor purge.
- If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error.
- If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.
- If problem is unresolved, inform the supervisor for further action.

12.2.4. Daily Calibration Check (DCC) – If DCC is non-compliant consider the following suggestions to correct the problem:

- If majority of the analyte response are low and no evidence of leak in the system is apparent, it is indicative of a bad purge or leak in the vial. Re-analyze DCC.
- If problem persist, rule out standard degradation. Prepare a fresh standard and repeat DCC.
- Otherwise execute instrument maintenance and perform ICAL.

12.2.5. Instrument Blank – If instrument blank is non-compliant, consider the following suggestions to correct the problem:

- If trace level of THMs is observed, it is indicative that water filters need replacement. Otherwise, bake the trap at the manufacturer's recommended temperature for about 30 minutes.
- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem is unresolved, inform the supervisor for further action.

12.3. **Preparation Batch QC**

12.3.1. For insufficient amount of sample(s), inform the supervisor immediately for further action.

12.3.2. If MB is non-compliant, consider the suggestions as described in Instrument Blank.

12.3.3. If LCS is non-compliant, consider the following suggestions to correct the problem:

- If result is bias low or high, prepare a fresh standard and re-analyze LCS and the associated samples.
- If problem is unresolved, inform the supervisor for further advice.

12.3.4. If MS is non-compliant consider the following suggestion to correct the problem:

- Check the standard log and analytical log and verify that the spike amount value used for calculation is correct.
- If LCS is within acceptance criteria then and the right amount of spike amount used for calculation is correct, then it is indicative of matrix interference. Discuss the probable matrix interference in the case narrative.

12.4. Discuss water samples that are labeled preserved having a pH ≥ 2 and/or residual chlorine ≥ 5 mg/L in the case narrative.

12.5. A Non-Conformance Report (NCR) is required when the following circumstances occur.

- Anomalies other than specified in Appendix 1, is observed.
- Sample is out of technical holding time.

12.5.1. Refer to EMAX-QA08 for NCR details.

13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standards in fume hoods.

14.0 WASTE MANAGEMENT

14.1. No samples shall be dumped on the laboratory sink.

14.2. Separate and properly identify all unused and expired analytical standards for proper disposal.

14.3. Place all waste generated during analytical process in properly labeled satellite waste containers for proper collection.

14.4. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation Batch** - is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical batch** - is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – is defined as the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type I error) is 1%.

15.1.4. Limit of Detection (LOD) – is defined as the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative result rate (Type II error) is 1 %.

15.1.5. Limit of Quantitation (LOQ) – is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.1.6. Safety Data Sheet (SDS) – is written information concerning a chemical physical properties, toxicity, health hazards, fire hazard and reactivity data including storage, spill and handling precautions.

15.1.7. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.8. Calibration Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.9. Carry-over – are contaminants retained in the instrument/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.10. Calibration Check Compounds (CCC) – evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.11. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.12. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.13. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.14. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.15. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.16. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.17. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.18. Matrix – is a component or form of a sample.

15.1.19. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.20. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.21. Response Factor – is the ratio of the peak area of the target compound in the sample or sample extract.

15.1.22. Surrogate – are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard; used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be detected in environmental media.

15.1.23. SPCC – System performance check compounds are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.1.24. Reagent Water – is purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.25. Reagent Soil – organic-free Ottawa sand or equivalent.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing Volatile analysis by GC/MS. The standard analyte list and RL are presented in Tables 6 & 7. In instances where there is a project or program QAPP, the requirements given in the project takes precedence over this SOP.

15.3. **Department of Defense (DoD) and Department of Energy (DoE) Projects**

15.3.1. Samples from DoD and DoE sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, is applied.

16.0 REFERENCES

16.1. U.S. EPA Method 8260B; SW846, as updated

16.2. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. **Tables**

17.1.1. Table 1 Initial Calibration Intermediate Standards Preparation

17.1.2. Table 2 Initial Calibration Verification/LCS/MS/MSD Intermediate Standards Preparation

17.1.3. Table 3 Surrogate/Internal Standards Preparation

17.1.4. Table 4 Tuning Solution Standards Preparation

17.1.5. Table 5 BFB Key Ion Abundance Criteria

17.1.6. Table 6 Typical Analyte List, Quantitation Ions, IS, Surrogates, Calibration Standards, Detection Limits for 5 ml Purge

17.1.7. Table 7 Typical Analyte List, Quantitation Ions, IS, Surrogates, Calibration Standards, Detection Limits for 25 ml Purge

17.2. **Figures**

17.2.1. Figure 1 Peak Evaluation Techniques

17.2.2. Figure 2 Typical Chromatogram

17.2.3. Figure 3 Typical ICAL Summary

17.2.4. Figure 4 Typical Instrument Performance Check (Tuning)

17.2.5. Figure 5 Typical Instrument Performance Check (Tuning) Summary

17.2.6. Figure 6 Typical Internal Standard Area and Retention Time Summary

17.2.7. Figure 7 Typical Sample Result Summary

17.2.8. Figure 8 Typical LCS/LCSD Summary

17.2.9. Figure 9 Typical MS/MSD Summary

17.2.10. Figure 10 Typical Case Narrative

17.3. **Appendices**

17.3.1. Appendix 1 Summary of Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability for 25 ml

17.3.3. Appendix 3 Demonstration of Capability for 5 ml

17.3.4. Appendix 4 Demonstration of Capability for 5 g

17.4. **Forms**

17.4.1. 8260FS Sample Preparation Log

17.4.2. 8260FA Analytical Run Log

17.4.3. 8260FM Instrument Maintenance Log

Table 1: INITIAL CALIBRATION INTERMEDIATE STANDARDS PREPARATION

ICAL/DCC Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µl)	Final Vol. (ml)	
I	1-Chlorohexane	AccuStandard	2000	50	2	50
	2-Chloroethylvinylether	CPI	2000	50	2	50
	Oxygenate Gasoline Additive	AccuStandard	2000-10000	50	2	50 - 250
	Custom VOA Mix	CPI	2000, 20000, 40000	50	2	50, 500, 1000
II	VOC Gas Mix	Ultra Scientific	2000	250	2	250
	Vinyl Acetate	CPI	2500	200	2	250
III	Carbon Disulfide	CPI	5000	100	2	250
IV	VOA Calibration Mix 1	Restek	5000	100	2	250
	Acrolein / Acrylonitrile	AccuStandard	5000	100	2	250

Table 2: INITIAL CALIBRATION VERIFICATION/LCS/MS/MSD INTERMEDIATE STANDARDS PREPARATION

ICV / LCS / MS Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µl)	Final Vol. (ml)	
I	1-Chlorohexane	Ultra Scientific	1000	100	2	50
	2-Chloroethylvinylether	AccuStandard	2000	50	2	50
	California Oxygenate Mix	Restek	2000 - 10000	50	2	50 – 250
	Custom 8260 Mega Mix	Restek	2000, 20000, 40000	50	2	50, 500, 1000
II	Volatile Organic Cpds Mix 6	Supelco	2000	250	2	250
	Vinyl Acetate	Restek	2000	250	2	250
III	Carbon Disulfide Solution	Ultra scientific	5000	20	2	50
IV	TCL Volatile Mix 1	Supelco	2000	250	2	250
	Acrolein / Acrylonitrile	Ultra Scientific	2000	250	2	250

Table 3: SURROGATE / INTERNAL STANDARDS PREPARATION

Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µl)	Final Vol. (ml)	
Surrogate	8260 Surrogate Mix	Restek	2500	200	2	250
Internal Standard	Custom 8260 Internal Standard Mix, 3-30	CPI	2500	200	2	250

Table 4: TUNING SOLUTION STANDARDS PREPARATION

BFB Intermediate Standard	Stock Standard			Preparation (Solvent: Methanol)		Final Conc. (mg/L)
	Standard Name	Source	Conc. (mg/L)	Aliquot (µl)	Final Vol. (ml)	
Tuning Compound	BFB	Restek	5000	20	2	50

Table 5: BFB KEY ION ABUNDANCE CRITERIA

M/z	Required Intensity (relative abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

Table 6: TYPICAL TARGET ANALYTE LIST FOR 5-ml PURGE

ANALYTES	CHARACTERISTIC ION(S)		IS	SURR	ICAL ANALYTE CONCENTRATIONS (µg/L)								ICV/DCC	LCS/MS	WATER (µg/L)			SOIL (µg/Kg)		
	PRIMARY	SECONDARY			1	2	3	4	5	6	7	8	EV(µg/L)	EV(µg/L)	DL	LOD	LOQ	DL	LOD	LOQ
1,1,1,2-Tetrachloroethane	131	133, 119, 117	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,1,1-Trichloroethane	97	99, 61	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,1,2,2-Tetrachloroethane	83	85	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,1,2-Trichloro-1,2,2-trifluoroethane	151	153	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
1,1,2-Trichloroethane	97	83, 85, 99	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,1-Dichloroethane	63	65, 83	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,1-Dichloroethene	61	63, 96	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,1-Dichloropropene	110	112	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,2,3-Trichlorobenzene	180	182, 145	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	1	2	5
1,2,3-Trichloropropane	110	61, 77	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
1,2,4-Trichlorobenzene	180	182, 145	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	1	2	5
1,2,4-Trimethylbenzene	105	120	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.55	1	5
1,2-Dibromo-3-chloropropane	157	155, 75	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
1,2-Dibromoethane	107	109	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,2-Dichlorobenzene	146	111, 148	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,2-Dichloroethane	62	64	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,2-Dichloropropane	63	41, 76	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,3,5-Trimethylbenzene	105	120, 119	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.59	1	5
1,3-Dichlorobenzene	146	111, 148	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.52	1	5
1,3-Dichloropropane	76	78	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1,4-Dichlorobenzene	146	111, 148	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
1-Chlorohexane	91	93, 55, 56	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.58	1	5
2,2-Dichloropropane	77	97, 79	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
2-Butanone (MEK)	43	72	IS1	Sur0/1	10	25	50	100	250	400	500	1000	250	250	2.5	5	10	2.5	5	10
2-Chloroethyl vinyl ether	63	65, 106	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
2-Chlorotoluene	91	126	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.82	1	5
2-Hexanone (MBK)	43	58, 100	IS2	Sur3	10	25	50	100	250	400	500	1000	250	250	2.5	5	10	2.86	5	10
4-Chlorotoluene	91	126	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.61	1	5	0.67	1	5
4-Methyl-2-pentanone (MIBK)	43	58, 85, 100	IS1	Sur0/1	10	25	50	100	250	400	500	1000	250	250	2.5	5	10	2.75	5	10
Acetone	43	58, 42	IS1	Sur0/1	10	25	50	100	250	400	500	1000	250	250	2.5	5	10	3.06	5	10
Acrolein	56	55	IS1	Sur0/1	10	25	50	100	250	400	500	1000	250	250	2.5	5	10	2.5	5	10
Acrylonitrile	53	52, 51	IS1	Sur0/1	10	25	50	100	250	400	500	1000	250	250	2.5	5	10	2.5	5	10
Benzene	78	77, 52	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Bromobenzene	156	77, 158	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Bromochloromethane	49	128, 130	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Bromodichloromethane	83	85	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Bromoform	173	171, 175	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	1	2	5
Bromomethane	94	96	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1.1	2	5	1.81	2	5

Table 6: TYPICAL TARGET ANALYTE LIST FOR 5-ml PURGE

ANALYTES	CHARACTERISTIC ION(S)		IS	SURR	ICAL ANALYTE CONCENTRATIONS (µg/L)								ICV/DCC	LCS/MS	WATER (µg/L)			SOIL (µg/Kg)		
	PRIMARY	SECONDARY			1	2	3	4	5	6	7	8	EV(µg/L)	EV(µg/L)	DL	LOD	LOQ	DL	LOD	LOQ
Carbon disulfide	76	78	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Carbon tetrachloride	119	117	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.54	1	5
Chlorobenzene	112	51, 77, 114	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Chloroethane	64	49, 66	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
Chloroform	83	85, 47	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Chloromethane	50	52	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1	2	5	1.02	2	5
cis-1,2-Dichloroethene	96	61, 98	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
cis-1,3-Dichloropropene	75	77, 39, 110	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Dibromochloromethane	129	127	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Dibromomethane	93	95, 174	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Dichlorodifluoromethane	85	87	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1.3	2	5	1.16	2	5
Dichlorofluoromethane	67	69	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Diisopropyl ether (DIPE)	45	87	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Ethyl Methacrylate	69	99, 41	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
Ethylbenzene	91	106	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Ethyl-tert-butyl ether (ETBE)	59	87	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Hexachlorobutadiene	225	223, 227	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	1	2	5
Iodomethane	142	127	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	1	2	5
Isopropylbenzene	105	120, 79, 103	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.64	1	5
m/p-Xylenes	91	106	IS2	Sur3	4	10	20	40	100	160	200	400	100	100	1	2	10	1	2	10
Methylene chloride	49	84, 86	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	1	2	5
Methyl-t-butyl ether (MTBE)	73	57	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
Naphthalene	128	127	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
n-Butylbenzene	91	92, 134	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.73	1	5	0.7	1	5
n-Propylbenzene	91	65, 120	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.51	1	5	0.65	1	5
o-Xylene	91	106	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
p-Isopropyltoluene	119	91, 134	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.56	1	5	0.62	1	5
sec-Butylbenzene	105	134	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.67	1	5
Styrene	104	78, 103	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
tert-Amylmethyl ether (TAME)	87	55,73	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
tert-Butyl alcohol (TBA)	59	41	IS1	Sur0/1	10	25	50	100	250	400	500	1000	250	250	7.1	10	25	9.18	10	20
tert-Butylbenzene	134	91, 119	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.62	1	5
Tetrachloroethene	164	129, 131, 166	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.52	1	5	0.5	1	5
Toluene	91	92	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
trans-1,2-Dichloroethene	61	96, 98	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
trans-1,3-Dichloropropene	75	77, 39	IS2	Sur3	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5
trans-1,4-Dichloro-2-butene	53	88	IS3	Sur2	2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
Trichloroethene	130	97, 132, 95	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.5	1	5	0.5	1	5

Table 6: TYPICAL TARGET ANALYTE LIST FOR 5-ml PURGE

ANALYTES	CHARACTERISTIC ION(S)		IS	SURR	ICAL ANALYTE CONCENTRATIONS (µg/L)								ICV/DCC	LCS/MS	WATER (µg/L)			SOIL (µg/Kg)		
	PRIMARY	SECONDARY			1	2	3	4	5	6	7	8	EV(µg/L)	EV(µg/L)	DL	LOD	LOQ	DL	LOD	LOQ
Trichlorofluoromethane	101	103	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.86	1	5	1.06	2	5
Vinyl acetate	43	86	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	1	2	5	1.26	2	5
Vinyl chloride	62	64	IS1	Sur0/1	2	5	10	20	50	80	100	200	50	50	0.61	1	5	1	2	5
Dibromofluoromethane (Sur0)	111	113, 192	IS1		2	5	10	20	50	80	100	200	50	50	1	2	5	0.5	1	5
1,2-Dichloroethane-d4 (Sur1)	65	102	IS1		2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
4-Bromofluorobenzene (Sur2)	95	174, 176	IS3		2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
Toluene-D8 (Sur3)	98	100	IS2		2	5	10	20	50	80	100	200	50	50	1	2	5	1	2	5
1,4-Difluorobenzene (IS1)	114	88																		
Chlorobenzene-d5 (IS2)	117	82, 119																		
1,2-Dichlorobenzene-d4 (IS3)	152	150																		

Note: Since, retention time of Dibromofluoromethane (Sur0) and 1,2-Dichloroethane-d4 (Sur1) is too close (~43 sec) hence, Dibromofluoromethane (Sur0) is only used when required by the project.

Table 7: TYPICAL TARGET ANALYTE LIST FOR 25-ml PURGE

Analytes	CHARACTERISTIC ION(S)		IS	SURR	ICAL ANALYTE CONCENTRATIONS (µg/L)									ICV/DCC	LCS/MS	WATER (µg/L)		
	PRIMARY	SECONDARY			1	2	3	4	5	6	7	8	9	EV(µg/L)	EV(µg/L)	DL	LOD	LOQ
1,1,1,2-Tetrachloroethane	131	133, 119, 117	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,1,1-Trichloroethane	97	99, 61	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,1,2,2-Tetrachloroethane	83	85	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	151	153	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.17	0.3	0.5
1,1,2-Trichloroethane	97	83, 85, 99	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,1-Dichloroethane	63	65, 83	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,1-Dichloroethene	61	63, 96	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,1-Dichloropropene	110	112	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,2,3-Trichlorobenzene	180	182, 145	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.3	0.5
1,2,3-Trichloropropane	110	61, 77	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.25	0.5	1
1,2,4-Trichlorobenzene	180	182, 145	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.3	0.5
1,2,4-Trimethylbenzene	105	120	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
1,2-Dibromo-3-chloropropane	157	155, 75	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.25	0.5	1
1,2-Dibromoethane	107	109	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,2-Dichlorobenzene	146	111, 148	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,2-Dichloroethane	62	64	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,2-Dichloropropane	63	41, 76	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,3,5-Trimethylbenzene	105	120, 119	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.13	0.2	0.5
1,3-Dichlorobenzene	146	111, 148	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
1,3-Dichloropropane	76	78	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1,4-Dichlorobenzene	146	111, 148	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
1-Chlorohexane	91	93, 55, 56	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.14	0.2	0.5
2,2-Dichloropropane	77	97, 79	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.16	0.2	0.5
2-Butanone (MEK)	43	72	IS1	Sur0/1	1.5	2.5	5	10	25	50	100	150	200	50	50	2	4	10
2-Chloroethyl vinyl ether	63	65, 106	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.5	1	2
2-Chlorotoluene	91	126	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.12	0.2	0.5
2-Hexanone (MBK)	43	58, 100	IS2	Sur3	1.5	2.5	5	10	25	50	100	150	200	50	50	2.3	4	5
4-Chlorotoluene	91	126	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
4-Methyl-2-pentanone (MIBK)	43	58, 85, 100	IS1	Sur0/1	1.5	2.5	5	10	25	50	100	150	200	50	50	2.2	4	5
Acetone	43	58, 42	IS1	Sur0/1	1.5	2.5	5	10	25	50	100	150	200	50	50	2.6	5	10
Acrolein	56	55	IS1	Sur0/1	1.5	2.5	5	10	25	50	100	150	200	50	50	2.5	5	10
Acrylonitrile	53	52, 51	IS1	Sur0/1	1.5	2.5	5	10	25	50	100	150	200	50	50	2.5	5	10
Benzene	78	77, 52	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5

Table 7: TYPICAL TARGET ANALYTE LIST FOR 25-ml PURGE

Analytes	CHARACTERISTIC ION(S)		IS	SURR	ICAL ANALYTE CONCENTRATIONS (µg/L)									ICV/DCC	LCS/MS	WATER (µg/L)		
	PRIMARY	SECONDARY			1	2	3	4	5	6	7	8	9	EV(µg/L)	EV(µg/L)	DL	LOD	LOQ
Bromobenzene	156	77, 158	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Bromochloromethane	49	128, 130	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
Bromodichloromethane	83	85	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Bromoform	173	171, 175	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.3	0.5
Bromomethane	94	96	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.16	0.3	0.5
Carbon disulfide	76	78	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Carbon tetrachloride	119	117	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Chlorobenzene	112	51, 77, 114	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Chloroethane	64	49, 66	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.27	0.3	0.5
Chloroform	83	85, 47	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Chloromethane	50	52	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.3	0.5
cis-1,2-Dichloroethene	96	61, 98	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
cis-1,3-Dichloropropene	75	77, 39, 110	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Dibromochloromethane	129	127	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Dibromomethane	93	95, 174	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Dichlorodifluoromethane	85	87	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.3	0.5
Dichlorofluoromethane	67	69	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Diisopropyl ether (DIPE)	45	87	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
Ethyl Methacrylate	69	99, 41	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.25	0.5	1
Ethylbenzene	91	106	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Ethyl-tert-butyl ether (ETBE)	59	87	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
Hexachlorobutadiene	225	223, 227	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.22	0.3	0.5
Iodomethane	142	127	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.3	0.5
Isopropylbenzene	105	120, 79, 103	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
m/p-Xylenes	91	106	IS2	Sur3	0.6	1	2	4	10	20	40	60	80	20	20	0.21	0.4	1
Methylene chloride	49	84, 86	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.25	0.5	1
Methyl-t-butyl ether (MTBE)	73	57	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.13	0.2	0.5
Naphthalene	128	127	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.25	0.5	1
n-Butylbenzene	91	92, 134	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.17	0.2	0.5
n-Propylbenzene	91	65, 120	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.13	0.2	0.5
o-Xylene	91	106	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
p-Isopropyltoluene	119	91, 134	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.14	0.2	0.5
sec-Butylbenzene	105	134	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.13	0.2	0.5

Table 7: TYPICAL TARGET ANALYTE LIST FOR 25-ml PURGE

Analytes	CHARACTERISTIC ION(S)		IS	SURR	ICAL ANALYTE CONCENTRATIONS (µg/L)									ICV/DCC	LCS/MS	WATER (µg/L)		
	PRIMARY	SECONDARY			1	2	3	4	5	6	7	8	9	EV(µg/L)	EV(µg/L)	DL	LOD	LOQ
Styrene	104	78, 103	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
tert-Amylmethyl ether (TAME)	87	55,73	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
tert-Butyl alcohol (TBA)	59	41	IS1	Sur0/1	1.5	2	5	10	25	50	100	150	200	50	50	2.5	5	10
tert-Butylbenzene	134	91, 119	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.13	0.2	0.5
Tetrachloroethene	164	129, 131, 166	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.2	0.5
Toluene	91	92	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
trans-1,2-Dichloroethene	61	96, 98	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
trans-1,3-Dichloropropene	75	77, 39	IS2	Sur3	0.3	0.5	1	2	5	10	20	30	40	10	10	0.11	0.2	0.5
trans-1,4-Dichloro-2-butene	53	88	IS3	Sur2	0.3	0.5	1	2	5	10	20	30	40	10	10	0.5	1	2
Trichloroethene	130	97, 132, 95	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.1	0.2	0.5
Trichlorofluoromethane	101	103	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.15	0.3	0.5
Vinyl acetate	43	86	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.25	0.5	1
Vinyl chloride	62	64	IS1	Sur0/1	0.3	0.5	1	2	5	10	20	30	40	10	10	0.12	0.2	0.5
Dibromofluoromethane (Sur0)	111	113, 192	IS1		0.3	0.5	1	2	5	10	20	30	40	10	10	0.5	1	2
1,2-Dichloroethane-d4 (Sur1)	65	102	IS1		0.3	0.5	1	2	5	10	20	30	40	10	10	0.5	1	2
4-Bromofluorobenzene (Sur2)	95	174, 176	IS3		0.3	0.5	1	2	5	10	20	30	40	10	10	0.5	1	2
Toluene-D8 (Sur3)	98	100	IS2		0.3	0.5	1	2	5	10	20	30	40	10	10	0.5	1	2
1,4-Difluorobenzene (IS1)	114	88																
Chlorobenzene-d5 (IS2)	117	82, 119																
1,2-Dichlorobenzene-d4 (IS3)	152	150																

Note: Since retention time of Dibromofluoromethane (Sur0) and 1,2-Dichloroethane-d4 (Sur1) is too close (~43 sec) hence, Dibromofluoromethane (Sur0) is only used when required by the project.

Figure 1: **PEAK EVALUATION TECHNIQUES**

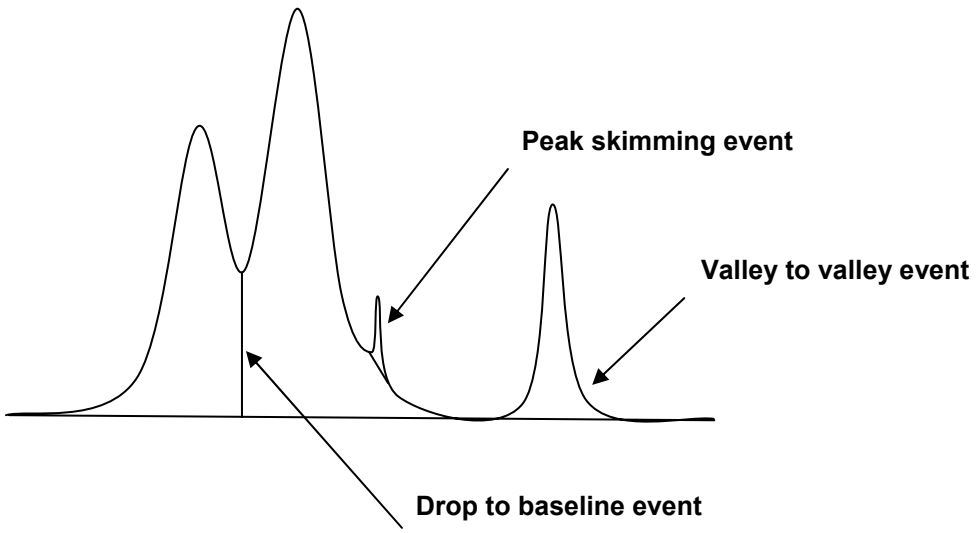
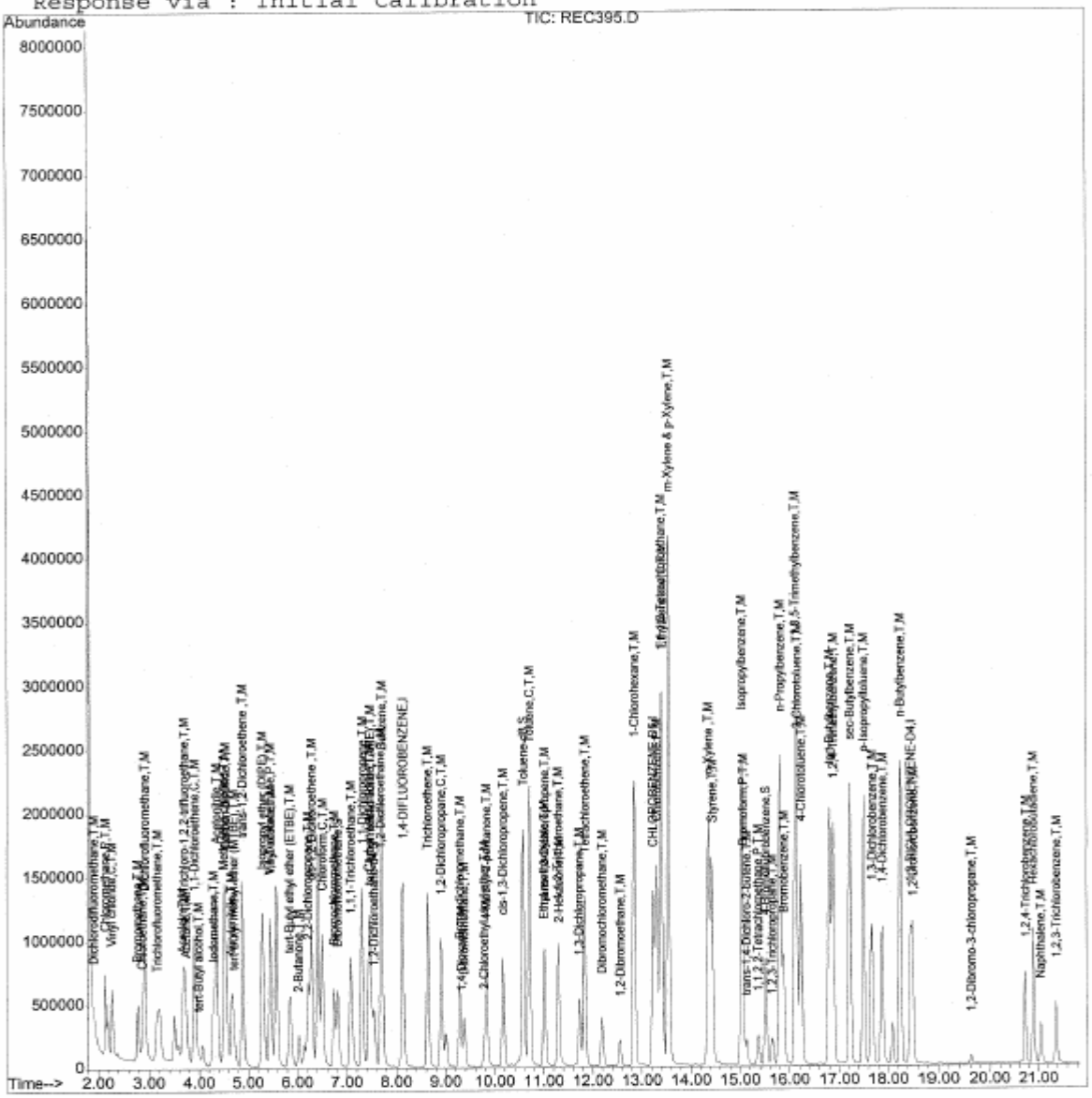


Figure 2: **TYPICAL CHROMATOGRAM**

Quantitation Report

Data File : D:\HPCHEM\1\DATA\11E25\REC395.D Vial: 2
Acq On : 25 May 2011 1:40 pm Operator: AS
Sample : IV067E2402 10ppb Inst : TO67
Misc : 10ppb 8260/50ppb KET-ACR-ACN-TBA Multiplr: 1.00
MS Integration Params: LSCINT1.P
Quant Time: May 25 16:32 2011 Quant Results File: VO67E24.RES

Method : D:\HPCHEM\1\METHODS\VO67E24.M (RTE Integrator)
Title : METHOD 8260B 4.0
Last Update : Wed May 25 16:26:28 2011
Response via : Initial Calibration



REC395.D VO67E24.M Wed May 25 16:38:57 2011 Page 4

Figure 3: **TYPICAL ICAL SUMMARY**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :03
Beginning DateTime :03/12/13 07:57
Spike Units :PPB
IC File :RCB023

Column Spec :ZB-624 ID :0.25MM
Ending DateTime :03/12/13 12:58
HPChem Method :V003C12

M	IDX	Parameters	.3 07:57 RCB018	.5 08:31 RCB019	1 09:05 RCB020	2 09:39 RCB021	5 10:11 RCB022	10 10:45 RCB023	20 11:18 RCB024	30 11:52 RCB025	50 12:25 RCB026	100 12:58 RCB027	Av_RRF	%_RSD	Av_Rt_M
	1	1,4-DIFLUOROBENZENE	1	1	1	1	1	1	1	1	1	1	1	0	13.1167
	2	Chlorotrifluoroethylene	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	3	Dichlorodifluoromethane	0.312	0.311	0.326	0.327	0.302	0.284	0.298	0.281	0.271	0.265	0.298	7.35	4.0527
	4	Chloromethane	0.497	0.479	0.499	0.498	0.449	0.423	0.434	0.414	0.395	0.379	0.447	10.02	4.5516
	5	Vinyl chloride	0.295	0.288	0.315	0.308	0.286	0.271	0.286	0.277	0.270	0.273	0.287	5.39	4.8866
	6	2-Chloro-1,1,1-trifluoroethane	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	7	Bromomethane	0.307	0.306	0.320	0.311	0.275	0.265	0.267	0.247	0.210	------	0.279	12.91	5.7735
	8	Chloroethane	0.209	0.223	0.239	0.233	0.210	0.202	0.209	0.197	0.184	0.165	0.207	10.58	6.0466
	9	Dichlorofluoromethane	0.670	0.653	0.680	0.650	0.648	0.592	0.632	0.621	0.635	0.625	0.641	3.96	6.5916
	10	Trichlorofluoromethane	0.321	0.351	0.385	0.402	0.365	0.363	0.384	0.376	0.364	0.363	0.367	5.95	6.6749
5	11	Acrolein	0.012	0.010	0.011	0.011	0.012	0.013	0.013	0.013	0.013	0.013	0.012	9.23	7.7679
	12	1,1,2-Trichloro-1,2,2-trifluoroethane	0.214	0.199	0.207	0.193	0.190	0.173	0.180	0.176	0.185	0.180	0.190	7.16	7.8901
	13	1,1-Dichloroethene	0.613	0.612	0.620	0.579	0.570	0.534	0.548	0.523	0.543	0.514	0.566	6.97	7.9392
5	14	Acetone	------	------	0.045	0.035	0.032	0.031	0.029	0.027	0.029	0.028	0.032	18.18	8.1020
	15	Iodomethane	0.553	0.519	0.566	0.525	0.512	0.471	0.490	0.476	0.484	0.486	0.508	6.41	8.3338
	16	Carbon disulfide	1.259	1.220	1.291	1.367	1.204	1.194	1.218	1.179	1.183	1.151	1.227	5.20	8.4588
	17	Methyl acetate	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	18	Methylene chloride	------	------	0.548	0.484	0.450	0.419	0.422	0.397	0.422	0.401	0.443	11.51	9.0085
5	19	tert-Butyl alcohol	0.009	0.009	0.011	0.010	0.010	0.009	0.010	0.009	0.010	0.009	0.010	6.11	9.2093
	20	tert-Butyl methyl ether (MTBE)	0.430	0.405	0.440	0.420	0.409	0.367	0.381	0.371	0.404	0.374	0.400	6.43	9.4267
	21	trans-1,2-Dichloroethene	0.681	0.638	0.664	0.629	0.618	0.585	0.584	0.553	0.577	0.535	0.606	7.83	9.4834
5	22	Acrylonitrile	0.036	0.036	0.041	0.040	0.038	0.039	0.037	0.037	0.038	0.036	0.038	5.13	9.5161
	23	Isopropyl ether (DIPE)	1.387	1.263	1.335	1.285	1.234	1.171	1.151	1.110	1.121	1.024	1.208	9.29	10.2472
	24	1,1-Dichloroethane	0.768	0.739	0.749	0.730	0.706	0.676	0.668	0.644	0.653	0.605	0.694	7.62	10.2785
	25	Vinyl acetate	------	0.332	0.283	0.324	0.337	0.355	0.379	0.413	0.347	0.317	0.343	10.92	10.3003
	26	tert-Butyl ethyl ether (ETBE)	0.796	0.755	0.728	0.707	0.718	0.694	0.681	0.696	0.732	0.705	0.721	4.69	10.8667
	27	2,2-Dichloropropane	0.395	0.372	0.378	0.353	0.339	0.345	0.323	0.310	0.300	0.263	0.338	11.78	11.2345
5	28	2-Butanone	0.083	0.072	0.068	0.069	0.064	0.064	0.055	0.056	0.058	0.053	0.064	14.51	11.2761
	29	cis-1,2-Dichloroethene	0.469	0.440	0.442	0.430	0.415	0.405	0.384	0.379	0.390	0.365	0.412	8.05	11.2687
5	30	2-Butanol	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	31	Bromochloromethane	0.307	0.309	0.315	0.309	0.309	0.274	0.277	0.276	0.288	0.257	0.292	6.89	11.6797
	32	Tetrahydrofuran	------	------	0.048	0.045	0.037	0.034	0.033	0.036	0.036	0.034	0.038	13.93	11.7372
	33	Chloroform	0.705	0.690	0.687	0.691	0.672	0.607	0.605	0.606	0.620	0.579	0.646	7.24	11.7705
	34	Dibromofluoromethane	0.326	0.367	0.356	0.342	0.340	0.327	0.311	0.315	0.311	0.294	0.329	6.83	12.0326
	35	1,1,1-Trichloroethane	0.523	0.515	0.500	0.484	0.512	0.471	0.477	0.472	0.470	0.435	0.486	5.50	12.0386
	36	Cyclohexane	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	37	1,1-Dichloropropene	0.209	0.194	0.192	0.189	0.183	0.178	0.181	0.182	0.174	0.159	0.184	7.23	12.2738
	38	Carbon tetrachloride	0.467	0.452	0.446	0.423	0.441	0.427	0.429	0.426	0.426	0.403	0.434	4.16	12.2857
	39	1,2-Dichloroethane-d4	0.270	0.266	0.275	0.269	0.258	0.251	0.225	------	------	------	0.259	6.60	12.5581
	40	Benzene	1.724	1.622	1.501	1.421	1.497	1.348	1.382	1.392	1.393	------	1.476	8.50	12.6150
	41	tert-Amyl methyl ether (TAME)	0.100	0.103	0.107	0.100	0.109	0.098	0.097	0.102	0.105	0.098	0.102	4.11	12.6595
	42	1,2-Dichloroethane	0.299	0.308	0.290	0.294	0.303	0.287	0.279	0.277	0.287	0.256	0.288	5.20	12.6729
	43	Trichloroethene	0.428	0.404	0.405	0.389	0.419	0.382	0.382	0.375	0.400	0.366	0.395	4.98	13.5291
	44	Methylcyclohexane	------	------	------	------	------	------	------	------	------	------	0.000	0.00	0.0000
	45	1,2-Dichloropropane	0.387	0.398	0.375	0.376	0.407	0.377	0.381	0.361	0.376	0.342	0.378	4.76	13.8776
20	46	1,4-Dioxane	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	9.47	14.0562
	47	Dibromomethane	0.163	0.146	0.158	0.146	0.166	0.142	0.149	0.144	0.158	0.145	0.152	5.80	14.0935
	48	Bromodichloromethane	0.438	0.407	0.437	0.429	0.470	0.419	0.416	0.430	0.448	0.413	0.431	4.33	14.2617

Figure 3 (cont.): **TYPICAL ICAL SUMMARY**

49	2-Chloroethyl vinyl ether	------	0.052	0.053	0.059	0.064	0.062	0.064	0.067	0.077	0.073	0.063	13.09	14.5606
50	cis-1,3-Dichloropropene	0.511	0.509	0.493	0.489	0.553	0.509	0.513	0.510	0.537	0.492	0.512	3.91	14.8291
5 51	4-Methyl-2-pentanone	0.182	0.169	0.170	0.164	0.180	0.168	0.154	0.160	0.170	0.144	0.166	6.86	14.9541
52	CHLOROBENZENE-D5	1	1	1	1	1	1	1	1	1	1	1	0	17.1073
53	Toluene-d8	1.471	1.484	1.407	1.468	1.417	1.414	1.426	1.350	1.404	------	1.427	2.94	15.1712
54	Toluene	1.975	1.822	1.622	1.764	1.814	1.638	1.732	1.646	1.710	------	1.747	6.46	15.2622
55	Ethyl methacrylate	0.274	0.248	0.237	0.247	0.287	0.268	0.263	0.270	0.286	0.266	0.264	6.15	15.5111
56	trans-1,3-Dichloropropene	0.383	0.368	0.358	0.376	0.420	0.392	0.406	0.404	0.429	0.403	0.394	5.77	15.5483
57	1,1,2-Trichloroethane	0.222	0.209	0.198	0.196	0.213	0.196	0.195	0.206	0.217	0.201	0.205	4.79	15.8267
58	Tetrachloroethene	0.438	0.389	0.368	0.385	0.382	0.355	0.371	0.366	0.383	0.352	0.379	6.42	15.9995
5 59	2-Hexanone	0.119	0.137	0.116	0.121	0.117	0.125	0.112	0.121	0.125	0.106	0.120	6.87	16.0248
60	1,3-Dichloropropane	0.416	0.397	0.392	0.417	0.411	0.384	0.385	0.389	0.415	0.377	0.398	3.79	16.0531
61	Dibromochloromethane	0.252	0.234	0.233	0.261	0.259	0.256	0.262	0.267	0.287	0.268	0.258	6.22	16.3941
62	1,2-Dibromoethane	0.207	0.208	0.195	0.197	0.212	0.193	0.202	0.205	0.224	0.208	0.205	4.47	16.5847
63	1-Chlorohexane	0.897	0.862	0.785	0.803	0.835	0.761	0.806	0.779	0.829	0.757	0.811	5.53	16.9495
64	Chlorobenzene	1.152	1.065	0.937	0.954	0.990	0.958	0.962	0.991	1.007	0.911	0.993	7.08	17.1475
65	Ethylbenzene	2.251	2.178	2.021	1.994	2.182	1.965	2.014	2.014	1.839	------	2.051	6.29	17.1930
66	1,1,1,2-Tetrachloroethane	0.319	0.317	0.311	0.307	0.333	0.304	0.308	0.319	0.318	0.294	0.313	3.37	17.2264
2 67	m-Xylene & p-Xylene	1.713	1.626	1.515	1.469	1.497	1.439	1.490	1.387	------	------	1.517	6.90	17.3227
68	o-Xylene	1.694	1.653	1.478	1.477	1.519	1.428	1.437	1.428	1.440	------	1.506	6.65	17.8581
69	Styrene	1.028	1.012	0.971	0.933	1.027	0.971	0.981	0.978	0.998	0.874	0.977	4.73	17.8787
70	1,2-DICHLOROBENZENE-D4	1	1	1	1	1	1	1	1	1	1	1	0	20.6245
71	Bromoform	0.330	0.326	0.329	0.333	0.339	0.334	0.362	0.385	0.425	0.401	0.356	9.92	18.2613
72	Isopropylbenzene	5.562	5.517	5.180	5.026	5.022	4.609	5.010	5.013	5.337	------	5.142	5.76	18.2767
73	4-Bromofluorobenzene	1.603	1.546	1.384	1.356	1.335	1.258	1.308	1.333	1.419	1.324	1.386	7.83	18.5621
74	1,1,2,2-Tetrachloroethane	0.746	0.756	0.716	0.675	0.696	0.618	0.665	0.707	0.749	0.704	0.703	6.08	18.7036
75	trans-1,4-Dichloro-2-butene	0.187	0.180	0.176	0.186	0.198	0.177	0.197	0.205	0.223	0.201	0.193	7.69	18.7438
76	n-Propylbenzene	8.651	8.030	7.852	7.211	7.500	6.892	7.592	7.274	------	------	7.625	7.21	18.7857
77	1,2,3-Trichloropropane	0.177	0.170	0.160	0.153	0.158	0.140	0.147	0.149	0.157	0.138	0.155	7.93	18.8019
78	Bromobenzene	1.165	1.071	1.055	1.014	1.052	0.931	0.983	1.022	1.109	1.010	1.041	6.31	18.8227
79	1,3,5-Trimethylbenzene	4.694	4.553	4.332	4.080	4.256	3.733	4.106	4.10[illegible]	4.355	3.299	4.151	9.67	18.9612
80	2-Chlorotoluene	5.150	4.552	4.413	4.224	4.372	3.923	4.126	4.108	4.517	3.691	4.308	9.28	18.9999
81	4-Chlorotoluene	4.441	3.866	3.719	3.646	3.838	3.506	3.604	3.728	4.047	3.296	3.769	8.31	19.1265
82	tert-Butylbenzene	1.011	0.999	0.944	0.893	0.936	0.837	0.894	0.889	0.955	0.865	0.922	6.14	19.4213
83	1,2,4-Trimethylbenzene	4.627	4.271	3.973	4.095	4.026	3.564	3.677	3.874	4.208	3.401	3.972	9.12	19.4794
84	sec-Butylbenzene	6.845	6.467	6.537	6.165	6.138	5.570	5.934	5.860	6.013	------	6.170	6.32	19.6962
85	p-Isopropyltoluene	4.982	4.670	4.483	4.208	4.407	4.011	4.268	4.060	4.454	------	4.394	6.93	19.8402
86	1,3-Dichlorobenzene	2.358	2.168	2.115	2.002	2.047	1.927	2.037	1.985	2.204	2.008	2.085	6.15	19.9961
87	1,4-Dichlorobenzene	2.379	2.019	1.958	1.903	1.942	1.756	1.873	1.837	2.027	1.854	1.955	8.73	20.1063
88	n-Butylbenzene	5.550	4.899	5.079	4.650	4.817	4.593	4.886	4.619	4.980	------	4.897	6.06	20.3928
89	1,2-Dichlorobenzene	1.816	1.636	1.646	1.560	1.576	1.448	1.505	1.471	1.578	1.464	1.570	7.08	20.6528
90	1,2-Dibromo-3-chloropropane	0.063	0.069	0.073	0.072	0.076	0.068	0.073	0.073	0.078	0.074	0.072	6.04	21.7696
91	1,2,4-Trichlorobenzene	0.972	0.844	0.786	0.841	0.831	0.798	0.763	0.733	0.817	0.766	0.815	8.11	23.0070
92	Hexachlorobutadiene	------	0.740	0.722	0.700	0.678	0.604	0.560	0.503	0.559	0.527	0.621	14.43	23.1360
93	Naphthalene	1.249	1.099	1.013	1.042	1.036	0.961	0.917	0.843	0.957	0.895	1.001	11.58	23.4983
94	1,2,3-Trichlorobenzene	0.700	0.631	0.619	0.614	0.617	0.556	0.499	0.460	0.505	0.476	0.568	14.08	23.9168

Spike Amount = Nominal Amount * M
Ave_%RSD : 7.5 Max_%RSD : 18.2

Use Least Square Linear Regression with weighting factor of inverse concentration for comps with %_RSD > 15
Resp_Ratio = xo + x1 * Amt_Ratio

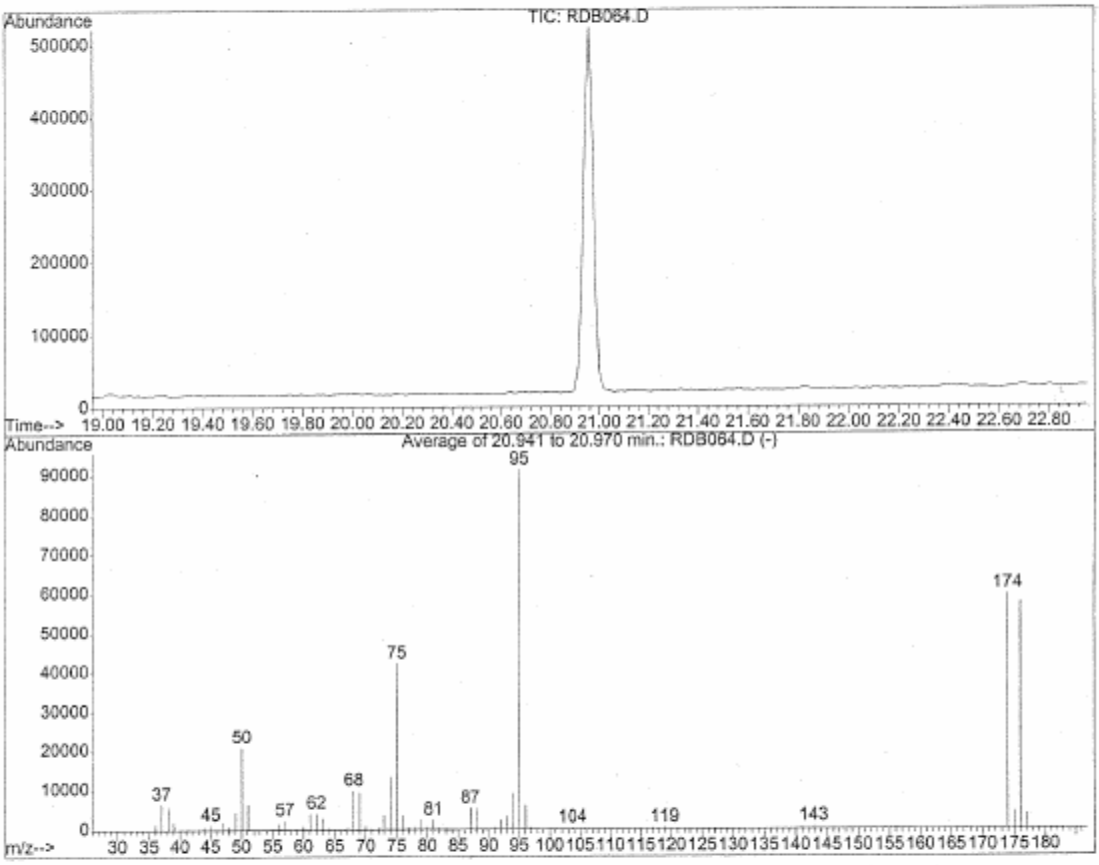
IDX	Parameter	x0	x1	CCF
14	Acetone	0.00872	0.02772	0.9996

Figure 4: **TYPICAL INSTRUMENT PERFORMANCE CHECK (TUNING)**

BFB

Data File : D:\HPCHEM\1\DATA\11D07\RDB064.D
Acq On : 7 Apr 2011 7:43 pm
Sample : BFB03D04
Misc : T/CHECK
MS Integration Params: 524INT.P
Method : D:\HPCHEM\1\METHODS\VO03D07.M (RTE Integrator)
Title : METHOD 8260 25mL

Vial: 2
Operator: MW
Inst : TO03
Multiplr: 1.00



AutoFind: Scans 1163, 1164, 1165; Background Corrected with Scan 1156

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
50	95	15	40	22.9	20916	PASS
75	95	30	60	46.4	42347	PASS
95	95	100	100	100.0	91301	PASS
96	95	5	9	6.6	6055	PASS
173	174	0.00	2	0.0	0	PASS
174	95	50	100	65.3	59619	PASS
175	174	5	9	7.4	4406	PASS
176	174	95	101	96.7	57635	PASS
177	176	5	9	6.7	3884	PASS

RDB064.D VO03D07.M Fri Apr 08 09:01:53 2011

Figure 5: TYPICAL INSTRUMENT PERFORMANCE CHECK (TUNING) SUMMARY

5A
VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: EMAX Inc — Contract: CLEAN WATER PROJECT
Lab Code: EMXT — Case No.: — SAS No.: — SDG No.: YYMNNN
Lab File ID: RDC521 — BFB Injection Date : 04/29/14
Instrument ID: 67 — BFB Injection Time : 09:52
GC Column:RTX502.2ID:0.25mm (mm) — Heated Purge: (Y/N) N

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	20.69
75	30.0 - 60.0% of mass 95	45.82
95	Base peak, 100% relative abundance	100.00
96	5.0 - 9.0% of mass 95	6.39
173	Less than 2.0% of mass 174	0.00(0.0)1
174	Greater than 50% of mass 95	70.43
175	5.0 - 9.0% of mass 174	5.04(7.2)1
176	95.0 - 101.0% of mass 174	67.25(95.5)1
177	5.0 - 9.0% of mass 176	4.57(6.8)2

1-Value is % mass 174 — 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
1	VSTD010	CVO67D0914	RDC523	04/29/14	11:14
2	MBLK1W	VO67D21B	RDC527	04/29/14	13:15
3	LCS1W	VO67D21L	RDC524	04/29/14	11:44
4	LCD1W	VO67D21C	RDC525	04/29/14	12:15
5	XXX-59XX001	MNNN-02	RDC534	04/29/14	16:55
6	XXX-59XX001MS	MNNN-02M	RDC535	04/29/14	17:26
7	XXX-59XX001MSD	MNNN-02S	RDC536	04/29/14	18:57

Figure 6: TYPICAL INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

8A
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name : EMAX INC.
Lab Code : EMXT
Lab File ID : RDC168
Instrument ID: 67
GC Column : RTX502.2ID:0.25mm (mm)

Project : CLEAN WATER PROJECT
SDG No. : YYMNNN
Date Analyzed : 04/09/14
Time Analyzed : 18:54
Heated Purge : No

		IS1(DBF)		IS2(CBZ)		IS3(DCB)	
		AREA #	RT #	AREA #	RT #	AREA #	RT #
	12 HOUR STD	1321331	8.08	1022177	13.17	321226	18.40
	UPPER LIMIT	2642662	8.58	2044354	13.67	642452	18.90
	LOWER LIMIT	660666	7.58	511089	12.67	160613	17.90
	SAMPLE ID						
1	VSTD010	1155410	8.07	908594	13.15	276831	18.38
2	MBLK1W	1259632	8.07	956984	13.15	261376	18.38
3	LCS1W	1216852	8.07	957974	13.15	290568	18.38
4	LCD1W	1262335	8.07	983468	13.15	300886	18.38
5	XXX-59GW001	1202358	8.07	934767	13.16	277693	18.38
6	XXX-59GW001MS	1216852	8.07	957974	13.17	290568	18.38
7	XXX-59GW001MSD	1262335	8.07	983468	13.17	300886	18.38

IS1 (DFB) = 1,4-Difluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,2-Dichlorobenzene-d4

AREA UPPER LIMIT = + 100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = + 0.5 minutes (30 sec) of internal standard RT
RT LOWER LIMIT = - 0.5 minutes (30 sec) of internal standard RT

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

Figure 7: **TYPICAL SAMPLE RESULT SUMMARY**

METHOD SW5030C/8260B
VOLATILE ORGANICS BY GC/MS

Client	: XYZ INC.	Date Collected:	04/28/14
Project	: CLEAN WATER PROJECT	Date Received:	04/29/14
Batch No.	: YYMNNN	Date Extracted:	04/29/14 16:55
Sample ID:	XX-59XX001	Date Analyzed:	04/29/14 16:55
Lab Samp ID:	MNNN-02	Dilution Factor:	1
Lab File ID:	RDC534	Matrix	: WATER
Ext Btch ID:	VO67D21	% Moisture	: NA
Calib. Ref.:	RDC168	Instrument ID	: 67

PARAMETERS	RESULTS (ug/L)	LOQ (ug/L)	DL (ug/L)	LOD (ug/L)
BENZENE	0.11J	1.0	0.10	0.20
BROMODICHLOROMETHANE	ND	1.0	0.10	0.20
BROMOFORM	1.5	1.0	0.15	0.30
BROMOMETHANE	ND	1.0	0.16	0.30
CARBON TETRACHLORIDE	ND	1.0	0.10	0.20
CHLOROBENZENE	ND	1.0	0.10	0.20
CHLOROETHANE	ND	1.0	0.27	0.30
CHLOROFORM	ND	1.0	0.10	0.20
CHLOROMETHANE	ND	2.0	0.15	0.30
DIBROMOCHLOROMETHANE	0.20J	1.0	0.10	0.20
1,2-DICHLOROBENZENE	ND	1.0	0.10	0.20
1,3-DICHLOROBENZENE	ND	1.0	0.11	0.20
1,4-DICHLOROBENZENE	ND	1.0	0.10	0.20
DICHLORODIFLUOROMETHANE (FREON 12)	ND	1.0	0.15	0.30
1,1-DICHLOROETHANE	ND	1.0	0.10	0.20
1,2-DICHLOROETHANE	ND	1.0	0.10	0.20
1,1-DICHLOROETHENE	ND	1.0	0.10	0.20
1,2-DICHLOROETHENE (TOTAL)	0.30J	1.0	0.10	0.20
1,2-DICHLOROPROPANE	ND	1.0	0.10	0.20
TRANS-1,3-DICHLOROPROPENE	ND	1.0	0.11	0.20
CIS-1,3-DICHLOROPROPENE	ND	1.0	0.10	0.20
ETHYLBENZENE	ND	1.0	0.10	0.20
METHYLENE CHLORIDE	ND	5.0	0.25	0.50
1,1,2,2-TETRACHLOROETHANE	ND	1.0	0.11	0.20
TETRACHLOROETHENE	0.19J	1.0	0.15	0.20
TOLUENE	62	1.0	0.10	0.20
1,1,1-TRICHLOROETHANE	ND	1.0	0.10	0.20
1,1,2-TRICHLOROETHANE	ND	1.0	0.10	0.20
TRICHLOROFLUOROMETHANE (FREON 11)	ND	1.0	0.15	0.30
TRICHLOROETHENE	14	1.0	0.10	0.20
VINYL CHLORIDE	ND	2.0	0.12	0.20
XYLENES (TOTAL)	ND	1.0	0.10	0.50

SURROGATE PARAMETERS	RESULTS	SPK_AMT	% RECOVERY	QC LIMIT
1,2-DICHLOROETHANE-D4	8.44	10.00	84.4	70-120
4-BROMOFLUOROBENZENE	9.41	10.00	94.1	75-120
TOLUENE-D8	10.3	10.00	103	85-120
DIBROMOFLUOROMETHANE	9.95	10.00	99.5	85-115

Figure 8: TYPICAL LCS/LCSD SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: YYMNNN
METHOD: SW5030C/8260B

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1W				
LAB SAMP ID:	VO67D21B	VO67D21L	VO67D21C		
LAB FILE ID:	RDC527	RDC524	RDC525		
DATE EXTRACTED:	04/29/1413:15	04/29/1411:44	04/29/1412:15	DATE COLLECTED:	NA
DATE ANALYZED:	04/29/1413:15	04/29/1411:44	04/29/1412:15	DATE RECEIVED:	04/29/14
PREP. BATCH:	VO67D21	VO67D21	VO67D21		
CALIB. REF:	RDC168	RDC168	RDC168		

ACCESSION:

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Benzene	ND	10.0	9.32	93	10.0	9.17	92	2	80-120	30
Bromodichloromethane	ND	10.0	9.65	97	10.0	9.37	94	3	75-120	30
Bromoform	ND	10.0	10.1	101	10.0	9.80	98	3	70-130	30
Bromomethane	ND	10.0	10.6	106	10.0	9.80	98	7	30-145	30
Carbon Tetrachloride	ND	10.0	8.35	83	10.0	8.20	82	2	65-140	30
Chlorobenzene	ND	10.0	9.78	98	10.0	9.68	97	1	80-120	30
Chloroethane	ND	10.0	11.0	110	10.0	10.1	101	8	60-135	30
Chloroform	ND	10.0	9.84	98	10.0	9.56	96	3	65-135	30
Chloromethane	ND	10.0	10.2	102	10.0	9.58	96	7	40-125	30
Dibromochloromethane	ND	10.0	9.64	96	10.0	9.49	95	2	60-135	30
1,2-Dichlorobenzene	ND	10.0	10.3	103	10.0	10.1	101	2	70-120	30
1,3-Dichlorobenzene	ND	10.0	10.1	101	10.0	9.91	99	2	75-125	30
1,4-Dichlorobenzene	ND	10.0	10.0	100	10.0	9.87	99	1	75-125	30
Dichlorodifluoromethane (Freon 12)	ND	10.0	9.93	99	10.0	9.39	94	6	30-155	30
1,1-Dichloroethane	ND	10.0	9.27	93	10.0	8.99	90	3	70-135	30
1,2-Dichloroethane	ND	10.0	7.97	80	10.0	7.88	79	1	70-130	30
1,1-Dichloroethene	ND	10.0	7.58	76	10.0	7.41	74	2	70-130	30
1,2-Dichloroethene (Total)	ND	20.0	17.1	85	20.0	16.6	83	3	70-125	30
1,2-Dichloropropane	ND	10.0	9.90	99	10.0	9.70	97	2	75-125	30
Trans-1,3-Dichloropropene	ND	10.0	8.39	84	10.0	8.49	85	1	55-140	30
cis-1,3-Dichloropropene	ND	10.0	9.23	92	10.0	8.93	89	3	70-130	30
Ethylbenzene	ND	10.0	9.84	98	10.0	9.67	97	2	75-125	30
Methylene Chloride	ND	10.0	8.28	83	10.0	8.40	84	1	55-140	30
1,1,2,2-Tetrachloroethane	ND	10.0	10.5	105	10.0	10.3	103	2	65-130	30
Tetrachloroethene	ND	10.0	9.31	93	10.0	9.20	92	1	45-150	30
Toluene	ND	10.0	9.57	96	10.0	9.47	95	1	75-120	30
1,1,1-Trichloroethane	ND	10.0	8.74	87	10.0	8.56	86	2	65-130	30
1,1,2-Trichloroethane	ND	10.0	10.3	103	10.0	10.3	103	0	75-125	30
Trichlorofluoromethane (Freon 11)	ND	10.0	10.8	108	10.0	9.93	99	9	60-145	30
Trichloroethene	ND	10.0	9.46	95	10.0	9.19	92	3	70-125	30
Vinyl Chloride	ND	10.0	10.3	103	10.0	9.61	96	7	50-145	30
Xylenes (Total)	ND	30.0	28.5	95	30.0	28.0	93	2	80-120	30

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	QC LIMIT (%)
1,2-Dichloroethane-d4	10.0	8.20	82	10.0	8.24	82	70-120
4-Bromofluorobenzene	10.0	9.69	97	10.0	9.70	97	75-120
Toluene-d8	10.0	10.4	104	10.0	10.4	104	85-120
Dibromofluoromethane	10.0	9.92	99	10.0	9.85	98	85-115

Figure 9: TYPICAL MS/MSD SUMMARY

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: YYMNNN
METHOD: SW5030C/8260B

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	XXX-59XX001	XXX-59XX001MS	XXX-59XX001MSD		
LAB SAMP ID:	MNNN-02	MNNN-02M	MNNN-02S		
LAB FILE ID:	RDC534	RDC535	RDC536		
DATE EXTRACTED:	04/29/1416:55	04/29/1417:26	04/29/1418:15	DATE COLLECTED:	NA
DATE ANALYZED:	04/29/1416:55	04/29/1417:26	04/29/1418:15	DATE RECEIVED:	04/29/14
PREP. BATCH:	VO67D21	VO67D21	VO67D21		
CALIB. REF:	RDC168	RDC168	RDC168		

ACCESSION:

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Benzene	ND	10.0	9.32	93	10.0	9.17	92	2	80-120	30
Bromodichloromethane	ND	10.0	9.65	97	10.0	9.37	94	3	75-120	30
Bromoform	ND	10.0	10.1	101	10.0	9.80	98	3	70-130	30
Bromomethane	ND	10.0	10.6	106	10.0	9.80	98	7	30-145	30
Carbon Tetrachloride	ND	10.0	8.35	83	10.0	8.20	82	2	65-140	30
Chlorobenzene	ND	10.0	9.78	98	10.0	9.68	97	1	80-120	30
Chloroethane	ND	10.0	11.0	110	10.0	10.1	101	8	60-135	30
Chloroform	ND	10.0	9.84	98	10.0	9.56	96	3	65-135	30
Chloromethane	ND	10.0	10.2	102	10.0	9.58	96	7	40-125	30
Dibromochloromethane	ND	10.0	9.64	96	10.0	9.49	95	2	60-135	30
1,2-Dichlorobenzene	ND	10.0	10.3	103	10.0	10.1	101	2	70-120	30
1,3-Dichlorobenzene	ND	10.0	10.1	101	10.0	9.91	99	2	75-125	30
1,4-Dichlorobenzene	ND	10.0	10.0	100	10.0	9.87	99	1	75-125	30
Dichlorodifluoromethane (Freon 12)	ND	10.0	9.93	99	10.0	9.39	94	6	30-155	30
1,1-Dichloroethane	ND	10.0	9.27	93	10.0	8.99	90	3	70-135	30
1,2-Dichloroethane	ND	10.0	7.97	80	10.0	7.88	79	1	70-130	30
1,1-Dichloroethene	ND	10.0	7.58	76	10.0	7.41	74	2	70-130	30
1,2-Dichloroethene (Total)	ND	20.0	17.1	85	20.0	16.6	83	3	70-125	30
1,2-Dichloropropane	ND	10.0	9.90	99	10.0	9.70	97	2	75-125	30
Trans-1,3-Dichloropropene	ND	10.0	8.39	84	10.0	8.49	85	1	55-140	30
cis-1,3-Dichloropropene	ND	10.0	9.23	92	10.0	8.93	89	3	70-130	30
Ethylbenzene	ND	10.0	9.84	98	10.0	9.67	97	2	75-125	30
Methylene Chloride	ND	10.0	8.28	83	10.0	8.40	84	1	55-140	30
1,1,2,2-Tetrachloroethane	ND	10.0	10.5	105	10.0	10.3	103	2	65-130	30
Tetrachloroethene	ND	10.0	9.31	93	10.0	9.20	92	1	45-150	30
Toluene	ND	10.0	9.57	96	10.0	9.47	95	1	75-120	30
1,1,1-Trichloroethane	ND	10.0	8.74	87	10.0	8.56	86	2	65-130	30
1,1,2-Trichloroethane	ND	10.0	10.3	103	10.0	10.3	103	0	75-125	30
Trichlorofluoromethane (Freon 11)	ND	10.0	10.8	108	10.0	9.93	99	9	60-145	30
Trichloroethene	ND	10.0	9.46	95	10.0	9.19	92	3	70-125	30
Vinyl Chloride	ND	10.0	10.3	103	10.0	9.61	96	7	50-145	30
Xylenes (Total)	ND	30.0	28.5	95	30.0	28.0	93	2	80-120	30

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	QC LIMIT (%)
1,2-Dichloroethane-d4	10.0	8.20	82	10.0	8.24	82	70-120
4-Bromofluorobenzene	10.0	9.69	97	10.0	9.70	97	75-120
Toluene-d8	10.0	10.4	104	10.0	10.4	104	85-120
Dibromofluoromethane	10.0	9.92	99	10.0	9.85	98	85-115

Figure 10: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ INC.

Project : CLEAN WATER PROJECT

SDG : YYDNNN

METHOD SW5030C/8260B
VOLATILE ORGANICS BY GC/MS

A total of two (2) water samples were received on 04/29/14 for Volatile Organics by GC/MS analysis, Method 5030C/8260B in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods and Project QAPP Clean Water Project.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms of ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Results were compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for VO67D21L/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries and RPDs for MNNN-02M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits. Refer to sample result forms for details.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met; otherwise, anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in Table 5	Retune instrument and verify		
Multi point Initial Calibration(ICAL) minimum of 5 points	Initially; as needed	SPCCs : RF ≥ 0.1 for Bromoform, Chloromethane and 1,1-Dichloroethane RF ≥ 0.3 for Chlorobenzene and 1,1,2,2-Tetrachloroethane CCCs: RSD ≤ 30% for the following analytes: Chloroform, 1,1-DCE, 1,2-DCP, Ethylbenzene, Toluene and Vinyl Chloride. 1.) if RRF is applied, then RSD ≤ 15% 2.) If 1st order is applied, then r ≥ 0.995 with min 5 pt ICAL 3.) If 2nd order is applied, then r ≥ 0.99 with min 6 pt ICAL	Check for outliers. Otherwise, optimize the instrument then repeat initial calibration.		
Initial calibration verification (ICV)	After initial calibration	All analytes within ± 20% of expected value except for the following compounds due to erratic chromatographic behavior: Bromomethane, Chloroethane, Chloromethane, Dichlorodifluoromethane but must be within ± 35% of expected value.	Verify second source standard. Prepare fresh standard and rerun ICV. If that fails, Optimize instrument and repeat ICAL.		
Evaluation of relative retention times (RRT)	Each sample	Within ± 0.06 RRT units	Correct the problem then reanalyze all samples analyzed since the last retention time check		
Continuing Calibration verification (CCV)	Daily, before sample analysis and every 12 hours of analysis time	SPCCs: Min. RF same as ICAL CCC : %Diff ≤ 20% (when using RFs) or drift (when using least squares regression or non-linear calibration)	Correct the problem then repeat initial calibration		
Internal Standard (IS)	All samples	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		
Method blank (MB)	One per preparation batch	No analytes detected > ½ LOQ	Rule out instrument contamination by re-analyzing the MB. If problem persist refer to PSR. In the absence of PSR, report NDs and results >10X of the MB concentration. Otherwise, cure contamination source, re-prep and re-analyze method blank and all associated samples.		
LCS	One LCS per preparation	Within project QC Limits	Re-prep and re-analyze the LCS and all associated samples		
MS/MSD	One MS/MSD per every 20 project samples per matrix	Within project QC Limits	Check if sample was properly spiked. If indicative of matrix interference, discuss in case narrative, otherwise re-prep and re-analyze the sample		
Surrogate	Every Sample, MB, LCS, MS/MSD, DCC	Within project QC Limits	Correct the problem then re-analyze		
Comments: This QCP is applicable in the absence of the PSR Report values between LOD and LOQ. Refer to PSR for Flagging Criteria.			Reviewed by: Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY for 25 ml

DEMONSTRATION OF CAPABILITY
METHOD: SW 8260

Unit: µg/L
Sample Amount(ml): 25
Sample Purge(ml): 25

Date Analyzed: 01/31 & 02/01/12
Analyzed by: D. Nguyen

PARAMETER	RAY133	RAY134	RBY004	RBY005	True Value	Ave. Conc.	Ave. % Rec.	Std. Dev.	RSD	QC Criteria	Comments
	VOF5A10L	VOF5A10C	VOF5B01L	VOF5B01C							
Acetone	46.2	49.8	45.0	49.4	50	47.6	95	2.378	5	60 - 130	Passed
Acetonitrile	83.4	86.1	88.7	83.0	100	85.3	85	2.632	3	50 - 130	Passed
Acrolein	47.0	50.2	42.0	48.0	50	46.8	94	3.502	7	10 - 160	Passed
Acrylonitrile	50.0	52.1	45.0	51.3	50	49.6	99	3.188	6	60 - 150	Passed
Benzene	9.39	10.0	9.71	9.62	10	9.69	97	0.255	3	70 - 130	Passed
Bromobenzene	9.65	10.4	9.85	10.1	10	10.0	100	0.344	3	70 - 130	Passed
Bromochloromethane	9.08	9.78	9.18	9.48	10	9.4	94	0.315	3	70 - 130	Passed
Bromodichloromethane	9.58	10.1	9.81	10.0	10	9.9	99	0.239	2	70 - 130	Passed
Bromoform	9.70	10.3	9.00	10.0	10	9.76	98	0.568	6	60 - 130	Passed
Bromomethane	9.49	10.2	10.6	10.3	10	10.14	101	0.465	5	50 - 140	Passed
tert-Butyl alcohol	51.8	54.4	42.6	48.4	50	49.3	99	5.096	10	50 - 150	Passed
2-Butanone (MEK)	49.3	51.8	42.1	50.5	50	48.4	97	4.344	9	70 - 130	Passed
n-Butylbenzene	10.0	10.8	11.1	10.4	10	10.6	106	0.472	4	70 - 130	Passed
sec-Butylbenzene	9.94	10.8	10.8	10.5	10	10.5	105	0.397	4	70 - 130	Passed
tert-Butylbenzene	8.78	9.46	9.31	8.95	10	9.1	91	0.315	3	70 - 130	Passed
Carbon disulfide	9.24	10.2	8.45	8.74	10	9.15	92	0.755	8	50 - 130	Passed
Carbon tetrachloride	9.24	10.0	10.0	9.65	10	9.7	97	0.343	4	60 - 130	Passed
Chlorobenzene	9.08	9.68	9.39	9.22	10	9.3	93	0.257	3	70 - 130	Passed
2-Chloroethyl vinyl ether	9.55	9.91	8.16	9.38	10	9.3	93	0.760	8	10 - 160	Passed
Chloroethane	9.11	9.81	9.89	10.1	10	9.72	97	0.414	4	60 - 130	Passed
Chloroform	9.02	9.65	9.54	9.39	10	9.4	94	0.272	3	70 - 130	Passed
1-Chlorohexane	8.77	9.38	9.10	8.85	10	9.0	90	0.278	3	70 - 130	Passed
Chloromethane	9.12	9.52	9.39	9.53	10	9.39	94	0.191	2	50 - 130	Passed
2-Chlorotoluene	9.86	10.7	10.1	10.7	10	10.3	103	0.433	4	70 - 130	Passed
4-Chlorotoluene	9.70	10.4	11.1	9.9	10	10.3	103	0.611	6	70 - 130	Passed
Isopropyl ether (DIPE)	9.76	10.4	9.33	9.68	10	9.8	98	0.435	4	70 - 130	Passed
Dibromochloromethane	9.85	10.4	9.62	10.2	10	10.0	100	0.346	3	70 - 130	Passed
1,2-Dibromo-3-chloropropane	9.14	9.80	8.25	8.90	10	9.02	90	0.641	7	60 - 130	Passed
1,2-Dibromoethane	9.90	10.5	9.39	10.2	10	10.0	100	0.487	5	70 - 130	Passed
Dibromomethane	9.82	10.3	8.87	9.58	10	9.6	96	0.584	6	70 - 130	Passed
1,1-Dichloroethane	9.15	9.83	9.42	9.31	10	9.4	94	0.292	3	70 - 130	Passed
1,2-Dichloroethane	9.45	10.0	9.52	9.89	10	9.7	97	0.261	3	70 - 130	Passed
1,2-Dichlorobenzene	8.98	9.68	9.33	9.26	10	9.3	93	0.290	3	70 - 130	Passed
1,3-Dichlorobenzene	9.61	10.4	9.92	9.88	10	9.9	99	0.327	3	70 - 130	Passed
trans-1,4-Dichloro-2-Butene	10.6	11.5	9.58	10.8	10	10.6	106	0.812	8	50 - 140	Passed
1,4-Dichlorobenzene	9.82	10.6	10.1	10.1	10	10.2	102	0.340	3	70 - 130	Passed
Dichlorodifluoromethane	9.14	10.0	9.22	9.67	10	9.50	95	0.383	4	50 - 140	Passed
1,1-Dichloroethene	9.17	9.8	9.40	9.27	10	9.4	94	0.289	3	60 - 130	Passed
cis-1,2-Dichloroethene	9.40	10.1	9.71	9.60	10	9.7	97	0.285	3	70 - 130	Passed
trans-1,2-Dichloroethene	9.27	9.83	9.34	9.21	10	9.4	94	0.282	3	60 - 130	Passed
Dichlorofluoromethane	8.27	9.12	9.84	9.25	10	9.12	91	0.646	7	70 - 130	Passed
1,1-Dichloropropene	9.42	10.2	9.79	9.72	10	9.8	98	0.319	3	70 - 130	Passed
1,2-Dichloropropane	9.43	10.0	9.48	9.68	10	9.6	96	0.256	3	70 - 130	Passed
1,3-Dichloropropane	9.82	10.4	9.54	10.1	10	10.0	100	0.359	4	70 - 130	Passed

Appendix 2 (cont.): DEMONSTRATION OF CAPABILITY for 25 ml

DEMONSTRATION OF CAPABILITY
METHOD: SW 8260

Unit: µg/L
Sample Amount(ml): 25
Sample Purge(ml): 25

Date Analyzed: 01/31 & 02/01/12
Analyzed by: D. Nguyen

PARAMETER	RAY133	RAY134	RBY004	RBY005	True Value	Ave. Conc.	Ave. % Rec.	Std. Dev.	RSD	QC Criteria	Comments
	VOF5A10L	VOF5A10C	VOF5B01L	VOF5B01C							
2,2-Dichloropropane	9.07	10.4	10.2	9.65	10	9.8	98	0.598	6	60 - 140	Passed
cis-1,3-Dichloropropene	10.0	10.7	10.0	10.3	10	10.3	103	0.339	3	70 - 130	Passed
trans-1,3-Dichloropropene	9.30	9.75	9.06	9.42	10	9.4	94	0.288	3	70 - 130	Passed
tert-Butyl ethyl ether (ETB	11.1	11.8	10.1	10.8	10	11.0	110	0.685	6	70 - 130	Passed
Ethyl Methacrylate	9.30	9.68	8.15	9.21	10	9.1	91	0.656	7	70 - 130	Passed
Ethylbenzene	9.47	10.1	10.0	9.68	10	9.8	98	0.300	3	70 - 130	Passed
2-Hexanone (MBK)	50.6	52.3	42.7	50.6	50	49.0	98	4.298	9	70 - 140	Passed
Hexachlorobutadiene	8.21	8.92	8.99	8.08	10	8.6	86	0.469	5	70 - 130	Passed
Iodomethane	9.16	10.0	9.31	9.21	10	9.43	94	0.417	4	50 - 150	Passed
Isopropylbenzene	10.4	11.2	11.0	10.8	10	10.9	109	0.380	3	70 - 130	Passed
p-Isopropyltoluene	10.1	11.0	11.0	10.4	10	10.6	106	0.423	4	70 - 130	Passed
Methylene Chloride	8.56	9.09	8.74	8.87	10	8.8	88	0.225	3	60 - 130	Passed
4-Methyl-2-pentanone (MIBK)	52.9	54.7	45.5	53.6	50	51.7	103	4.184	8	70 - 130	Passed
tert-Butyl methyl ether	10.1	10.7	8.99	10.1	10	10.0	100	0.723	7	60 - 130	Passed
Naphthalene	10.3	10.7	9.41	9.88	10	10.07	101	0.565	6	50 - 140	Passed
n-Propylbenzene	10.6	11.4	11.2	11.1	10	11.1	111	0.369	3	70 - 130	Passed
Styrene	9.63	10.4	10.0	9.8	10	10.0	100	0.311	3	70 - 130	Passed
tert-Amyl methyl ether (TAME)	11.3	12.0	10.2	11.1	10	11.1	111	0.747	7	60 - 140	Passed
1,1,1,2-Tetrachloroethane	9.32	9.91	9.59	9.54	10	9.6	96	0.246	3	70 - 130	Passed
1,1,2,2-Tetrachloroethane	9.92	10.6	9.52	10.5	10	10.1	101	0.501	5	60 - 130	Passed
Tetrachloroethene	9.08	9.77	9.50	9.01	10	9.3	93	0.356	4	60 - 130	Passed
Toluene	9.68	10.3	10.1	9.94	10	10.0	100	0.262	3	70 - 130	Passed
1,1,1-Trichloroethane	8.83	10.0	10.2	9.52	10	9.6	96	0.591	6	70 - 130	Passed
1,1,2-Trichloroethane	9.67	10.1	9.45	10.1	10	9.8	98	0.346	4	70 - 130	Passed
1,2,3-Trichlorobenzene	8.77	9.14	8.46	8.40	10	8.7	87	0.339	4	60 - 130	Passed
1,2,4-Trichlorobenzene	9.04	9.63	8.93	8.60	10	9.1	91	0.432	5	60 - 140	Passed
Trichloroethene	9.21	9.93	9.42	9.29	10	9.5	95	0.326	3	70 - 130	Passed
Trichlorofluoromethane	9.06	9.62	10.1	10.3	10	9.76	98	0.544	6	60 - 140	Passed
1,2,3-Trichloropropane	9.93	10.5	9.45	10.6	10	10.1	101	0.524	5	70 - 130	Passed
1,1,2-Trichloro1,2,2-trifluoroethane	8.70	9.49	9.45	9.05	10	9.2	92	0.376	4	60 - 150	Passed
1,2,4-Trimethylbenzene	9.8	10.6	10.6	10.2	10	10.3	103	0.374	4	70 - 130	Passed
1,3,5-Trimethylbenzene	9.9	10.7	10.5	10.2	10	10.3	103	0.335	3	70 - 130	Passed
Vinyl Acetate	10.9	11.0	9.68	11.1	10	10.66	107	0.662	6	40 - 150	Passed
Vinyl Chloride	8.26	8.56	9.02	9.01	10	8.71	87	0.372	4	60 - 130	Passed
m-Xylene & p-xylene	19.2	20.6	20.4	19.6	20	19.9	100	0.633	3	60 - 140	Passed
o-Xylene	8.80	9.41	9.18	8.93	10	9.1	91	0.270	3	70 - 130	Passed
1,2-Dichloroethane-d4	10.0	10.0	9.9	10.3	10	10.05	101	0.200	2	70 - 130	Passed
Toluene-d8	10.3	10.3	10.4	10.3	10	10.32	103	0.046	0.5	70 - 130	Passed
4-Bromofluorobenzene	10.6	10.6	10.5	10.9	10	10.68	107	0.189	2	70 - 130	Passed
Dibromofluoromethane	10.0	9.93	10.1	10.2	10	10.06	101	0.106	1	70 - 130	Passed

Appendix 3: DEMONSTRATION OF CAPABILITY for 5 ml

DEMONSTRATION OF CAPABILITY
METHOD: SW 8260

Unit: µg/L
Sample Amount(ml): 5
Sample Purge(ml): 5

Date Analyzed: 01/07/13 & 01/08/13
Analyzed by: C. Mendoza

PARAMETER	RAN044 VSF4A07L	RAN045 VSF4A07C	RAN058 VSF4A08L	RAN059 VSF4A08C	True Value	Ave. Conc.	Ave. % Rec.	Std. Dev.	RSD	QC Criteria	Comments
Acetone	261	261	275	272	250	267	107	7.569	3	60 130	Passed
Acetonitrile	540	546	510	533	500	532	106	15.685	3	30 160	Passed
Acrolein	334	330	337	325	250	331	133	5.396	2	30 160	Passed
Acrylonitrile	269	270	278	271	250	272	109	4.119	2	70 130	Passed
Benzene	51.0	52.3	48.2	49.6	50	50.3	101	1.744	3	70 130	Passed
Bromobenzene	46.8	48.0	45.4	46.2	50	46.6	93	1.104	2	70 130	Passed
Bromochloromethane	51.7	52.2	50.7	51.2	50	51.5	103	0.611	1	70 130	Passed
Bromodichloromethane	49.5	50.8	48.4	49.2	50	49.5	99	1.022	2	70 130	Passed
Bromoform	47.8	48.6	45.6	47.5	50	47.4	95	1.282	3	70 130	Passed
Bromomethane	54.8	51.5	50.4	50.5	50	51.8	104	2.076	4	60 130	Passed
tert-Butyl alcohol	281	286	255	271	250	273	109	13.989	5	60 140	Passed
2-Butanone (MEK)	279	278	284	282	250	281	112	3.049	1	70 130	Passed
n-Butylbenzene	53.8	54.5	49.7	50.6	50	52.2	104	2.387	5	70 130	Passed
sec-Butylbenzene	52.0	52.5	47.9	49.4	50	50.5	101	2.181	4	70 130	Passed
tert-Butylbenzene	52.4	52.3	48.2	49.6	50	50.6	101	2.047	4	70 130	Passed
Carbon disulfide	48.2	46.9	44.2	46.0	50	46.4	93	1.669	4	60 130	Passed
Carbon tetrachloride	52.9	53.1	49.7	51.2	50	51.7	103	1.588	3	70 130	Passed
Chlorobenzene	49.3	50.2	47.1	47.9	50	48.6	97	1.402	3	70 130	Passed
2-Chloroethyl vinyl ether	50.1	49.7	36.4	38.4	50	43.7	87	7.258	17	50 150	Passed
Chloroethane	58.5	52.1	53.0	53.1	50	54.2	108	2.944	5	70 130	Passed
Chloroform	52.1	52.6	50.9	51.3	50	51.7	103	0.749	1	70 130	Passed
1-Chlorohexane	56.0	56.6	50.6	51.8	50	53.7	107	2.974	6	70 130	Passed
Chloromethane	53.8	48.8	48.5	50.0	50	50.3	101	2.456	5	60 130	Passed
2-Chlorotoluene	49.0	48.9	45.9	46.6	50	47.6	95	1.619	3	70 130	Passed
4-Chlorotoluene	51.9	53.0	49.5	49.8	50	51.1	102	1.675	3	70 130	Passed
2-Chloro-1,1,1-trifluoroethane	54.6	53.8	51.2	54.3	50	53.5	107	1.562	3	30 160	Passed
Chlorotrifluoroethylene	46.4	44.7	41.6	45.6	50	44.6	89	2.093	5	30 160	Passed
Dibromochloromethane	48.4	49.7	47.4	47.9	50	48.4	97	1.017	2	70 130	Passed
1,2-Dibromo-3-chloropropane	47.1	47.9	44.3	45.6	50	46.2	92	1.577	3	60 130	Passed
1,2-Dibromoethane	49.2	50.7	47.3	48.4	50	48.9	98	1.452	3	70 130	Passed
Dibromomethane	48.1	49.6	47.1	48.3	50	48.3	97	1.022	2	70 130	Passed
1,1-Dichloroethane	55.3	55.9	52.7	53.4	50	54.3	109	1.554	3	70 130	Passed
1,2-Dichloroethane	49.5	50.1	48.7	49.8	50	49.5	99	0.593	1	70 130	Passed
1,2-Dichlorobenzene	47.0	47.6	45.5	45.6	50	46.4	93	1.084	2	70 130	Passed
1,3-Dichlorobenzene	48.6	49.3	45.9	46.2	50	47.5	95	1.704	4	70 130	Passed
trans-1,4-Dichloro-2-Butene	51.0	50.7	48.7	50.0	50	50.1	100	1.012	2	70 130	Passed
1,4-Dichlorobenzene	49.0	49.7	46.6	46.7	50	48.0	96	1.599	3	70 130	Passed
Dichlorodifluoromethane	51.3	47.0	46.7	47.4	50	48.1	96	2.151	4	60 130	Passed
1,1-Dichloroethene	58.3	58.5	54.2	55.1	50	56.5	113	2.189	4	70 130	Passed
cis-1,2-Dichloroethene	53.3	53.5	50.9	51.2	50	52.2	104	1.358	3	70 130	Passed
trans-1,2-Dichloroethene	55.7	55.7	51.9	52.8	50	54.0	108	1.960	4	70 130	Passed
Dichlorofluoromethane	56.9	57.0	54.7	55.1	50	55.9	112	1.234	2	70 130	Passed
1,1-Dichloropropene	53.1	53.5	48.5	49.7	50	51.2	102	2.483	5	70 130	Passed
1,2-Dichloropropane	51.0	52.2	48.8	50.4	50	50.6	101	1.413	3	70 130	Passed

Appendix 3 (cont.): DEMONSTRATION OF CAPABILITY for 5 ml

DEMONSTRATION OF CAPABILITY
METHOD: SW 8260

Unit: µg/L
Sample Amount(ml): 5
Sample Purge(ml): 5

Date Analyzed: 01/07/13 & 01/08/13
Analyzed by: C. Mendoza

PARAMETER	RAN044 VSF4A07L	RAN045 VSF4A07C	RAN058 VSF4A08L	RAN059 VSF4A08C	True Value	Ave. Conc.	Ave. % Rec.	Std. Dev.	RSD	QC Criteria	Comments
1,3-Dichloropropane	49.4	50.8	47.8	49.3	50	49.3	99	1.251	3	70 130	Passed
2,2-Dichloropropane	57.2	57.1	54.0	54.5	50	55.7	111	1.706	3	70 140	Passed
cis-1,3-Dichloropropene	51.3	52.8	49.1	50.4	50	50.9	102	1.548	3	70 130	Passed
trans-1,3-Dichloropropene	51.2	52.4	49.6	50.5	50	50.9	102	1.191	2	70 130	Passed
tert-Butyl ethyl ether (ETB	56.5	57.2	53.8	55.1	50	55.7	111	1.523	3	70 130	Passed
Ethyl Methacrylate	52.9	53.6	49.9	51.0	50	52	104	1.679	3	30 160	Passed
Ethylbenzene	51.6	52.9	48.5	49.6	50	50.7	101	1.946	4	70 130	Passed
2-Hexanone (MBK)	275	275	284	277	250	278.0	111	4.403	2	70 130	Passed
Hexachlorobutadiene	47.3	49.2	45.7	45.1	50	46.8	94	1.814	4	70 130	Passed
Iodomethane	40.7	39.4	36.9	39.0	50	39.0	78	1.595	4	60 130	Passed
Isopropyl ether (DIPE)	57.2	58.2	54.5	56.0	50	56.5	113	1.595	3	70 130	Passed
Isopropylbenzene	52.1	52.3	48.0	49.5	50	50.5	101	2.093	4	70 130	Passed
p-Isopropyltoluene	52.4	53.0	48.7	49.2	50	51	102	2.199	4	70 130	Passed
Methyl acetate	52.9	52.1	54.2	55.6	50	53.7	107	1.525	3	30 160	Passed
Methylene Chloride	50.4	51.6	49.6	50.2	50	50.5	101	0.856	2	70 130	Passed
4-Methyl-2-pentanone (MIBK)	278	279	283	276	250	278.7	111	2.713	1	70 130	Passed
tert-Butyl methyl ether	54.7	55.3	52.6	53.8	50	54.1	108	1.140	2	70 130	Passed
Naphthalene	43.7	44.3	40.8	39.8	50	42.2	84	2.180	5	60 140	Passed
n-Propylbenzene	51.9	52.3	47.9	49.3	50	50.4	101	2.098	4	70 130	Passed
Styrene	51.6	53.2	49.6	50.4	50	51.2	102	1.553	3	70 130	Passed
tert-Amyl methyl ether (TAME)	55.3	56.0	53.3	54.2	50	54.7	109	1.212	2	70 130	Passed
1,1,1,2-Tetrachloroethane	48.7	50.4	47.5	48.2	50	48.7	97	1.250	3	30 160	Passed
1,1,2,2-Tetrachloroethane	49.1	49.2	45.7	47.4	50	47.9	96	1.652	3	30 160	Passed
Tetrachloroethene	50.6	51.2	47.0	48.0	50	49.2	98	2.014	4	70 130	Passed
Toluene	51.3	52.4	48.6	49.7	50	50.5	101	1.718	3	70 130	Passed
1,1,1-Trichloroethane	55.0	55.2	52.6	52.9	50	53.9	108	1.405	3	30 160	Passed
1,1,2-Trichloroethane	48.3	50.1	46.3	48.0	50	48.2	96	1.553	3	30 160	Passed
1,2,3-Trichlorobenzene	48.0	49.6	46.0	44.8	50	47.1	94	2.140	5	70 130	Passed
1,2,4-Trichlorobenzene	50.8	51.5	46.7	45.5	50	48.6	97	2.965	6	70 130	Passed
Trichloroethene	50.7	51.5	47.7	48.3	50	49.5	99	1.834	4	70 130	Passed
Trichlorofluoromethane	61.7	55.1	54.8	55.3	50	56.7	113	3.322	6	70 140	Passed
1,2,3-Trichloropropane	47.8	47.7	45.6	47.4	50	47.1	94	1.036	2	70 130	Passed
1,1,2-Trichloro1,2,2-trifluoroethane	57.4	56.8	52.9	53.6	50	55.2	110	2.264	4	70 - 130	Passed
1,2,4-Trimethylbenzene	51.5	52.0	48.2	49.2	50	50.2	100	1.810	4	70 130	Passed
1,3,5-Trimethylbenzene	51.7	52.3	48.0	49.2	50	50.3	101	2.016	4	70 130	Passed
Vinyl Acetate	65.3	59.2	58.1	58.5	50	60.3	121	3.366	6	50 140	Passed
Vinyl Chloride	59.8	52.9	54.5	54.5	50	55.4	111	3.040	5	70 140	Passed
m-Xylene & p-xylene	103	105	97.0	98.7	100	101.0	101	3.765	4	70 130	Passed
o-Xylene	52.3	53.5	49.4	50.7	50	51.5	103	1.786	3	70 130	Passed
Allyl Chloride	57.3	58.3	54.1	55.5	50	56.3	113	1.869	3	30 160	Passed

Appendix 4: DEMONSTRATION OF CAPABILITY for 5 g

DEMONSTRATION OF CAPABILITY
METHOD: SW 8260

Unit: µg/Kg
Sample Amount(g): 5
Sample Purge(ml): 5

Date Analyzed: 03/20 & 03/21/12
Analyzed by: C. Mendoza

PARAMETER	RCP061 VO02C04L	RCP062 VO02C04C	RCP086 VO02C06L	RCP087 VO02C06C	True Value	Ave. Conc.	Ave. % Rec.	Std. Dev.	RSD	QC Criteria	Comments
Acetone	259	264	288	281	250	273	109	14.006	5	40 - 140	Passed
Acetonitrile	480	506	528	546	500	515	103	28.361	6	50 - 150	Passed
Acrylonitrile	240	245	275	268	250	257	103	17.133	7	10 - 160	Passed
Benzene	50.1	49.3	49.9	49.6	50	49.7	99	0.364	1	70 - 130	Passed
Bromobenzene	49.3	47.4	48.9	49.1	50	48.7	97	0.838	2	70 - 130	Passed
Bromochloromethane	52.6	53.3	55.0	56.1	50	54.2	108	1.592	3	70 - 130	Passed
Bromodichloromethane	50.1	49.8	51.8	52.2	50	51.0	102	1.207	2	70 - 130	Passed
Bromoform	49.2	49.2	50.3	49.6	50	49.6	99	0.501	1	70 - 130	Passed
Bromomethane	46.4	46.6	45.4	46.7	50	46.3	93	0.585	1	60 - 130	Passed
tert-Butyl alcohol	254	266	274	285	250	270	108	13.169	5	40 - 150	Passed
2-Butanone (MEK)	246	251	271	260	250	257	103	11.327	4	60 - 140	Passed
n-Butylbenzene	53.2	51.3	52.5	53.9	50	52.7	105	1.105	2	70 - 130	Passed
sec-Butylbenzene	52.1	51.3	51.9	52.3	50	51.9	104	0.441	1	70 - 130	Passed
tert-Butylbenzene	48.4	48.0	48.7	49.4	50	48.6	97	0.572	1	70 - 130	Passed
Carbon disulfide	48.1	49.8	52.1	42.5	50	48.1	96	4.087	8	60 - 130	Passed
Carbon tetrachloride	52.5	51.2	52.2	51.2	50	51.8	104	0.666	1	70 - 130	Passed
Chlorobenzene	51.3	51.3	49.8	51.2	50	50.9	102	0.728	1	70 - 130	Passed
2-Chloroethyl vinyl ether	57.8	57.8	51.8	51.2	50	54.6	109	3.681	7	50 - 140	Passed
Chloroethane	55.0	56.1	52.3	53.3	50	54.2	108	1.696	3	70 - 140	Passed
Chloroform	55.4	55.5	53.0	54.3	50	54.5	109	1.171	2	70 - 130	Passed
1-Chlorohexane	53.3	51.9	51.8	52.2	50	52.3	105	0.678	1	70 - 130	Passed
Chloromethane	49.5	51.4	50.8	52.4	50	51.0	102	1.201	2	60 - 130	Passed
2-Chlorotoluene	44.7	48.4	45.5	48.0	50	46.6	93	1.814	4	70 - 130	Passed
4-Chlorotoluene	57.2	51.0	56.4	52.5	50	54.3	109	3.031	6	60 - 130	Passed
Dibromochloromethane	49.5	49.7	51.1	52.9	50	50.8	102	1.574	3	70 - 130	Passed
1,2-Dibromo-3-chloropropane	44.9	46.0	47.8	48.2	50	46.7	93	1.570	3	60 - 130	Passed
1,2-Dibromoethane	47.2	48.1	50.3	50.4	50	49.0	98	1.600	3	70 - 130	Passed
Dibromomethane	48.8	48.5	49.8	50.6	50	49.4	99	0.957	2	70 - 130	Passed
1,1-Dichloroethane	55.4	55.2	54.5	55.8	50	55.2	110	0.518	1	70 - 130	Passed
1,2-Dichloroethane	51.3	50.9	51.7	51.1	50	51.3	103	0.310	1	70 - 130	Passed
1,2-Dichlorobenzene	50.3	50.3	49.0	50.0	50	49.9	100	0.602	1	70 - 130	Passed
1,3-Dichlorobenzene	50.6	50.0	50.0	50.8	50	50.3	101	0.429	1	70 - 130	Passed
trans-1,4-Dichloro-2-Butene	48.8	47.7	53.8	52.2	50	50.6	101	2.848	6	60 - 140	Passed
1,4-Dichlorobenzene	51.7	51.0	49.8	50.8	50	50.8	102	0.775	2	70 - 130	Passed
Dichlorodifluoromethane	66.9	67.2	58.9	59.2	50	63.1	126	4.620	7	60 - 130	Passed
1,1-Dichloroethene	51.9	53.0	52.1	54.3	50	52.8	106	1.104	2	60 - 130	Passed
cis-1,2-Dichloroethene	49.5	49.2	53.0	54.8	50	51.6	103	2.725	5	70 - 130	Passed
trans-1,2-Dichloroethene	53.2	52.2	54.2	55.1	50	53.7	107	1.267	2	70 - 130	Passed
Dichlorofluoromethane	49.3	51.4	53.2	56.7	50	52.6	105	3.134	6	70 - 130	Passed
1,1-Dichloropropene	51.5	49.7	50.8	50.5	50	50.6	101	0.753	1	70 - 130	Passed
1,2-Dichloropropane	50.5	49.7	52.0	51.8	50	51.0	102	1.108	2	70 - 130	Passed
1,3-Dichloropropane	47.6	47.9	50.9	51.5	50	49.5	99	2.010	4	70 - 130	Passed
2,2-Dichloropropane	56.3	55.0	54.4	55.9	50	55.4	111	0.857	2	60 - 140	Passed
cis-1,3-Dichloropropene	51.7	51.3	52.3	52.4	50	52.0	104	0.517	1	70 - 130	Passed

Appendix 4 (cont.): DEMONSTRATION OF CAPABILITY for 5 g

DEMONSTRATION OF CAPABILITY
METHOD: SW 8260

Unit: µg/Kg
Sample Amount(g): 5
Sample Purge(ml): 5

Date Analyzed: 03/20 & 03/21/12
Analyzed by: C. Mendoza

PARAMETER	RCP061	RCP062	RCP086	RCP087	True Value	Ave. Conc.	Ave. % Rec.	Std. Dev.	RSD	QC Criteria	Comments
	VO02C04L	VO02C04C	VO02C06L	VO02C06C							
trans-1,3-Dichloropropene	52.6	52.3	53.1	53.7	50	52.9	106	0.623	1	70 - 130	Passed
1,4-Dioxane	878	878	947	958	1000	915	92	43.314	5	50 - 150	Passed
tert-Butyl ethyl ether (ETBE)	54.0	53.9	54.2	55.2	50	54.3	109	0.617	1	70 - 130	Passed
Ethyl Methacrylate	49.5	49.8	51.2	51.4	50	50.5	101	0.964	2	70 - 130	Passed
Ethylbenzene	50.5	50.8	50.7	51.3	50	50.8	102	0.355	1	70 - 130	Passed
2-Hexanone (MBK)	241	247	270	256	250	253	101	12.291	5	20 - 160	Passed
Hexachlorobutadiene	52.6	48.4	49.6	49.2	50	49.9	100	1.873	4	70 - 130	Passed
Iodomethane	61.3	61.7	50.7	52.5	50	56.6	113	5.760	10	60 - 140	Passed
Isopropyl ether (DIPE)	53.2	53.2	54.7	55.5	50	54.2	108	1.156	2	70 - 130	Passed
Isopropylbenzene	55.9	53.8	51.7	50.4	50	52.9	106	2.417	5	70 - 130	Passed
p-Isopropyltoluene	53.6	52.7	51.5	51.5	50	52.3	105	1.040	2	70 - 130	Passed
Methylene Chloride	48.6	49.4	49.9	51.6	50	49.9	100	1.276	3	70 - 130	Passed
4-Methyl-2-pentanone (MIBK)	243	249	266	253	250	253	101	9.792	4	50 - 150	Passed
tert-Butyl methyl ether	51.2	51.8	52.3	53.4	50	52.2	104	0.957	2	70 - 130	Passed
Naphthalene	49.7	47.2	48.9	48.7	50	48.6	97	1.018	2	60 - 140	Passed
n-Propylbenzene	50.2	48.4	51.1	49.9	50	49.9	100	1.136	2	70 - 130	Passed
Styrene	52.6	53.1	51.7	53.0	50	52.6	105	0.637	1	70 - 130	Passed
tert-Amyl methyl ether (TAME)	51.9	52.9	52.4	53.9	50	52.8	106	0.850	2	70 - 130	Passed
1,1,1,2-Tetrachloroethane	50.7	51.8	50.8	52.0	50	51.3	103	0.670	1	70 - 130	Passed
1,1,2,2-Tetrachloroethane	48.3	48.6	50.5	49.7	50	49.3	99	1.013	2	70 - 130	Passed
Tetrachloroethene	52.5	50.5	50.0	50.2	50	50.8	102	1.184	2	70 - 130	Passed
Toluene	49.9	49.3	50.1	50.1	50	49.9	100	0.359	1	70 - 130	Passed
1,1,1-Trichloroethane	55.4	55.0	53.7	54.8	50	54.7	109	0.756	1	70 - 130	Passed
1,1,2-Trichloroethane	49.6	49.4	50.3	51.7	50	50.2	100	1.049	2	70 - 130	Passed
1,2,3-Trichlorobenzene	52.9	49.1	50.9	50.8	50	50.9	102	1.545	3	70 - 130	Passed
1,2,4-Trichlorobenzene	56.6	52.9	52.3	54.2	50	54.0	108	1.911	4	70 - 140	Passed
Trichloroethene	51.4	50.6	49.6	49.4	50	50.3	101	0.955	2	70 - 130	Passed
Trichlorofluoromethane	63.3	61.5	57.5	55.8	50	59.6	119	3.486	6	70 - 140	Passed
1,2,3-Trichloropropane	45.2	45.3	48.9	48.3	50	46.9	94	1.942	4	70 - 130	Passed
1,1,2-Trichloro1,2,2-trifluoroethane	57.2	58.5	50.7	54.4	50	55.2	110	3.450	6	70 - 140	Passed
1,2,4-Trimethylbenzene	52.6	51.3	51.3	51.4	50	51.7	103	0.647	1	70 - 130	Passed
1,3,5-Trimethylbenzene	50.7	49.9	51.0	51.1	50	50.7	101	0.516	1	70 - 130	Passed
Vinyl Acetate	50.9	47.8	59.8	57.1	50	53.9	108	5.524	10	20 - 160	Passed
Vinyl Chloride	55.2	57.3	51.7	52.9	50	54.3	109	2.495	5	60 - 140	Passed
m-Xylene & p-xylene	102	101	101	104	100	102.0	102	1.343	1	70 - 130	Passed
o-Xylene	49.9	50.3	51.3	52.6	50	51.0	102	1.217	2	70 - 130	Passed

8260FS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

PRESERVATION LOG FOR VOLATILES

VP.xls

PrepBatchID	Lab Sample ID	W1 (g)	DateTime	Wf (g)	DateTime	ExpWs(g)	Ws(g)	Prep@Factor	Comments

☐ EMAX-5035 Rev. ☐ Balance Calibration Check performed prior to use Surrogate ID: Prepared By:

☐ Encore+$NaHSO_4 \cdot H_2O$ ☐ BalanceID 25451062 BlankSoil Lot#: Standard Added By:

☐ Frozen Sample ☐ BalanceID 25650797 NaHSO4H2O: Witnessed By:

☐ Pre-weighed vial Expected Ws(g): 5 Extract Rcvd By:

☐ Volumetric dispenser was checked with 5-ml volumetric flask Sample Location:

W1=Weight of Vial + Stirrer+NaHSO4•H2O+Solvent Wf=W1 + Sample

8260FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

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ANALYSIS LOG FOR VOLATILES

SOP ☐ EMAX-8260 Rev.No. __ ☐ EMAX-624 Rev.No. __ ☐ EMAX-8260SIM Rev.No. __ ☐ EMAX-TCPSIM Rev.No. __ ☐ EMAX-M8260SIM Rev.No. __ ☐ EMAX-8260C Rev. No. __

Start Date: ☐ 5-mL Purge ☐ 10-mL Purge ☐ 25-mL Purge Book # A06 -053

BATCH _____

Sample Prep ID	Data File Name	Lab Sample ID	Sample Amount	DF	Matrix W pH < 2	Matrix W Cl_2 < 5ppm	Matrix S	Notes
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

Instrument No.	06
INITIAL CALIBRATION REFERENCE	
DATE	
ICAL ID	

STANDARDS

NAME	ID	Amount (µl)	Conc. (mg/L)
DCC			
DCC			
DCC			
DCC			
BFB			
IS/SURR.			
ICV/LCS			
ICV/LCS			
ICV/LCS			
ICV/LCS			
Data File Folder			
	LOT #		
pH strip			
Chlorine strip			
Methanol			
$NaHSO_4$			
Reagent Water			
Sand			

Electronic Data Archival Location	Date
HPCHEM_VOA/TO06	

Comments: _____

☐ Refer to sample weight log

Analyzed By: _____

Date Disposed: _____ Disposed By:

8260FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: 05 Month: Year: 201_ Book # : MD3-005

DATE						
Bake Trap (210°C-260°C)						
Column Head Pressure (2-60 psi)						
Injector Port Temperature (160°C-220°C)						
Interface Temperature (250°C-280°C)						
Verify Computer Date and Time						
Check Gas Pressure (Daily)						
Check IS/Surrogate auto injection vial as appropriate (Daily)						
Check the foreline pump oil level (Weekly)						
AutoTune the MSD (As needed)						
Analyst's initial						
Trouble Shooting						
Problem(s) Encountered						
Return-to-Control (Analyst Initial)						

Code	Problems Encountered	Code	Corrrective Action

STANDARD OPERATING PROCEDURES

SEMIVOLATILE ORGANICS BY GC/MS

SOP No.:	EMAX-8270	Revision No.	S	Date:	12-Dec-11
Prepared By:	Souzan Grease			Date:	12/08/11
Approved By:	Kenette Pimentel QA Manager			Date:	12.08.11
Approved By:	Caspar Pang Laboratory Director			Date:	12-8-11

Control Number: **8270-05-**

1.0 SCOPE AND APPLICATION

1.1. This method is used to determine the concentration of semivolatile organic compounds extracted from many types of solid waste matrices, soils, air sampling media and water samples. Analytes that are listed in Table 7 were determined when this SOP was established. Additional analytes may be added upon completion of similar validation as the analytes that are listed in Table 7. This SOP is an adaptation of method SW846 8270D. Since 8270D is an update and enhancement of 8270C, this SOP is also applicable to 8270C.

2.0 SUMMARY OF METHOD

2.1. Samples are extracted with methylene chloride. Extracts are concentrated and appropriate cleanup procedure is applied if necessary.

2.2. Internal standards are added to an aliquot of the final extract and are qualitatively and quantitatively analyzed by gas chromatography equipped with mass spectrometry (GC/MS).

2.3. **Interference**

2.3.1. Solvents, reagents, glassware, and other sample processing devices are all possible sources of artifacts and/or interferences to sample analysis. Hence, quality control of chemicals and proper decontamination of re-usable glassware and proofing the analytical instrument to be free from contamination shall be observed.

2.3.2. Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interference. Determine source of interference in the preparation and/or cleanup of the samples and Perform corrective action to eliminate the problem.

2.3.3. Contamination by carry-over can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, rinse the sample syringe with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

2.3.4. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Table 7 for established limits.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The dynamic range established for this method are:

Water (µg/L)	Soil (µg/kg)
10 - 100 µg/L	330 - 3300 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Sample Preservation**

5.1.1. Store water and soil samples at ≤ 6°C away from light without freezing.

5.1.2. Store all extracts at ≤ 6°C without freezing.

5.2. **Holding Time**

5.2.1. Extract water samples within 7 days from sampling date.

5.2.2. Extract soil samples within 14 days from sampling date.

5.2.3. Analyze all extracts within 40 days from extraction completion date.

6.0 ASSOCIATED SOPs

6.1. EMAX-1311 TCLP for Organic and Inorganic Analytes

6.2. EMAX-3510 Extraction, Separatory Funnel

6.3. EMAX-3520 Extraction, Continuous Liquid/Liquid

6.4. EMAX-3540 Extraction, Soxhlet

6.5. EMAX-3550 Extraction, Pulse Sonication

6.6. EMAX-3580 Waste Dilution

6.7. EMAX-3640 Cleanup, GPC

6.8. EMAX-DM01 Data Flow and Review

6.9. EMAX-QA04 Detection Limit (DL)

6.10. EMAX-QA05 Training

6.11. EMAX-QA08 Corrective Action

6.12. EMAX-QC01 Quality Control for Chemicals

6.13. EMAX-QC02 Analytical Standard Preparation

6.14. EMAX-QC07 Glassware Cleaning

6.15. EMAX-SM01 Sample Management

6.16. EMAX-SM03 Waste Disposal

6.17. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS for all chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	Agilent Technologies 7890A with split/splitless injection, Shimadzu GC-17A, or equivalent
Mass Spectrometer	Agilent Technologies 5975C MSD or Shimadzu GCMS – GP 5000 capable of scanning from 1.6 to 1050 amu every 1 second using 70 volts electrode energy in the electron impact ionization mode or equivalent
GC/MS Interface	Capillary-direct into the mass spectrometer source or equivalent
Chromatographic Column	ZB-5MS (20m x 0.18mm x 0.32 µm) or equivalent
Data System	MS-ChemStation with Enviroquant software or equivalent
GC Autosampler	Agilent Technologies 7683B series injector or Shimadzu AOC-20i capable of direct injection of 1 µl and 10 µl of extract.
Gases	Ultra high purity helium
Syringes	10 µl, 25 µl, 50 µl, 100 µl, 250 µl, 500 µl and 1000 µl syringe Hamilton 202N or equivalent
Vials	Autosampler vials with teflon lined septa

8.2. **Chemicals and Reagents**

Solvents	Methylene chloride pesticides grade, high purity methanol
Reagents	Na_2SO_4 reagent grade

9.0 STANDARDS

9.1. Standard Preparation

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.2. Stock Standard

9.2.1. Purchase stock standards as certified solutions from AccuStandard or other reputable vendor (refer to Table 1 for the listing of all certified solutions). The standard is expected to be at 96% purity. Read vendor's note if correction has been applied to certified values otherwise corrections must be applied.

9.2.2. Transfer the stock standard solutions into 2 ml amber vial with Teflon lined screw caps and store at -10°C to -20°C.

9.3. Intermediate Standard

9.3.1. Using stock standard solutions, prepare the intermediate standard in Methylene Chloride according to Table 1.

9.4. Internal Standard

9.4.1. The internal standard shall include 1,4-Dichlorobenzene-d_4, Naphthalene-d_8, Acenaphthalene-d_{10}, Phenanthrene-d_{10}, Chrysene-d_{12} and Perylene-d_{12} in methylene chloride solution.

9.4.2. Purchase internal standard solutions as certified solution from AccuStandard or other reputable vendor at 4,000 µg/ml.

9.4.3. Prepare a 10 ml of 2,000 µg/ml of working internal standard from 4,000 µg/ml (refer to Table 2). Transfer the solution in a properly labeled 10 ml amber vial and store in -10°C to -20°C.

9.5. GC/MS Tuning

9.5.1. The tuning standard shall include decafluorotriphenylphosphine (DFTPP), 4,4-DDT, Pentachlorophenol, and Benzidine.

9.5.2. Purchase tuning standard solution as certified standard at 1000 µg/ml.

9.5.3. Prepare a 10 ml of 50 µg/L of working standard tuning solution (refer to table 2). Transfer the solution in 1 ml amber vial and store in -10°C to -20°C.

9.6. Surrogate Standard

9.6.1. Purchase surrogate stock standards as certified standard.

9.6.1.1. The acid surrogate mixture includes Phenol-d_5, 2-Fluorophenol, and 2,4,6-Tribromophenol at 150 µg/ml.

9.6.1.2. The basic neutral surrogate mixture includes Nitrobenzene-d_5, 2-Fluorobiphenyl, Terphenyl-d_{14}, and 1,2-Dichlorobenzene-d_4 at 50 µg/ml.

9.6.2. For typical extraction [soil: 30g-2ml or water: 1000ml-2ml], add 0.4 ml of surrogate spiking standard to the sample prior to extraction. Spike volume may be adjusted to normalize with

the final extract and yield the same concentration.

9.7. **Calibration Standard**

9.7.1. Prepare working standard solutions for initial calibration and daily calibration (refer to Table 2 for details). Transfer the solutions in 1 ml amber vial and store them at ≤ 6°C without freezing.

9.8. **ICAL Verification Standard (Second Source Verification) (ICV)**

9.8.1. Purchase a certified ICV standard from a different vendor. The ICV standard contains the same list of compounds as the stock standard (refer to Table 1-B for the standard mix and the corresponding vendors).

9.8.2. Prepare a 500 µl of 25 µg/ml check standard solution (refer to Table 2). Transfer the solution in a properly labeled 1 ml amber vial and store at ≤ 6°C without freezing.

9.9. **LCS/MS Spiking Standards**

9.9.1. Purchase spiking standards as certified solutions. The spiking solution may be from the same source as the initial calibration standard[1].

9.9.2. Spike MS/MSD/LCS/LCD samples with 0.2 ml of full spiking solution prior to sample extraction.

9.9.3. Spike volume may be adjusted to normalize with the final extract volume and yield the same concentration.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. For aqueous samples (including TCLP leachates), refer to EMAX-3510 or EMAX-3520 or EMAX-1311. Check the extraction log for presence of residual chlorine.

10.1.2. For solid samples, refer to EMAX-3550 or EMAX-3540.

10.1.3. For waste samples, refer to EMAX-3580.

10.1.4. After extraction, examine the color and consistency of the extract. If the extract appears to be opaque and/or viscous, it is advisable to perform extract cleanup preferably GPC. Refer to EMAX-3640.

10.2. **Instrument Parameters**

10.2.1. Set the instrument parameters as suggested in Table 3. Fine tune the instrument to obtain optimum instrument condition.

10.2.2. Print and display current condition on the instrument for easy access when performing daily instrument routine check.

10.2.3. In the event that instruments parameters necessitate a changed, replace the instrument parameter printout with the new parameter setup and archive the previous instrument parameters in the instrument maintenance log.

[1] SW846 Method 8270D, Section 7.9

10.2.4. Set injection volume to 1 µl to 2 µl.

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

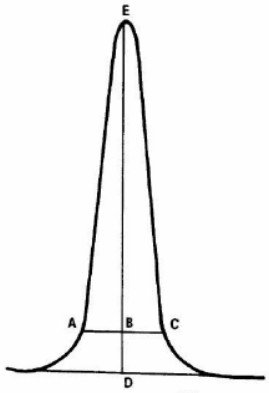
10.3.2. Perform Tune Check

10.3.2.1. Analyze a solution containing 50 µg/ml of tuning standard working solution, DFTTP, DDT, benzidine and pentachlorophenol.

10.3.2.2. Evaluate the tune check by averaging of three scans (the peak apex scan and the scan immediately preceding and the scan immediately following the apex). Apply a background subtraction using a single scan no more than 20 scans prior to the elution of DFTPP. Do not subtract part of the DFTPP peak or any other discrete peak that does not coelute with DFTPP. Use the DFTPP mass intensity criteria in the manufacturer's instructions as primary tuning acceptance criteria otherwise refer to Table 4 for acceptance criteria.

10.3.2.3. Evaluate column performance and injection port inertness using the data acquisition software.

- Degradation of DDT to DDE and DDD must be less than 20% based on area obtained from the total ion chromatogram.
- Benzidine and Pentachlorophenol must be present at their normal responses. Evaluate the tailing factor of benzidine and pentachlorophenol. Tailing factor should not be > 2. Refer to the attached figure for peak evaluation.



TAILING FACTOR= $\frac{BC}{AB}$

Example calculation: Peak Height = DE = 100 mm
10% Peak Height = BD = 10 mm
Peak Width at 10% Peak Height = AC = 23 mm
AB = 11 mm
BC = 12 mm

Therefore: Tailing Factor = $\frac{12}{11}$ = 1.1

10.3.2.4. If tune check is non-compliant, refer to Section 12 for corrective action.

10.3.3. Initial Calibration (ICAL)

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Optimize the instrument condition prior to ICAL.

- Ensure that instrument parameters are set up properly
- Ensure that there is no evidence of leak
- Ensure that instrument maintenance as scheduled is performed

- Ensure that instrument tune check and column performance is not indicative that it is at the threshold of failing the acceptance criteria.

10.3.3.3. Analyze a multi-point initial calibration curve as suggested in Figure 3 after a valid tune check.

10.3.3.4. Generate a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRFm), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq-10.5.1.1, Eq-10.5.1.2, Eq-10.5.1.5 and Eq-10.5.1.6, respectively.

10.3.3.5. Evaluate the ICAL Acceptance

10.3.3.5.1. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.5.2. Evaluate retention time of each analyte with respect to the nearest internal standard. The relative retention time (RRT) of each analyte should agree within ±0.06 RRT units.

10.3.3.5.3. Check the response factors for each analyte as suggested in Table 9. Meeting the minimum response factor is indicative that the analytes are behaving as expected.

10.3.3.5.4. Check RSD and correlation coefficient. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Perform necessary instrument maintenance and repeat calibration. Refer to 10.3.3.2., Section 12 for corrective action.

10.3.3.6. Application of ICAL Curve for Quantitation

10.3.3.6.1. If RSD is ≤20% average response factor may be applied.

10.3.3.6.2. Apply Inverse Weighting Factor ($1/y$ or $1/y^2$; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.99.

10.3.3.6.3. Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.99.

10.3.3.6.4. It may be appropriate to force the regression through zero for specific analytes.[2] When exercising this option [as included in the data acquisition software], make sure that the origin (0,0) is not included as a calibration point but

[2] SW846 Method 8000B, Section 7.5.3

rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.6.5. Re-quantitate the calibration point near or at LOQ and calculate for percent recovery. Percent recovery within ± 30%[3] of their expected values is indicative that calibration accuracy at the lower calibration range is good.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. Initial Calibration Verification (ICV)

10.3.4.1. Verify the concentration of the ICAL by analyzing the ICV from a second source (See Table 2 for standard preparation). Result should be within ±30% of expected value unless otherwise specified by the project.

10.3.4.2. Evaluate the ICV for minimum response factor, internal standard retention time and internal standard response as described in 10.3.5.2.

10.3.4.3. If any of the above criteria is non-compliant, refer to Section 12 for corrective action.

10.3.5. Daily Continuing Calibration (DCC)

10.3.5.1. Analyze DCC (See Table 2 for standard preparation) to check the validity of the ICAL every 12 hour shift unless otherwise specified by the project.

10.3.5.2. DCC Evaluation

- Check that RF is ≥ minimum response factor listed in Table 9.
- Check that all analytes are ≤ 20%D (% Difference for ARF and %Drift for other quantitation technique) unless otherwise specified by the project.
- Check Internal Standard Retention time. Expected retention time is within ± 30 sec from that of the midpoint of the ICAL.
- Check Internal Standard Response. Expected response of extracted ion current profile (EICP) is no greater that a factor of two (-50% to +100%).
- If any of the above criteria is non-compliant, refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. Extract Preparation

10.4.1.1. Allow extracts to equilibrate with room temperature.

10.4.1.2. Measure 300 µl of extract, transfer into an autosampler vial.

10.4.1.3. Add 6 µl of 2000 µg/ml of internal standard (refer to 9.4.3).

10.4.1.4. Seal the vial with Teflon-lined septa cap.

10.4.2. Analytical Sequence

10.4.2.1. Analyze instrument blank.

[3] SW846 Method 8270D, Section 11.4.5.6

10.4.2.2. Analyze DFTPP and evaluate tuning.

10.4.2.3. Analyze DCC and check ICAL validity.

10.4.2.4. Analyze Method Blank.

10.4.2.5. Analyze Lab Control Sample and Lab Control Sample Duplicate (optional).

10.4.2.6. Analyze matrix spikes (MS/MSD) as per project requirement.

10.4.2.7. Analyze samples to a maximum number of 12-hour from the time of DFTPP injection.

10.4.3. Sample Result Evaluation

10.4.3.1. **Check QC criteria**

- Check method blank. If result is non-compliant and analyte in question is not detected in any sample or contamination is < 10X of the sample concentration, results maybe reportable. Verify with the PM if results can be reported.
- Check surrogate recoveries against PSR. In the absence of PSR, default to EMAX QC limits.
- Check concentration of target analytes. Dilute and re-analyze samples having result(s) exceeding calibration range unless otherwise specified by the project. Maintain IS concentration on diluted samples.
- Check Internal Standard Response. Expected response of EICP is no greater that a factor of two (-50% to +100%).
- Check Internal Standard Retention Time. Expected retention time is within ± 30 seconds of the ICAL midpoint.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.4.3.2. **Qualitative Identification**

- The intensities of the characteristic ions must maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Manually integrate the peak if necessary in accordance to EMAX-DM01.
- Investigate visible peaks in the chromatogram that were not identified in the data output. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification[4] (TIC).

[4] Library search is performed only when indicated in the PSR.

- Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting.

10.4.3.3. **Quantitation**

- Apply the appropriate quantitation method (Section 10.5.3) to calculate the concentration of any positively identified target analyte. Apply the sample preparation and dilution factor to calculate for the final concentration of the sample.

10.4.3.4. **Manual Integration**

10.4.3.4.1. Refer to EMAX-DM01 for details of manual integration.

10.4.3.5. **Dealing with Carryover**

- Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction. Otherwise, clean up the system and re-analyze the sample suspected to contain carryover.

10.5. **Calculations**

10.5.1. Initial Calibration

10.5.1.1. **Calculate for Relative Response Factor (RRF)**

$$RRF = \frac{(AX)(CIS)}{(AIS)(CX)} \qquad \text{Eq.-10.5.1.1}$$

where:

AX – Area of characteristic ion for the compound being measured

AIS – Area of characteristic ion for the specific internal standard

CX – Concentration of the compound being measured

CIS – Concentration of the specific internal standard

10.5.1.2. **Calculate for Average Relative Response Factor (RRFm)**

$$RRFm = \frac{\sum RRF}{n} \qquad \text{Eq-10.5.1.2}$$

where:

RRFm – average response factor

$\sum RRF$ – summation of response factors

n – number of measurements

10.5.1.3. **Calculate for Least Square Linear Regression**

$$y = ax + b \qquad \text{Eq.-10.5.1.3}$$

where:

y = Response Ratio *(AX/AIS)*

x = Amount Ratio (CX/CIS)

a = x1 = slope of the line

$$a = \frac{\sum (x - \bar{x})(y - \bar{y})}{(x - \bar{x})^2}$$

where:

$\bar{x}$ = Average of amount ratios

$\bar{y}$ = Average of response ratios

b = x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.5.1.4. **Calculate for Inverse Weighting Factor**

$$y = ax + b \qquad \text{Eq.-10.5.1.4}$$

where:

y = Response Ratio *(AX/AIS)*

x = Amount Ratio *(CX/CIS)*

a = x1 = slope of the line

$$a = \frac{\sum [(x - x_a)(y - y_a)]}{\sum (x - x_a)^2}$$

where:

$$x_a = \sum [x(1/x) / \sum (1/x)]$$

$$y_a = \sum [y(1/x) / \sum (1/x)] \text{ or}$$

$$x_a = \sum [x(1/x^2) / \sum (1/x^2)]$$

$$y_a = \sum [y(1/x^2) / \sum (1/x^2)]$$

b = x0 = intercept of the line

$$b = y_a - a * x_a$$

10.5.1.5. **Calculate for Standard Deviation**

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$ Eq.-10.5.1.5

where:

SD – standard deviation

x_i – result at i^{th} measurement

$\bar{x}$ – mean

n – number of measurements

10.5.1.6. **Calculate for % relative standard deviation (%RSD)**

$$\%RSD = \frac{SD}{RRF_m} * 100\%$$ Eq.-10.5.1.6

where:

SD – standard deviation

RRFm – average response factor

10.5.2. Calibration Check/Continuing Calibration

10.5.2.1. Calculate Percent Difference (%D) when RRFm is used for quantitation

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\%$$ Eq.-10.5.2.1

where:

RRFc – response factor from continuing calibration standard

RRFm – average response factor

10.5.2.2. Calculate Percent Deviation ($\%D_t$) when applied calculation is other than ARF

$$\%D_t = \frac{|T_t - T_f|}{T_t} * 100\%$$ Eq.-10.5.2.2

where:

T_t – true value of standard in µg/L

T_f – found value of standard in µg/L

10.5.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.5.3.1. **Water Samples**

$$Concentration\ (ug/L) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(V_t)}$$ Eq.-10.5.3.1

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard added

V_e – extract final volume from sample extraction, usually 1-ml

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1 µl

V_t – volume of water extracted in ml, usually 1000 ml

10.5.3.2. **Soil/Sediment Samples (Dry weight basis)**

$$Concentration(\mu g/Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)}$$ Eq.-10.5.3.2

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injected in ng

V_e – volume of extract in ml, usually 1 ml[5]

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1 µl

W_s – wet soil weight in kg

DW – % solid = $\frac{100 - \%moisture}{100}$

10.5.3.3. **Calculation for results subjected to cleanup shall have the following equations:**

$$Concentration(\mu g/Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} \bullet \frac{V_{bg}}{V_{ig}}$$ Eq.-10.5.3.3.1

[5] For extracts subjected to GPC V_i=0.5-ml

$$Concentration(\mu g / L) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(V_t)} \bullet \frac{V_{bg}}{V_{ig}}$$ Eq-10.5.3.3.2

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injection in ng

V_e – volume of extract in ml

DF – dilution factor $\frac{aliquot(\mu l) + solvent(\mu l)}{aliquot(\mu l)}$

A_{is} – area of characteristic ion for the compound to be measured

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1 µl

W_e – wet soil weight in Kg

DW - %solid= $\frac{100 - \%moisture}{100}$

V_t – volume of water extracted in ml

V_{bg} – total volume of extract before GPC clean-up in ml

V_{ig} – injected volume of extracts to GPC in ml

10.5.4. Base all sample result calculations on the ICAL curve, e.g., area ratio of Ax/Ais versus concentration using inverse weighting factor fitted to the initial calibration is also used for determination of sample concentration.

10.5.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.5.5.1. The area "Ax" and "Ais" are derived from total ion chromatogram. "Ais" refers to the closest internal standard (IS) free of interference.

10.5.5.2. RRF of the TIC is 1.

10.5.6. Accuracy and Precision

10.5.6.1. **Percent Recovery**

$$\%\ Recovery = \frac{Cf - C}{Cs} * 100$$ Eq.-10.5.6.1

where:

Cf – concentration found

C – concentration of sample (use 0 for LCS)

Cs – concentration of spike

10.5.6.2. **Relative Percent Difference (%RPD)**

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.6.2}$$

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.5.7. DDT Degradation

$$\%B = \frac{A_{DDD} + A_{DDE}}{A_{DDT} + A_{DDD} + A_{DDE}}(100) \qquad \text{Eq.-10.5.7}$$

where:

%B - percent breakdown

ADDD - area of DDD

ADDE - area of DDE

ADDT - area of DDT

10.6. **Data Reduction**

10.6.1. Make a copy of the analytical run log and sample preparation log.

10.6.2. Highlight the data to be reported.

10.6.3. Print a copy of the raw data and the QC report.

10.6.4. Check that all positively identified analytes are within the calibration range.

10.6.5. Collate the reportable data separating the QC results from the sample results.

10.6.6. Keep all other data generated with the analytical folder marked with “For record only”.

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe

10.7.2. Generate the sample results using F1NV3C.exe

10.7.3. Generate the QC summary using QCV3CN.exe

10.7.4. Generate the Instrument Performance Check (ICAL and DCC for 8270C) using F5SVTEST.exe.

10.7.5. Generate the Instrument Performance Check (ICAL and DCC for 8270D) using F5SVN.exe.

10.7.6. Generate the IS and RT Summary using F8SV.exe.

10.7.7. Generate Lab Chronicle using LABCHRN1.exe

10.7.8. Generate the Case Narrative using CN1.exe

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

10.8.1.1. Case Narrative

10.8.1.2. Lab Chronicle

10.8.1.3. Sample Results

10.8.1.4. Method Blank Results

10.8.1.5. LCS/LCSD Summary

10.8.1.6. MS/MSD Summary

10.8.1.7. Instrument Performance Check (ICAL)

10.8.1.8. ICAL Summary

10.8.1.9. ICV Summary

10.8.1.10. Instrument Performance Check (DCC)

10.8.1.11. IS and RT Summary

10.8.1.12. DCC Summary

10.8.1.13. Analytical Run Log

10.8.1.14. Sample Preparation Log

10.8.1.15. Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- Check internal standard area. They should be within -50 to +100% of the ICAL midpoint to be acceptable, otherwise follow PSR.
- Check retention time of each IS to the ICAL midpoint. They should be within ± 30 seconds to be acceptable, otherwise follow PSR.
- Check surrogate recoveries against Project Specific requirements (PSR). In the absence of PSR, default to in-house QC limits.
- Check concentrations of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required.
- Check the generated reports against the raw data.
- Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to form 8270FM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back to control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Vacuum System Verification	Verify pressure. Perform system tune check	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check instrument performance (e.g., Daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Source Cleaning	Remove and clean the Mass Spec ion source	Every 6 months or as necessary
Vacuum System Maintenance	Inspect vacuum pumps, and replace mechanical/diffusion pump oil	Every 6 months
Documentation	Record maintenance in instrument service logs	Daily prior to analysis to include services done by third party.

11.0 QUALITY CONTROL

11.1. Sample Preparation Batch QC

11.1.1. Analyze Method Blank (MB) to demonstrate that preparation of sample was free from contamination.

11.1.2. Analyze Lab Control Sample (LCS) to assess preparative batch accuracy.

11.1.3. Analyze Matrix Spike (MS/MSD) at a frequency specified by the project to assess matrix interference.

11.1.4. In the absence of MS/MSD prepare LCS/LCSD to check for precision.

11.1.5. Treat lab wares used in the sample preparation as specified in EMAX-QC07.

11.1.6. Perform quality control check on solvents and reagents prior to its use.

11.2. Analytical Batch QC

11.2.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.2.2. Perform Initial Calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest. Obtain secondary review before using the new ICAL.

11.2.3. Establish Retention Time Window position for each analyte every after ICAL for proper qualitative identification.

11.2.4. Perform Initial Calibration Verification (ICV) every after ICAL to verify accuracy of ICAL.

11.2.5. Perform Continuing Calibration Verification (CCV) every 12 hours to verify that the instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.2.6. Evaluate Relative Retention Time for each analytes in every sample to be within ± 0.06 RRTunits.

11.2.7. Verify Internal Standards (IS) for quantitatively accuracy and that its Retention Time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -50 to +100% of ICAL midpoint standard.

11.2.8. Evaluate Surrogate recovery to monitor instrument response on every sample.

11.3. **Method QC**

11.3.1. Establish Detection Limit (DL) to determine the smallest analyte concentration that can be demonstrated to be different from zero.

11.3.2. Establish Limit of Detection (LOD) to determine the smallest concentration of an analyte that can qualitatively identified in a sample with 99% confidence level.

11.3.3. Establish Limit of Quantitation (LOQ) to determine the lowest concentration that produces a quantitative result within specified limits of precision and bias.

11.3.4. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency, acceptance criteria and corrective action.

12.0 CORRECTIVE ACTIONS

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. **Sample Preparation QC**

12.2.1. If the instrument blank is non-compliant, consider the following suggestions to correct the problem:

12.2.1.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new autosampler syringe.

12.2.1.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.2.1.3. Rule out preparation contamination by preparing a new instrument blank.

12.2.1.4. If the problem persists, inform the supervisor for further advice.

12.2.2. If method blank is non-compliant, consider the following suggestions to correct the problem:

12.2.2.1. Rule out instrument contamination by checking instrument blank.

12.2.2.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01.

12.2.2.3. Rule out glassware contamination used for extraction as described in EMAX-QC07.

12.2.2.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents.

12.2.2.5. If problem persists, inform the supervisor for further advice.

12.2.3. If LCS is non-compliant, consider the following suggestions to correct the problem:

12.2.3.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level.

12.2.3.2. If LCS check is within 80-120% of expected value, check the calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.2.3.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS standard, re-extract and re-analyze LCS and the associated samples.

12.2.3.4. If LCS is within acceptance then and the right amount of spike is added into sample then it is indicative of matrix interference. Discuss the probable matrix interference in Case Narrative.

12.2.4. If MS is non-compliant, consider the following suggestions to correct the problem:

12.2.4.1. Verify from the sample preparation log that the spike amount added is correct.

12.2.4.2. If LCS is within acceptance criteria and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the probability of matrix interference in the case narrative.

12.3. **Analytical Batch QC**

12.3.1. Tune Check

12.3.1.1. If tune check is non-compliant, consider the following suggestion to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set-up.
- Check gas flow.
- Perform auto-tune or visual optimization.
- If the problem persists, inform the supervisor for further actions.

12.3.1.2. If instrument performance is non-compliant, consider the following suggestion to correct the problem:

- Excessive degradation of DDT and/or poor chromatography demonstrated by too much tailing are indications of dirty injection port. Clean or replace the injection port. If problem persist, cut off the first 6-12 inches of the capillary column.

12.3.2. Initial Calibration (ICAL)

12.3.2.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

- If RSD% is out of acceptance criteria, review result and identify presence of an outlier.
- If one of the standard return a bias-low or bias-high on all of the analytes, then the point is considered an outlier, prepare a standard at the ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration identifies the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects where the ICAL will be used.

12.3.2.2. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

- Check the connections and make sure they are air-tight and perform maintenance as needed.
- Check the gas flow.
- Re-tune the MS.
- Prepare a fresh standard and repeat calibration.
- Clean the MS source and repeat the calibration.

12.3.2.3. If the problem persists, inform the supervisor for further action.

12.3.3. Initial Calibration Verification (ICV)

12.3.3.1. If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Re-analyze ICV to rule out poor injection.
- If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.
- If ICV is still put of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.
- If problem persist, inform the supervisor for further action.

12.3.4. Daily Calibration Check (DCC)

12.3.4.1. If DCC is non-compliant consider the following suggestions to correct the problem:

- If majority of the analyte response are low and no evidence of leak in the system is apparent, it is indicative of a poor injection or leak in the vial. Re-analyze DCC.
- If problem persist, rule out standard degradation. Prepare a fresh standard

and repeat DCC.

12.3.4.2. If Continuing Calibration is non-compliant consider the following suggestions to correct the problem:

- Change the liner.
- Clean the injection port.
- Prepare a new standard.
- Cut or replace column.
- Rule out leaks by checking all connections.
- If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL.

12.3.5. Instrument Blank: If instrument blank is non-compliant, consider the following suggestions to correct the problem:

- Rule out instrument contamination.
- Rule out reagent contamination by testing each reagent used as described in EMAX-QC01.
- Rule out vials and glassware contamination as described in EMAX-QC07.
- If the problem persists, inform the supervisor for further advice.

12.4. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.4.1. If corrective action needs the function of the department; e.g. if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.4.2. If corrective action needs the assistance of the project manager; e.g. if the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.5. For other problems encountered, inform the supervisor immediately for further instruction.

13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standards in fume hoods.

14.0 WASTE MANAGEMENT

14.1. Practice the "Less is Better" strategies when preparing for analytical standards. This will minimize the production of surplus chemical wastes.

14.2. Separate and properly identify all unused expired analytical standards for proper disposal.

14.3. No samples shall be dumped on the laboratory sink.

14.4. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. Definition of Terms

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation Batch** – is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical Batch** – is composed of prepared samples (extracts, digestates or concentrates) which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – The lowest concentration or amount of the target analyte that can be identified, measured and reported with confidence that the analyte concentration is not false positive.

15.1.4. Limit of Detection (LOD) – An estimate of the minimum amount of substance that an analytical process can reliably detect.

15.1.5. Limit of Quantitation (LOQ) – The minimum levels, concentrations or quantities of target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

15.1.6. Material Safety Data Sheet (MSDS) – is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.7. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.8. Carry-over – are contaminants retained in the instruments/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.9. Calibration Check Compounds (CCC) – evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.10. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.11. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.12. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.13. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.14. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.15. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.16. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.17. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.18. Matrix – is a component or form of a sample.

15.1.19. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.20. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.21. Re-analysis – is a repeated analysis from the same extract/digestate or sample, identified with Lab Sample ID suffixed with "W".

15.1.22. Re-extract/digest – is a repeated sample preparation process identified with the Lab Sample ID suffixed with "R".

15.1.23. Response Factor – is the ratio of the peak area of the target compound in the sample or sample extract.

15.1.24. Surrogate – are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard used to evaluate analytical efficiency be measuring recovery. Compounds not expected to be expected to be detected in environmental media.

15.1.25. System Performance Check Compounds (SPCC) – are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing Semi Volatile analysis by GC/MS unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy Basic Ordering Agreement (DoE-BoA) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluation of Solid Wastes", EPA SW846, Methods 8000B, 8000C, 8270C and 8270D.

16.2. EMAX Quality Systems Manual (EMAX-QS00), as updated.

17.0 APPENDICES

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17.2.17. Figure 7 Typical Sample Result Summary

17.2.18. Figure 8 Typical LCS/LCSD Report Summary

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17.2.20. Figure 10 Typical Case Narrative

17.3. **Appendices**

17.3.1. Appendix 1 Summary of Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.3.3. Appendix 3 Demonstration of Capability for Appendix IX Compounds

17.4. **Forms**

17.4.1. 8270FS Sample Preparation Log

17.4.2. 8270FA Analytical Run Log

17.4.3. 8270FM Instrument Maintenance Log

Table 1: INTERMEDIATE STANDARD PREPARATION

A. Primary Source: Restek, CPI, AccuStandard or equivalent

Standard Name		Stock / Internal Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (µg/ml)
				Aliquot (µl)	Dil. Solution	Final Vol. (ml)	
Standard List	8270 Mega Mix	1000	Restek	1000	MeCl2	5	200
	8270 Custom Std.	2000	CPI	500	MeCl2	5	200
	Benzidine Mix	2000	Restek	500	MeCl2	5	200
	Benzoic Mix	2000	Restek	500	MeCl2	5	200
	Acid Surrogate Mix	7500	Restek	133.3	MeCl2	5	200
	Base/Neutral Surrogate Mix	5000	Restek	200	MeCl2	5	200
Appendix IX	Appendix IX Mix # 1	2000	Restek	300	MeCl2	5	120
	Appendix IX Mix # 2	1000	Restek	600	MeCl2	5	120
	EPA 8270 Organophosphorous Pesticides Mix	2000	Restek	300	MeCl2	5	120
	Cust. 8270 Std.	2000	AccuStandard	300	MeCl2	5	120
	Acid Surrogate Mix	7500	Restek	80	MeCl2	5	120
	Base/Neutral Surrogate Mix	5000	Restek	120	MeCl2	5	120

B. Secondary Source: CPI, AccuStandard, Restek or equivalent

Standard Name		Stock / Internal Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (µg/ml)
				Aliquot (µl)	Dil. Solution	Final Vol. (ml)	
Standard List	Custom Semi Volatile Standard	2000	CPI	NA	NA	NA	NA
	8270 LCS Solution	200	CPI				
	8270 Internal Standard	2000	AccuStandard				
	Benzidine	5000	Ultra				
Appendix IX	Appendix IX Mix # 1*	2000	Restek	300	MeCl2 / MeOH	5	120
	Appendix IX Mix # 2*	1000	Restek	600	MeCl2 / MeOH	5	120
	EPA 8270 Organophosphorous Pesticides Mix*	2000	Restek	300	MeCl2 / MeOH	5	120
	Cust. 8270 Std.	2000	CPI	300	MeCl2 / MeOH	5	120

*Different Lot

Table 1 (cont.): INTERMEDIATE STANDARD PREPARATION

a. Primary Source: Restek, SPEXertificate, AccuStandard, Ultra Scientific or equivalent

Standard Name		Stock / Internal Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (µg/ml)
				Aliquot (µl)	Dil. Solution	Final Vol. (ml)	
Standard List	Benzidine	1000	Restek	NA	NA	NA	NA
Appendix IX Additional	Kepone	2000	SPEXertificate	750	MeCl2	5	300
	Famphur	2000	AccuStandard	750	MeCl2	5	300
	Hexacholoropene	5000	Ultra Scientific	300	MeCl2	5	300

b. Secondary Source: CPI, Supelco or equivalent

Standard Name		Stock / Internal Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (µg/ml)
				Aliquot (µl)	Dil. Solution	Final Vol. (ml)	
Appendix IX Additional	Kepone	2000	CPI	750	MeCl2 / MeOH	5	300
	Famphur	2000	CPI	750	MeCl2 / MeOH	5	300
	Hexacholoropene	5000	Supelco	300	MeCl2 / MeOH	5	300

Table 2: WORKING STANDARD PREPARATION

Standard Name	Intermediate Standard µl of 200 mg/L	Internal Standard µl of 2000 mg/L	Dil. Solvent	Final Volume (µl)	Final Conc.
1	0.19	10	$MeCl_2$	500	0.075 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
2	0.375	10	$MeCl_2$	500	0.15 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
3	1.25	10	$MeCl_2$	500	0.5 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
4	2.5	10	$MeCl_2$	500	1 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
5	5	10	$MeCl_2$	500	2 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
6	12.5	10	$MeCl_2$	500	5 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
7	25	10	$MeCl_2$	500	10 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
8	50	10	$MeCl_2$	500	20 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
9	62.5	10	$MeCl_2$	500	25 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
10	75	10	$MeCl_2$	500	30 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
11	100	10	$MeCl_2$	500	40 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
12	125	10	$MeCl_2$	500	50 µg/ml of Cal. Std. 40 µg/ml of Internal Std.

Table 2A: WORKING STANDARD PREPARATION FOR BENZIDINE

Standard Name	Intermediate Standard µl of 1000 mg/L	Internal Standard µl of 2000 mg/L	Dil. Solvent	Final Volume (µl)	Final Conc.
1	1	10	$MeCl_2$	500	2 µg/ml of Benzidine Std. 40 µg/ml of Internal Std.
2	2.5	10	$MeCl_2$	500	5 µg/ml of Benzidine Std. 40 µg/ml of Internal Std.
3	5	10	$MeCl_2$	500	10 µg/ml of Benzidine Std. 40 µg/ml of Internal Std.
4	12.5	10	$MeCl_2$	500	25 µg/ml of Benzidine Std. 40 µg/ml of Internal Std.
5	15	10	$MeCl_2$	500	30 µg/ml of Benzidine Std. 40 µg/ml of Internal Std.
6	20	10	$MeCl_2$	500	40 µg/ml of Benzidine Std. 40 µg/ml of Internal Std.
7	25	10	$MeCl_2$	500	50 µg/ml of Benzidine Std. 40 µg/ml of Internal Std.

Table 2a: WORKING STANDARD PREPARATION FOR ADDITIONAL ANALYTES (APPENDIX IX)

Appendix IX Standard List

Standard Name	Intermediate Standard µl of 120 mg/L	Internal Standard µl of 2000 mg/L	Dil. Solvent	Final Volume (µl)	Final Conc.
1	8.33	10	$MeCl_2$	500	2 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
2	20.8	10	$MeCl_2$	500	5 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
3	41.6	10	$MeCl_2$	500	10 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
4	83.3	10	$MeCl_2$	500	20 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
5	104.2	10	$MeCl_2$	500	25 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
6	125	10	$MeCl_2$	500	30 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
7	166.7	10	$MeCl_2$	500	40 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
8	208.3	10	$MeCl_2$	500	50 µg/ml of Cal. Std. 40 µg/ml of Internal Std.

Appendix IX Additional

Standard Name	Intermediate Standard µl of 300 mg/L	Internal Standard µl of 2000 mg/L	Dil. Solvent	Final Volume (µl)	Final Conc.
1	33.3	10	$MeCl_2$	500	20 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
2	66.6	10	$MeCl_2$	500	40 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
3	83.3	10	$MeCl_2$	500	50 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
4	133.3	10	$MeCl_2$	500	80 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
5	166.6	10	$MeCl_2$	500	100 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
6	200	10	$MeCl_2$	500	120 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
7	233.3	10	$MeCl_2$	500	140 µg/ml of Cal. Std. 40 µg/ml of Internal Std.

Table 2B: WORKING SECONDARY SOURCE STANDARD

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (µl)	Dil. Solution	Final Vol. (µl)	
Custom Semi Volatile Standard	2000	6.25	$MeCl_2$	500	25
8270 LCS Solution	2000	62.5	$MeCl_2$	500	25
8270 Internal Standard	2000	10	$MeCl_2$	500	40

Table 2b: WORKING SECONDARY SOURCE STANDARD FOR BENZIDINE

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (µl)	Dil. Solution	Final Vol. (µl)	
Benzidine	5000	2.5	$MeCl_2$	500	25
8270 Internal Standard	2000	10	$MeCl_2$	500	40

Table 2C: WORKING SECONDARY SOURCE STANDARD FOR ADDITIONAL ANALYTES APPENDIX IX

Appendix IX Standard List

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (µl)	Dil. Solution	Final Vol. (µl)	
Appendix IX Spike	120	104.2	$MeCl_2$	500	25
8270 Internal Standard	2000	10	$MeCl_2$	500	40

Appendix IX Additional

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (µl)	Dil. Solution	Final Vol. (µl)	
Appendix IX Add. Spike	300	83.3	$MeCl_2$	500	50
8270 Internal Standard	2000	10	$MeCl_2$	500	40

Table 2D: WORKING INTERNAL STANDARD PREPARATION

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (ml)	Dil. Solution	Final Vol. (ml)	
Internal Standard Mix	4000	5	$MeCl_2$	10	2000

Table 2E: WORKING GC/MS TUNING (DFTPP) STANDARD

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (µl)	Dil. Solution	Final Vol. (µl)	
GC/MS Tuning Mix	1000	25	$MeCl_2$	500	50

Table 3: INSTRUMENT PARAMETERS

	Inst. E4 / Inst. E7	Inst. 052
Carrier Gas	Helium at 90 psi at outlet	Helium at 90 psi at outlet
Column head pressure	15 - 35 psi at 40°C	15-35 psi at 50°C
Injection port temperature	280-300°C	280-300°C
Interface	Direct column interference at 280-300°C	Direct column interference at 2 80-300°C
Valve time	Split 0.2 minute	Split 0.2 minutes
Oven Temperature Program		
Initial Temperature	50°C/min; hold for 0min.	50°C/min; hold for 0.2min.
Rate	30°C/min to 100°C; hold for 0.0 min.; 20°C/min to 200°C; hold for 0.0 min.; 25°C/min to 320°C; hold for 2.53 min.	10°C/min to 100°C; hold for 0 min. 38°C/min to 280°C; hold for 0 min.
Run Time	14 minutes	9.94 minutes
Scan Parameters		
Scan start time	After solvent peak	After solvent peak
Mass range	10 to 1050 AMU	40 to 500 AMU
Multiplier voltage	1000-3000	0.7-3
Number of sampling rate	1	0.4
Threshold	300	500-1500
Tuning File	DFTPP	DFTPP

Table 4A: DFTPP KEY ION ABUNDANCE CRITERIA FOR 8270D

Mass	Ion Abundance Criteria
51	10 – 80% of mass 198
68	< 2.0% of mass 69
69	Present
70	< 2.0% of mass 69
127	10 – 80% of mass 198
197	< 2% of mass 198
198	Base peak, 100% relative abundance (See Note), or >50% of mass 442
199	5 - 9% of mass 198
275	10 - 60% of mass 198
365	> 1% of mass 198
441	Present but < 24% of mass 442
442	Base peak or > 50% of mass 198
443	15 - 24% of mass 442

NOTE: All ion abundance MUST be normalized to m/z 198, the nominal base peak.

Table 4B: DFTTPP KEY IONS ABUNDANCE CRITERIA FOR 8270C

Mass	Ion Abundance Criteria
51	30 – 60% of mass 198
68	< 2.0% of mass 69
69	Present
70	< 2.0% of mass 69
127	40 – 60% of mass 198
197	< 1% of mass 198
198	Base peak, 100% relative abundance
199	5 - 9% of mass 198
275	10 – 30% of mass 198
365	> 1% of mass 198
441	Present but < mass 443
442	> 40% of mass 198
443	17 – 23% of mass 442

Table 5: QUANTITATION IONS

Analyte	Quantitation Ions	
	Primary	Secondary
Target Compound		
N-nitrosodimethylamine	74	42
Pyridine	79	52
Phenol	94	65
Aniline	93	66
Bis (2-Chloroethyl) ether	92.9	62.9
2-Chlorophenol	127.9	64
1,3-Dichlorobenzene	145.9	147.9
1,4-Dichlorobenzene	145.9	147.9
Benzyl alcohol	108	79
1,2-Dichlorobenzene	145.9	147.9
2-Methylphenol	107	108
Bis (2-chloroisopropyl) ether	45	76.9
4-Methylphenol	107	108
N-Nitroso-di-n-propylamine	70	42
Hexachloroethene	116.8	200.8
Nitrobenzene	77	123
Isophorone	82	138
2-Nitrophenol	139	65
2,4-Dimethylphenol	107	122
Benzoic acid	105	77
Bis (2-Chloroethoxy) methane	92.9	94.9
2,4-Dichlorophenol	161.9	163.9
1,2,4-Trichlorobenzene	179.9	181.9
3,4-Dimethylphenol	107	122
Naphthalene	128	129
4-Chloroaniline	127	129
Hexachlorobutadiene	224.8	222.8
Hydroquinone	110	81
4-Chloro-3-methylphenol	107	77
2-Methylnaphthalene	142	141
1-Methylnaphthalene	142	141
Hexachlorocyclopentadiene	236.8	234.8
2,3,5-Trichlorophenol	195.9	96.9
2,4,6-Trichlorophenol	195.9	197.9
2,4,5-Trichlorophenol	195.9	197.9
2,3,4-Trichlorophenol	195.9	96.9
Biphenyl	154	153
2-Chloronaphthalene	162	164
2-Nitroaniline	65	92
2,6-Dimethylnaphthalene	156	141
1,4-Dinitrobenzene	168	74.9

Table 5 (cont.): QUANTITATION IONS

Analyte	Quantitation Ions	
	Primary	Secondary
Dimethylphthalate	163	164
1,3-Dinitrobenzene	168	75
2,6-Dinitrotoluene	165	89
1,2-Dinitrobenzene	168	63
Acenaphthylene	152	151
3-Nitroaniline	138	92
Acenaphthene	153	152
2,4-Dinitrophenol	184	106.9
4-Nitrophenol	109	139
2,4-Dinitrotoluene	165	89
Dibenzofuran	168	139
2,3,5,6-Tetrachlorophenol	229.8	130.9
2,3,4,6-Tetrachlorophenol	231.8	229.8
2,3,5-Trimethylnaphthalene	171.1	155
Diethylphthalate	149	177
Fluorene	166	165
4-Chlorophenyl-phenylether	204	206
4-Nitroaniline	138	92
4,6-Dinitro-2-methylphenol	198	121
N-Nitrosodiphenylamine	169	168
Azobenzene	77	105
4-Bromophenyl-phenylether	247.9	250
Hexachlorobenzene	283.8	141.9
Pentachlorophenol	265.8	164.9
Phenanthrene	178	152
Dinoseb	211	163
Anthracene	178	152
Carbazole	167	139
Di-n-butylphthalate	149	150
1-Methylphenanthrene	192.1	165
Fluoranthene	202	100.9
Benzidine	184	92
Pyrene	202	100.9
Butylbenzylphthalate	149	91
Bis(2-ethylhexyl)adipate	129	57
3,3’-Dichlorobenzidine	252	254
Benzo(a)anthracene	228.1	113
Chrysene	228.1	226.1
bis(2-Ethylhexyl)phthalate	149	167
Di-n-octylphthalate	149	150
Benzo(b)fluoranthene	252.1	124.9
Benzo(k)fluoranthene	252.1	124.9

Table 5 (cont.): QUANTITATION IONS

Analyte	Quantitation Ions	
	Primary	Secondary
Benzo(e)pyrene	252.1	125
Benzo(a)pyrene	252.1	125
Perylene	252.1	125
Indeno(1,2,3-cd)pyrene	276.1	137.9
Dibenzo(a,h)anthracene	278.1	139
Benzo(g,h,i)perylene	276.1	137.9
Surrogate		
2-Fluorophenol	112	64
Phenol-d_5	99	71
1,2-Dichlorbenzene-d_4	151.9	149.9
Nitrobenzene-d_5	82	128
2-Fluorobiphenyl	172	171
2,4,6-Tribromophenol	329.8	331.8
Terphenyl-d_{14}	244.2	122
Internal Standard		
1,4-Dichlorobenzene-d_4	151.9	115
Naphtalene-d_8	136	68
Acenaphthene-d_{10}	164.1	162.1
Phenanthrene-d_{10}	188.1	94
Chrysene-d_{12}	240.1	120
Perylene-d_{12}	264.1	130
Appendix IX Compound		
Target Compound		
Acetophenone	77.0	120.0
2-Acetylaminofluorene	181.0	223.10
4-Aminobiphenyl	169.0	115.0
Aramite	184.9	62.9
Atrazine	200.0	215.0
Biphenyl	154.0	76.0
Chlorobenzilate	251.0	138.9
1-Chloronaphthalene	162.0	127.0
Diallate	86.0	234.0
Dibenzo(a,j)acridine	279.1	139.3
2-6Dichlorophenol	161.9	63.0
Dimethoate	86.9	124.9
p-Dimethylaminoazobene	120	225.1
7,12-Dimethylben(a)anthracene	256.1	241.1
3,3-Dimethylbenzidine	212.1	196.0
3,4-Dimethylphenol	107.0	122.0
1,3-Dinitrobenzene	167.9	75.9
Dinoseb	211.0	162.9
1,4-Dioxane	88.0	57.9
Diphenyl ether	170.0	141.0
Disulfoton	88.0	96.9
Ethyl methacrylate	69.0	41.0
Ethyl methanesulfonate	78.9	108.9

Table 5 (cont.): QUANTITATION IONS

Analyte	Quantitation Ions	
	Primary	Secondary
Ethyl parathion	96.9	108.9
Hexachloropropene	212.8	140.8
Isodrin	192.9	262.8
Isosafrole	162.0	104.0
3-Methylchlolanthrene	268.1	252.1
Methyl methanesulfonate	79.9	78.9
Methyl parathion	108.9	263.0
1,4-Naphthoquinone	158.0	130.0
1-Naphthylamine	143.0	115.0
2-Naphthylamine	143.0	115.0
N-nitrosodiethylamine	102.0	56.0
N-nitrosomethylethylamine	88.0	42.0
N-nitrosomorpholine	56.0	116.0
N-nitrosodi-n-butylamine	84.0	57.0
N-nitrosopiperdine	114.0	42.0
N-nitrosopyrrolidine	100.0	68.0
5-Nitro-o-toluidine	152.0	77.0
4-Nitroquinoline-N-oxide	89.0	190.0
Pentachlorobenzene	249.8	107.9
Pentachloroethane	166.8	116.8
Pentachloronitrobenzene	236.8	294.8
Phenacetin	108.0	179.0
Phorate	75.0	121.0
2-Picoline	93.0	65.9
Pronamide	172.9	174.9
Safrole	162.0	131.0
Sulfotepp	322.0	201.9
1,2,4,5-Tetrachlorobenzene	215.8	178.9
Thionazin	107.0	96.9
o-Toluidine	106.0	77.0
O,O,O-triethyl phosphorothioate	121.0	198.0
1,3,5-Trinitrobenzene	212.9	119.9
Famphur	218.0	124.9
Kepone	271.8	273.8
Hexachlorophene	195.9	197.9

Table 6: MINIMUM RESPONSE FACTOR

ANALYTE	Minimum Response Factor(RF)	ANALYTE	Minimum Response Factor(RF)
Benzaldehyde	0.010	4-Nitrophenol	0.010
Phenol	0.800	Dibenzofuran	0.800
Bis(2-chloroethyl)ether	0.700	2,4-Dinitrotoluene	0.200
2-Chlorophenol	0.800	Diethyl phthalate	0.010
2-Methylphenol	0.700	1,2,4,5-Tetrachlorobenzene	0.010
2,2'-Oxybis-(1-chloropropane)	0.010	4-Chlorophenyl-phenyl ether	0.400
Acetophenone	0.010	Fluorene	0.900
4-Methylphenol	0.600	4-Nitroaniline	0.010
N-Nitroso-di-n-propylamine	0.500	4,6-Dinitro-2-methylphenol	0.010
Hexachloroethane	0.300	4-Bromophenyl-phenyl ether	0.100
Nitrobenzene	0.200	N-Nitrosodiphenylamine	0.010
Isophorone	0.400	Hexachlorobenzene	0.100
2-Nitrophenol	0.100	Atrazine	0.010
2,4-Dimethylphenol	0.200	Pentachlorophenol	0.050
Bis(2-chloroethoxy)methane	0.300	Phenanthrene	0.700
2,4-Dichlorophenol	0.200	Anthracene	0.700
Naphthalene	0.700	Carbazole	0.010
4-Chloroaniline	0.010	Di-n-butyl phthalate	0.010
Hexachlorobutadiene	0.010	Fluoranthene	0.600
Caprolactam	0.010	Pyrene	0.600
4-Chloro-3-methylphenol	0.200	Butyl benzyl phthalate	0.010
2-Methylnaphthalene	0.400	3,3'-Dichlorobenzidine	0.010
Hexachlorocyclopentadiene	0.050	Benzo(a)anthracene	0.800
2,4,6-Trichlorophenol	0.200	Chrysene	0.700
2,4,5-Trichlorophenol	0.200	Bis-(2-ethylhexyl)phthalate	0.010
1,1'-Biphenyl	0.010	Di-n-octyl phthalate	0.010
2-Chloronaphthalene	0.800	Benzo(b)fluoranthene	0.700
2-Nitroaniline	0.010	Benzo(k)fluoranthene	0.700
Dimethyl phthalate	0.010	Benzo(a)pyrene	0.700
2,6-Dinitrotoluene	0.200	Indeno(1,2,3-cd)pyrene	0.500
Acenaphthylene	0.900	Dibenz(a,h)anthracene	0.400
3-Nitroaniline	0.010	Benzo(g,h,i)perylene	0.500
Acenaphthene	0.900	2,3,4,6-Tetrachlorophenol	0.010
2,4-Dinitrophenol	0.010		

Notes:

1. PSR supersedes Table 6.
2. Other analytes not listed above must have a minimum response factor of 0.01.
3. Table 6 is from SW846 Method 8270D, Table 4.

Table 7: ESTABLISHED LOD & LOQ

Matrix	WATER			
Parameter	**DL**	**LOD**	**LOQ**	**Unit**
Acenaphthene	2.5	5	10	µg/L
Acenaphthylene	2.5	5	10	µg/L
Aniline	5.3	10	20	µg/L
Anthracene	2.5	5	10	µg/L
Benzidine	10	20	50	µg/L
Benzo(a)anthracene	2.5	5	10	µg/L
benzo(a)pyrene	2.5	5	10	µg/L
Benzo(b)fluoranthene	2.6	5	10	µg/L
Benzo(e)pyrene	2.5	5	10	µg/L
Benzo(g,h,i)perylene	2.5	5	10	µg/L
Benzo(k)fluoranthene	2.5	5	10	µg/L
Benzoic Acid	10	20	40	µg/L
Benzyl Alcohol	2.5	5	10	µg/L
Biphenyl	2.5	5	10	µg/L
bis(2-chloroethoxy)methane	2.5	5	10	µg/L
bis(2-chloroethyl)ether	2.5	5	10	µg/L
bis(2-chloroisopropyl)ether	2.5	5	10	µg/L
bis(2-Ethylhexyl)adipate	2.5	5	10	µg/L
bis(2-Ethylhexyl)phthalate	2.5	5	10	µg/L
4-Bromophenyl-phenylether	2.5	5	10	µg/L
Butylbenzylphthalate	2.5	5	10	µg/L
Carbazole	2.5	5	10	µg/L
4-Chloro-3-methylphenol	2.5	5	10	µg/L
4-Chloroaniline	4.2	5	10	µg/L
2-Chloronaphthalene	2.5	5	10	µg/L
2-Chlorophenol	2.5	5	10	µg/L
4-Chlorophenyl-phenylether	2.5	5	10	µg/L
Chrysene	2.5	5	10	µg/L
Dibenzo(a,h)anthracene	2.5	5	10	µg/L
Dibenzofuran	2.5	5	10	µg/L
1,2-Dichlorobenzene	2.5	5	10	µg/L
1,3-Dichlorobenzene	2.5	5	10	µg/L
1,4-Dichlorobenzene	2.5	5	10	µg/L
3,3'-Dichlorobenzidine	2.5	5	10	µg/L
2,4-Dichlorophenol	2.5	5	10	µg/L
Diethylphthalate	2.5	5	10	µg/L
2,6-Dimethylnaphthalene	2.5	5	10	µg/L
2,4-Dimethylphenol	2.6	5	10	µg/L
Dimethylphthalate	2.5	5	10	µg/L
Di-n-butylphthalate	2.5	5	10	µg/L
4,6-Dinitro-2-methylphenol	2.5	5	10	µg/L
2,4-Dinitrophenol	2.5	5	10	µg/L
2,4-Dinitrotoluene	2.5	5	10	µg/L
2,6-Dinitrotoluene	2.5	5	10	µg/L
Di-n-octylphthalate	2.5	5	10	µg/L
1,2-Diphenylhydrazine*	2.5	5	10	µg/L
Fluoranthene	2.5	5	10	µg/L
Fluorene	2.5	5	10	µg/L

Matrix	SOIL			
Parameter	**DL**	**LOD**	**LOQ**	**Unit**
Acenaphthene	83	167	333	µg/Kg
Acenaphthylene	83	167	333	µg/Kg
Aniline	83	167	667	µg/Kg
Anthracene	83	167	333	µg/Kg
Benzidine	863	867	1333	µg/Kg
Benzo(a)anthracene	83	167	333	µg/Kg
benzo(a)pyrene	83	167	333	µg/Kg
Benzo(b)fluoranthene	86	167	333	µg/Kg
Benzo(e)pyrene	83	167	333	µg/Kg
Benzo(g,h,i)perylene	87	167	333	µg/Kg
Benzo(k)fluoranthene	83	167	333	µg/Kg
Benzoic Acid	333	667	1333	µg/Kg
Benzyl Alcohol	83	167	333	µg/Kg
Biphenyl	83	167	333	µg/Kg
bis(2-chloroethoxy)methane	83	167	333	µg/Kg
bis(2-chloroethyl)ether	83	167	333	µg/Kg
bis(2-chloroisopropyl)ether	83	167	333	µg/Kg
bis(2-Ethylhexyl)adipate	87	167	333	µg/Kg
bis(2-Ethylhexyl)phthalate	115	167	333	µg/Kg
4-Bromophenyl-phenylether	90	167	333	µg/Kg
Butylbenzylphthalate	83	167	333	µg/Kg
Carbazole	89	167	333	µg/Kg
4-Chloro-3-methylphenol	83	167	333	µg/Kg
4-Chloroaniline	83	167	333	µg/Kg
2-Chloronaphthalene	83	167	333	µg/Kg
2-Chlorophenol	83	167	333	µg/Kg
4-Chlorophenyl-phenylether	83	167	333	µg/Kg
Chrysene	83	167	333	µg/Kg
Dibenzo(a,h)anthracene	83	167	333	µg/Kg
Dibenzofuran	83	167	333	µg/Kg
1,2-Dichlorobenzene	83	167	333	µg/Kg
1,3-Dichlorobenzene	83	167	333	µg/Kg
1,4-Dichlorobenzene	83	167	333	µg/Kg
3,3'-Dichlorobenzidine	84	167	333	µg/Kg
2,4-Dichlorophenol	83	167	333	µg/Kg
Diethylphthalate	83	167	333	µg/Kg
2,6-Dimethylnaphthalene	83	167	333	µg/Kg
2,4-Dimethylphenol	83	167	333	µg/Kg
Dimethylphthalate	83	167	333	µg/Kg
Di-n-butylphthalate	97	167	333	µg/Kg
4,6-Dinitro-2-methylphenol	83	167	333	µg/Kg
2,4-Dinitrophenol	86	167	333	µg/Kg
2,4-Dinitrotoluene	83	167	333	µg/Kg
2,6-Dinitrotoluene	83	167	333	µg/Kg
Di-n-octylphthalate	97	167	333	µg/Kg
1,2-Diphenylhydrazine*	96	167	333	µg/Kg
Fluoranthene	126	167	333	µg/Kg
Fluorene	83	167	333	µg/Kg

Table 7: ESTABLISHED LOD & LOQ

Matrix	WATER				Matrix	SOIL			
Parameter	**DL**	**LOD**	**LOQ**	**Unit**	**Parameter**	**DL**	**LOD**	**LOQ**	**Unit**
Hexachlorobenzene	2.5	5	10	µg/L	Hexachlorobenzene	83	167	333	µg/Kg
Hexachlorobutadiene	2.5	5	10	µg/L	Hexachlorobutadiene	83	167	333	µg/Kg
Hexachlorocyclopentadiene	2.5	5	10	µg/L	Hexachlorocyclopentadiene	83	167	333	µg/Kg
Hexachloroethane	2.5	5	10	µg/L	Hexachloroethane	83	167	333	µg/Kg
Indeno(1,2,3-cd)pyrene	2.5	5	10	µg/L	Indeno(1,2,3-cd)pyrene	83	167	333	µg/Kg
Isophorone	2.5	5	10	µg/L	Isophorone	83	167	333	µg/Kg
1-Methylnaphthalene	2.5	5	10	µg/L	1-Methylnaphthalene	83	167	333	µg/Kg
2-Methylnaphthalene	2.5	5	10	µg/L	2-Methylnaphthalene	83	167	333	µg/Kg
1-Methylphenanthrene	2.5	5	10	µg/L	1-Methylphenanthrene	83	167	333	µg/Kg
2-Methylphenol	2.5	5	10	µg/L	2-Methylphenol	83	167	333	µg/Kg
4-Methylphenol	2.5	5	10	µg/L	4-Methylphenol	83	167	333	µg/Kg
Naphthalene	2.5	5	10	µg/L	Naphthalene	83	167	333	µg/Kg
2-Nitroaniline	2.5	5	10	µg/L	2-Nitroaniline	83	167	333	µg/Kg
3-Nitroaniline	2.5	5	10	µg/L	3-Nitroaniline	83	167	333	µg/Kg
4-Nitroaniline	2.5	5	10	µg/L	4-Nitroaniline	120	167	333	µg/Kg
Nitrobenzene	2.5	5	10	µg/L	Nitrobenzene	83	167	333	µg/Kg
2-Nitrophenol	2.5	5	10	µg/L	2-Nitrophenol	83	167	333	µg/Kg
4-Nitrophenol	2.5	5	10	µg/L	4-Nitrophenol	106	167	667	µg/Kg
n-Nitrosodimethylamine	2.5	5	10	µg/L	n-Nitrosodimethylamine	83	167	333	µg/Kg
n-Nitroso-di-n-propylamine	2.5	5	10	µg/L	n-Nitroso-di-n-propylamine	83	167	333	µg/Kg
n-Nitrosodiphenylamine	2.5	5	10	µg/L	n-Nitrosodiphenylamine	153	167	333	µg/Kg
Pentachlorophenol	2.5	5	10	µg/L	Pentachlorophenol	83	167	667	µg/Kg
Perylene	2.5	5	10	µg/L	Perylene	86	167	333	µg/Kg
Phenanthrene	2.5	5	10	µg/L	Phenanthrene	83	167	333	µg/Kg
Phenol	2.5	5	10	µg/L	Phenol	83	167	333	µg/Kg
Pyrene	2.5	5	10	µg/L	Pyrene	160	167	333	µg/Kg
Pyridine	11	20	40	µg/L	Pyridine	333	667	1333	µg/Kg
2,3,4,6-Tetrachlorophenol	3.6	5	10	µg/L	2,3,4,6-Tetrachlorophenol	100	167	333	µg/Kg
1,2,4-Trichlorobenzene	2.5	5	10	µg/L	1,2,4-Trichlorobenzene	83	167	333	µg/Kg
2,3,4-Trichlorophenol	2.5	5	10	µg/L	2,3,4-Trichlorophenol	83	167	333	µg/Kg
2,3,5-Trichlorophenol	2.5	5	10	µg/L	2,3,5-Trichlorophenol	165	167	333	µg/Kg
2,4,5-Trichlorophenol	2.5	5	10	µg/L	2,4,5-Trichlorophenol	91	167	333	µg/Kg
2,4,6-Trichlorophenol	2.5	5	10	µg/L	2,4,6-Trichlorophenol	83	167	333	µg/Kg
2,3,5-Trimethylnaphthalene	2.5	5	10	µg/L	2,3,5-Trimethylnaphthalene	83	167	333	µg/Kg
2-Fluorophenol	1.5	3	5	µg/L	2-Fluorophenol	61	100	167	µg/Kg
Phenol-d5	1.5	3	5	µg/L	Phenol-d5	52	100	167	µg/Kg
2-Fluorobiphenyl	0.5	1	1.67	µg/L	2-Fluorobiphenyl	24	33	56	µg/Kg
Nitrobenzene-d5	0.59	1	1.67	µg/L	Nitrobenzene-d5	17	33	56	µg/Kg
2,4,6-Tribromophenol	1.5	3	5	µg/L	2,4,6-Tribromophenol	55	100	167	µg/Kg
Terphenyl-d14	0.54	1	1.67	µg/L	Terphenyl-d14	24	33	56	µg/Kg
Appendix IX Compound									
a,a-dimethylphenethylamine	13	20	40	µg/L	a,a-dimethylphenethylamine	NA	NA	NA	µg/Kg
Acetophenone	2.5	5	10	µg/L	Acetophenone	83	167	333	µg/Kg
2-acetylaminofluorene	2.7	5	10	µg/L	2-acetylaminofluorene	83	167	333	µg/Kg
4-Aminobiphenyl	2.5	5	10	µg/L	4-Aminobiphenyl	85	167	333	µg/Kg
Aramite	2.5	5	10	µg/L	Aramite	83	167	333	µg/Kg
Atrazine	2.5	5	10	µg/L	Atrazine	83	167	333	µg/Kg
Biphenyl	2.5	5	10	µg/L	Biphenyl	83	167	333	µg/Kg

Table 7: ESTABLISHED LOD & LOQ

Matrix	WATER			
Parameter	**DL**	**LOD**	**LOQ**	**Unit**
Chlorobenzilate	2.5	5	10	µg/L
1-Chloronaphthalene	2.5	5	10	µg/L
Diallate	2.5	5	10	µg/L
Dibenzo(a,j)acridine	2.5	5	10	µg/L
2,6-Dichlorophenol	2.5	5	10	µg/L
Dimethoate	3	5	10	µg/L
p-Dimethylaminoazobenzene	2.5	5	10	µg/L
7,12-Dimethylben(a)anthracene	2.5	5	10	µg/L
3,3-Dimethylbenzidine	5	10	20	µg/L
3,4-Dimethylphenol	2.5	5	10	µg/L
1,3-Dinitrobenzene	2.5	5	10	µg/L
Dinoseb	2.5	5	10	µg/L
1,4-Dioxane	2.5	5	10	µg/L
Diphenyl ether	2.5	5	10	µg/L
Disulfoton	2.5	5	10	µg/L
Ethyl methacrylate	2.5	5	10	µg/L
Ethyl methanesulfonate	2.5	5	10	µg/L
Ethyl parathion	2.5	5	10	µg/L
Hexachloropropene	2.5	5	10	µg/L
Isodrin	2.5	5	10	µg/L
Isosafrole	2.5	5	10	µg/L
Methapyrilene	10	20	40	µg/L
3-Methylchlolanthrene	2.5	5	10	µg/L
Methyl methanesulfonate	2.5	5	10	µg/L
Methyl parathion	2.5	5	10	µg/L
1,4-Naphthoquinone	2.5	5	10	µg/L
1-Naphthylamine	2.5	5	10	µg/L
2-Naphthylamine	10	10	20	µg/L
N-nitrosodiethylamine	2.5	5	10	µg/L
N-nitrosomethylethylamine	2.5	5	10	µg/L
N-nitrosomorpholine	2.5	5	10	µg/L
N-nitrosodi-n-butylamine	2.5	5	10	µg/L
N-nitrosopiperdine	2.5	5	10	µg/L
N-nitrosopyrrolidine	2.5	5	10	µg/L
5-Nitro-o-toluidine	2.6	5	10	µg/L
4-Nitroquinoline-N-oxide	5	10	20	µg/L
Pentachlorobenzene	2.5	5	10	µg/L
Pentachloroethane	2.5	5	10	µg/L
Pentachloronitrobenzene	2.5	5	10	µg/L
Phenacetin	2.5	5	10	µg/L
p-phenylenediamine	10	20	40	µg/L
Phorate	2.5	5	10	µg/L
2-Picoline	2.5	5	10	µg/L
pronamide	2.5	5	10	µg/L
Safrole	2.5	5	10	µg/L
Sulfotepp	2.5	5	10	µg/L
1,2,4,5-Tetrachlorobenzene	2.5	5	10	µg/L
Thionazin	2.5	5	10	µg/L

Matrix	SOIL			
Parameter	**DL**	**LOD**	**LOQ**	**Unit**
Chlorobenzilate	83	167	333	µg/Kg
1-Chloronaphthalene	83	167	333	µg/Kg
Diallate	100	167	333	µg/Kg
Dibenzo(a,j)acridine	83	167	333	µg/Kg
2,6-Dichlorophenol	83	167	333	µg/Kg
Dimethoate	89	167	333	µg/Kg
p-Dimethylaminoazobenzene	83	167	333	µg/Kg
7,12-Dimethylben(a)anthracene	83	167	333	µg/Kg
3,3-Dimethylbenzidine	130	167	667	µg/Kg
3,4-Dimethylphenol	83	167	333	µg/Kg
1,3-Dinitrobenzene	83	167	333	µg/Kg
Dinoseb	83	167	333	µg/Kg
1,4-Dioxane	83	167	333	µg/Kg
Diphenyl ether	83	167	333	µg/Kg
Disulfoton	83	167	333	µg/Kg
Ethyl methacrylate	83	167	333	µg/Kg
Ethyl methanesulfonate	83	167	333	µg/Kg
Ethyl parathion	83	167	333	µg/Kg
Hexachloropropene	83	167	333	µg/Kg
Isodrin	83	167	333	µg/Kg
Isosafrole	83	167	333	µg/Kg
Methapyrilene	NA	NA	NA	µg/Kg
3-Methylchlolanthrene	83	167	333	µg/Kg
Methyl methanesulfonate	83	167	333	µg/Kg
Methyl parathion	83	167	333	µg/Kg
1,4-Naphthoquinone	83	167	333	µg/Kg
1-Naphthylamine	83	167	333	µg/Kg
2-Naphthylamine	330	333	667	µg/Kg
N-nitrosodiethylamine	83	167	333	µg/Kg
N-nitrosomethylethylamine	83	167	333	µg/Kg
N-nitrosomorpholine	83	167	333	µg/Kg
N-nitrosodi-n-butylamine	83	167	333	µg/Kg
N-nitrosopiperdine	83	167	333	µg/Kg
N-nitrosopyrrolidine	83	167	333	µg/Kg
5-Nitro-o-toluidine	83	167	333	µg/Kg
4-Nitroquinoline-N-oxide	83	167	333	µg/Kg
Pentachlorobenzene	83	167	333	µg/Kg
Pentachloroethane	83	167	333	µg/Kg
Pentachloronitrobenzene	83	167	333	µg/Kg
Phenacetin	83	167	333	µg/Kg
p-phenylenediamine	83	167	667	µg/Kg
Phorate	83	167	333	µg/Kg
2-Picoline	83	167	333	µg/Kg
pronamide	83	167	333	µg/Kg
Safrole	83	167	333	µg/Kg
Sulfotepp	83	167	333	µg/Kg
1,2,4,5-Tetrachlorobenzene	83	167	333	µg/Kg
Thionazin	83	167	333	µg/Kg

Table 7: ESTABLISHED LOD & LOQ

Matrix	WATER			
Parameter	**DL**	**LOD**	**LOQ**	**Unit**
o-toluidine	2.5	5	10	µg/L
O,O,O-triethyl phosphorothi	2.5	5	10	µg/L
1,3,5-Trinitrobenzene	5	10	20	µg/L
Famphur	10	20	50	µg/L
kepone	10	20	50	µg/L
Hexachlorophene	10	20	80	µg/L

Matrix	SOIL			
Parameter	**DL**	**LOD**	**LOQ**	**Unit**
o-toluidine	83	167	333	µg/Kg
O,O,O-triethyl phosphorothi	83	167	333	µg/Kg
1,3,5-Trinitrobenzene	83	167	333	µg/Kg
Famphur	420	833	1667	µg/Kg
kepone	420	833	1667	µg/Kg
Hexachlorophene	630	833	2670	µg/Kg

Note:
* Dissociated to Azobenzene
1. PSR supersedes Table 7

Figure 1: PEAK EVALUATION TECHNIQUE

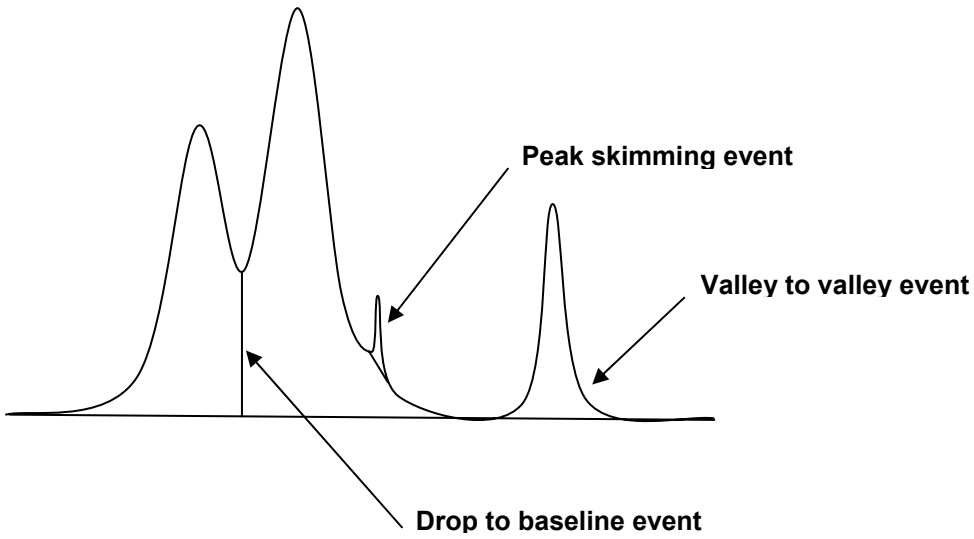
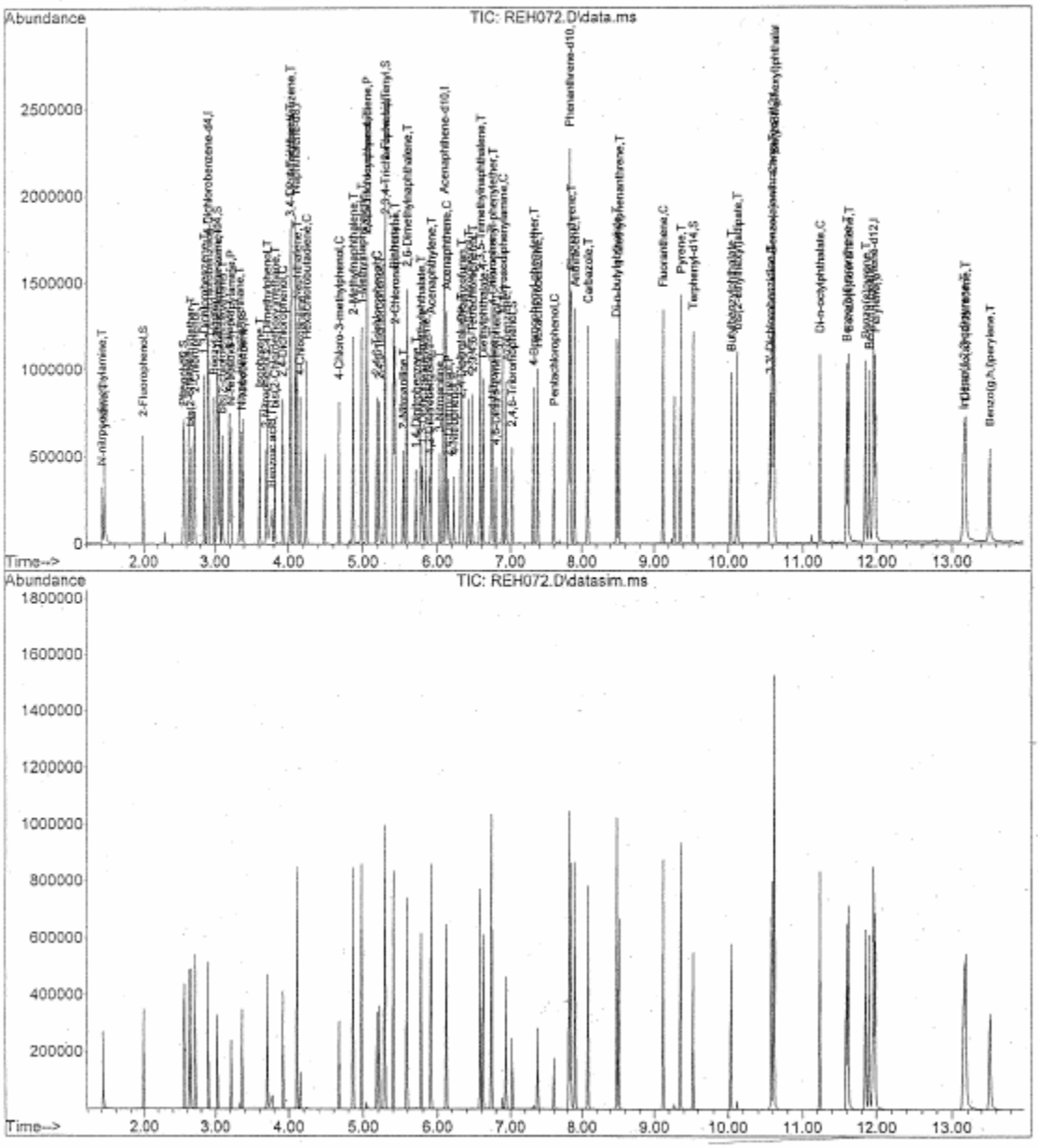


Figure 2: **TYPICAL CHROMATOGRAM**

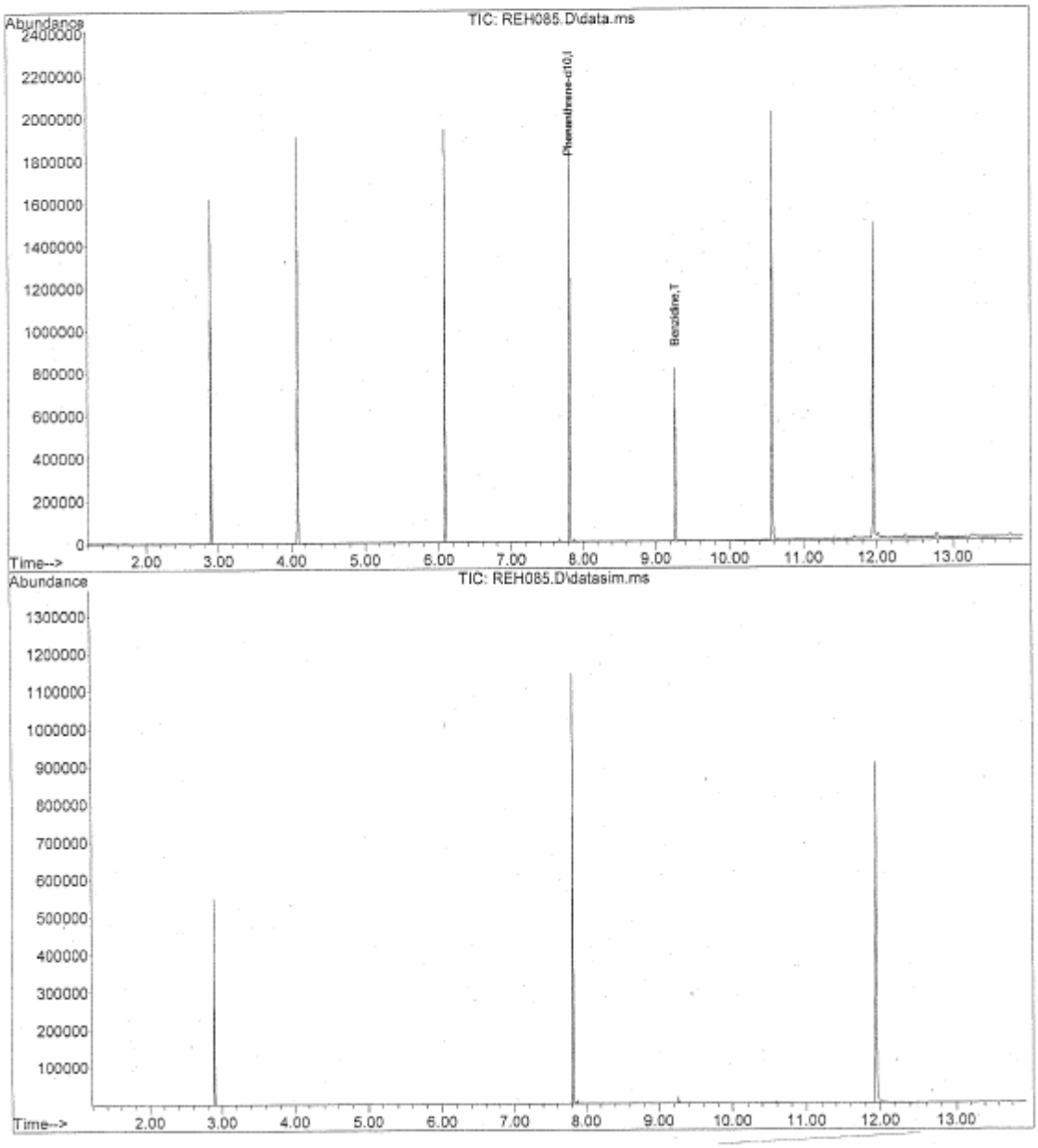
```
                    Quantitation Report     (QT Reviewed)
Data File : D:\DATA\11E11\REH072.D                          Vial: 6
Acq On    : 11 May 2011  15:29                        Operator: KV
Sample    : SVE7E114 25PPM                            Inst    : E7
Misc      :                                           Multiplr: 1.00
Integrator: RTE
Quant Time: May 11 16:49:52 2011
Quant Results File: SVE7E11.RES
Quant Method : C:\msdchem\1\METHODS\SVE7E11.M
Quant Title  : SEMIVOLATILES
QLast Update : Wed May 11 16:46:30 2011
Response via : Initial Calibration
DataAcq Meth:SVE7E11S.M
```



VE7E11.M Wed May 11 16:49:59 2011 Page: 4

Figure 2a: TYPICAL CHROMATOGRAM FOR BENZIDINE

```
                    Quantitation Report     (QT Reviewed)
Data File : D:\DATA\11E11\REH085.D                          Vial: 19
Acq On    : 11 May 2011  19:30                           Operator: KV
Sample    : SVE7E11A4 25PPM                              Inst    : E7
Misc      : BENZIDNE                                     Multiplr: 1.00
Integrator: RTE
Quant Time: May 12 10:09:48 2011
Quant Results File: SVE7E11A.RES
Quant Method : C:\msdchem\1\METHODS\SVE7E11A.M
Quant Title  : Semivolatiles - Benzidine
QLast Update : Thu May 12 10:08:59 2011
Response via : Initial Calibration
DataAcq Meth:SVE7E11S.M
```



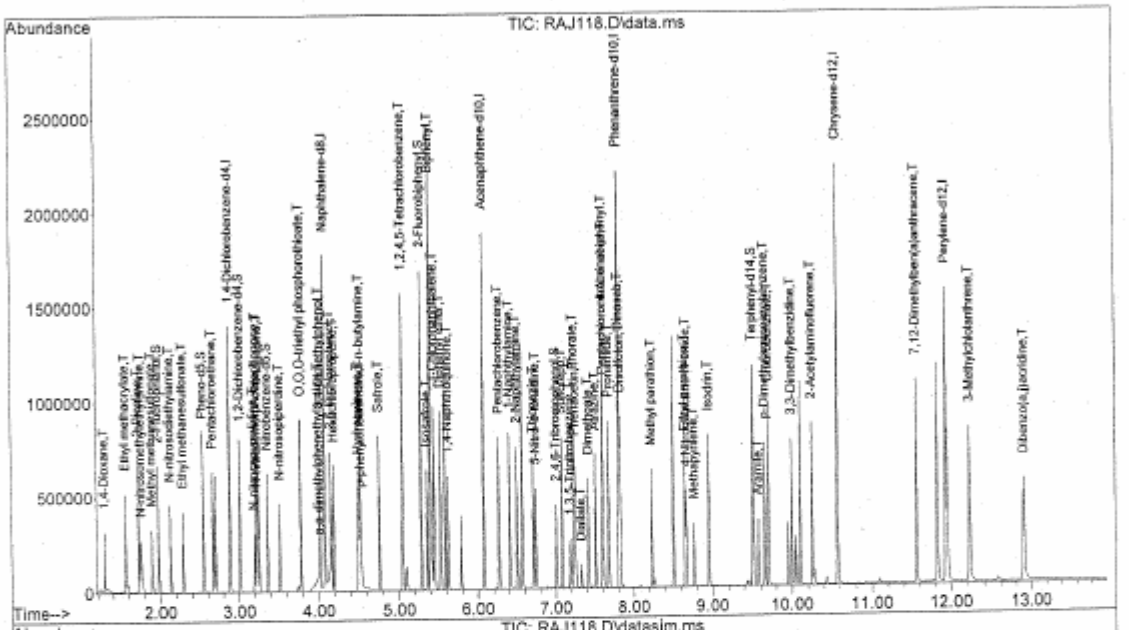

```
SVE7E11A.M Thu May 12 10:09:56 2011                          Page: 2
```

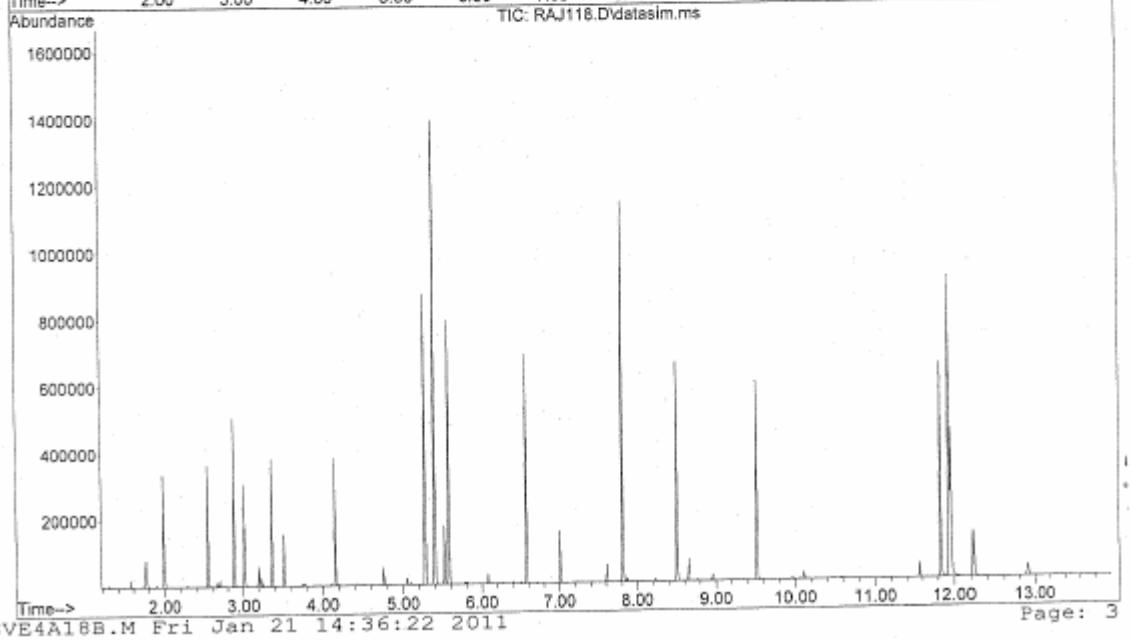
Figure 2b: TYPICAL CHROMATOGRAM FOR APPENDIX IX

Quantitation Report (QT Reviewed)

Data File : D:\DATA\11A18\RAJ118.D
Acq On : 18 Jan 2011 21:47
Sample : ISVE4A18B1 25PPM
Misc :
Integrator: RTE
Quant Time: Jan 21 14:36:09 2011
Quant Results File: SVE4A18B.RES
Quant Method : C:\msdchem\1\METHODS\SVE4A18B.M
Quant Title : SEMIVOLATILES APP9
QLast Update : Fri Jan 21 14:24:41 2011
Response via : Initial Calibration
DataAcq Meth:SVE4A11S.M

Vial: 19
Operator: DC
Inst : E4
Multiplr: 1.00

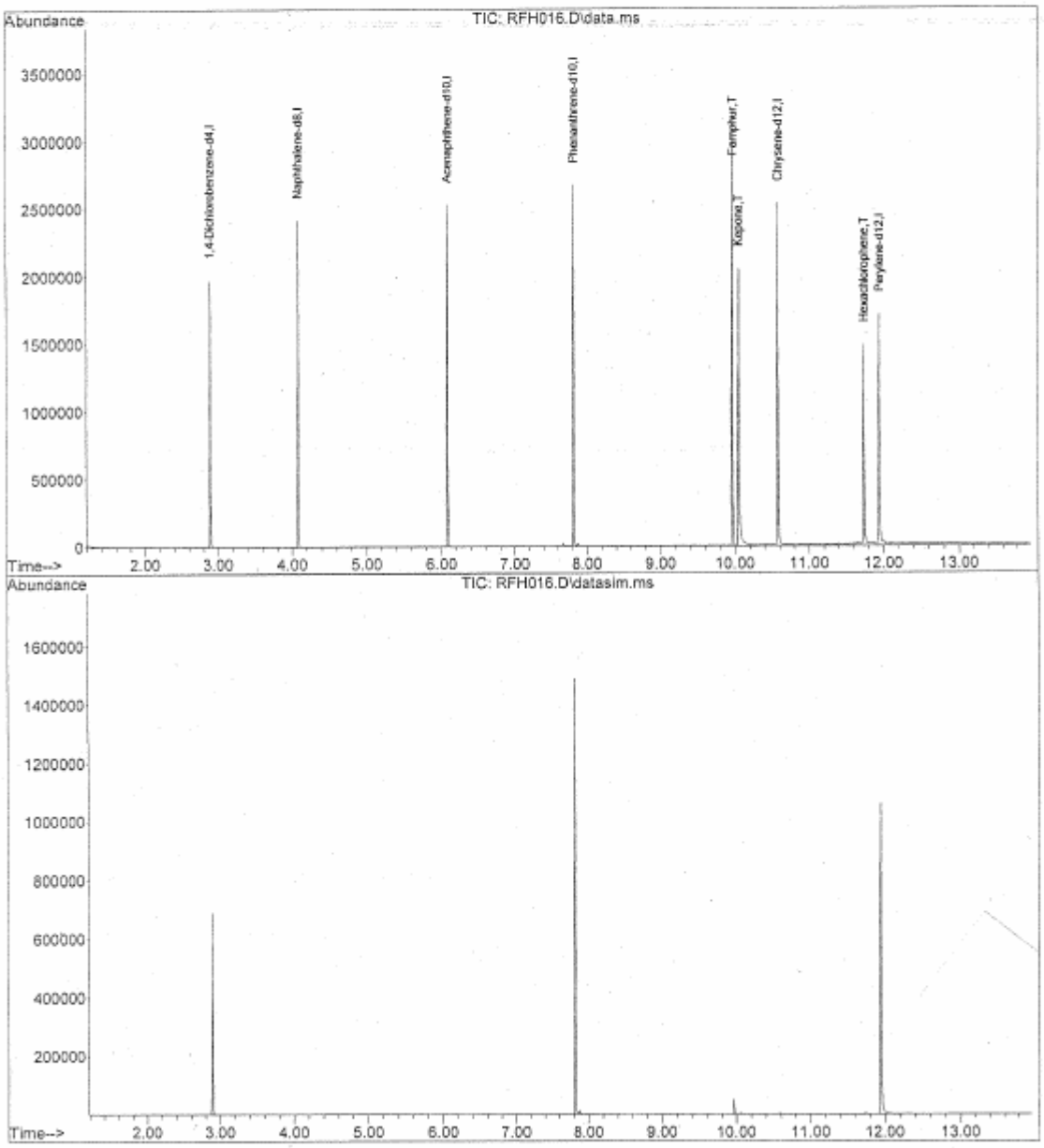




SVE4A18B.M Fri Jan 21 14:36:22 2011 Page: 3

Figure 2b (cont.): TYPICAL CHROMATOGRAM FOR APPENDIX IX

```
                    Quantitation Report     (QT Reviewed)
Data File : D:\DATA\11F06\RFH016.D                          Vial: 16
Acq On    :  6 Jun 2011  21:08                          Operator: KV
Sample    : SVE7F06C4 80PPM                             Inst    : E7
Misc      : APP9 ADD                                    Multiplr: 1.00
Integrator: RTE
Quant Time: Jun 07 09:24:16 2011
Quant Results File: SVE7F06C.RES
Quant Method : C:\msdchem\1\METHODS\SVE7F06C.M
Quant Title  : SEMIVOLATILES APP9
QLast Update : Tue Jun 07 09:20:39 2011
Response via : Initial Calibration
DataAcq Meth:SVE7E11S.M
```



SVE7F06C.M Tue Jun 07 09:24:24 2011 Page: 2

Figure 3: TYPICAL ICAL SUMMARY

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :06/23/11 20:40
Spike Units :PPM
IC File :RFJ223

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :06/23/11 22:33
HPChem Method :SVE4F23

IDX	Parameters	5 22:33 RFJ226	10 22:15 RFJ225	20 21:56 RFJ224	25 21:37 RFJ223	30 21:18 RFJ222	40 20:59 RFJ221	50 20:40 RFJ220	Av_RRF	%_RSD	Av_Rt_M
1	1,4-Dichlorobenzene-d4	1	1	1	1	1	1	1	1	0	2.8212
2	N-nitrosodimethylamine	0.470	0.514	0.505	0.509	0.525	0.521	0.533	0.511	3.92	1.3657
3	Pyridine	0.761	1.037	1.028	0.983	1.028	1.006	1.051	1.014	3.15	1.3965
4	2-Fluorophenol	1.047	1.176	1.153	1.100	1.150	1.111	1.183	1.130	3.73	1.9322
5	Phenol-d5	1.277	1.362	1.323	1.335	1.321	1.320	1.367	1.332	3.97	2.4890
6	Phenol	1.316	1.385	1.377	1.320	1.351	1.328	1.386	1.352	2.34	2.4996
7	Aniline	1.345	1.666	1.636	1.613	1.651	1.609	1.673	1.657	5.70	2.5218
8	bis(2-chloroethyl)ether	0.937	1.045	1.005	0.973	0.992	0.969	1.002	0.960	5.69	2.5921
9	2-Chlorophenol	1.401	1.781	1.738	1.732	1.780	1.757	1.805	1.728	3.92	2.6519
10	1,3-Dichlorobenzene	1.558	1.933	1.862	1.556	1.622	1.587	1.677	1.623	3.15	2.7789
11	1,2-Dichlorobenzene-d4	0.997	1.029	0.976	0.988	1.008	0.973	1.017	1.001	1.87	2.8297
12	1,4-Dichlorobenzene	1.590	1.680	1.915	1.922	1.947	1.922	1.985	1.931	2.07	2.8356
13	Benzyl alcohol	0.713	0.786	0.745	0.755	0.784	0.757	0.792	0.762	3.70	2.9118
14	1,2-Dichlorobenzene	1.533	1.593	1.550	1.521	1.559	1.523	1.571	1.550	3.72	2.6425
15	2-Methylphenol	0.911	0.935	0.937	0.915	0.944	0.913	0.963	0.931	2.06	2.6825
16	bis(2-chloroisopropyl)ether	1.993	2.207	2.364	2.098	2.175	2.074	2.181	2.156	5.46	3.0959
17	4-Methylphenol	1.159	1.251	1.247	1.244	1.262	1.237	1.284	1.240	3.18	3.1210
18	N-Nitroso-di-n-propylamine	0.559	0.608	0.594	0.592	0.612	0.580	0.614	0.594	3.35	3.1433
19	Hexachloroethane	0.551	0.577	0.567	0.565	0.584	0.560	0.583	0.570	2.19	3.2609
20	Naphthalene-d8	1	1	1	1	1	1	1	1	0	3.2907
21	Nitrobenzene-d5	0.243	0.273	0.266	0.262	0.262	0.260	0.269	0.262	3.64	3.5097
22	Nitrobenzene	0.230	0.249	0.245	0.241	0.241	0.240	0.249	0.242	2.23	3.5177
23	Isophorone	0.208	0.242	0.248	0.232	0.224	0.239	0.261	0.230	5.79	3.5319
24	2-Nitrophenol	0.173	0.192	0.193	0.185	0.193	0.190	0.199	0.190	1.36	3.6103
25	2,4-Dimethylphenol	0.271	0.293	0.295	0.289	0.294	0.287	0.301	0.290	3.23	3.6327
26	Benzoic acid	0.158	0.179	0.201	0.208	0.214	0.219	0.228	0.201	12.19	3.7013
27	bis(2-Chloroethoxy)methane	0.311	0.324	0.315	0.304	0.312	0.305	0.315	0.312	2.22	3.7299
28	2,4-Dichlorophenol	0.288	0.304	0.304	0.296	0.305	0.299	0.311	0.301	2.66	3.8422
29	1,2,4-Trichlorobenzene	0.331	0.350	0.346	0.336	0.339	0.333	0.349	0.340	1.98	3.8466
30	3,4-Dimethylphenol	0.373	0.397	0.394	0.386	0.393	0.385	0.401	0.390	2.43	3.9405
31	Naphthalene	1.039	1.037	1.014	0.997	1.013	0.997	1.024	1.017	1.79	4.0248
32	4-Chloroaniline	0.414	0.446	0.437	0.430	0.439	0.431	0.443	0.435	1.57	4.0729
33	Hexachlorobutadiene	0.176	0.183	0.177	0.170	0.180	0.174	0.180	0.177	2.55	4.1247
34	Hydroquinone								0.000	0.00	0.0000
35	4-Chloro-3-methylphenol	0.244	0.251	0.253	0.248	0.255	0.250	0.260	0.252	1.97	4.5903
36	2-Methylnaphthalene	0.650	0.693	0.670	0.663	0.698	0.694	0.681	0.676	2.04	4.7794
37	1-Methylnaphthalene	0.637	0.657	0.643	0.640	0.639	0.625	0.645	0.641	1.50	4.8876
38	Acenaphthene-d10	1	1	1	1	1	1	1	1	0	4.9860
39	Hexachlorocyclopentadiene	0.370	0.412	0.416	0.404	0.415	0.401	0.431	0.407	4.62	4.9568
40	2,4,5-Trichlorophenol	0.394	0.415	0.415	0.411	0.414	0.405	0.423	0.411	2.28	4.9616
41	2,4,6-Trichlorophenol	0.364	0.399	0.400	0.394	0.397	0.387	0.406	0.392	3.50	5.0923
42	2,3,5-Trichlorophenol	0.417	0.435	0.437	0.431	0.430	0.422	0.443	0.430	2.34	5.1267
43	2,3,4-Trichlorophenol	0.360	0.380	0.374	0.367	0.416	0.358	0.426	0.383	5.17	5.2004
44	2-Fluorobiphenyl	1.430	1.482	1.447	1.450	1.447	1.388	1.450	1.438	2.07	5.2004
45	Biphenyl	1.418	1.725	1.762	1.758	1.765	1.688	1.772	1.720	2.06	5.3146
46	2-Chloronaphthalene	1.197	1.424	1.426	1.421	1.442	1.383	1.439	1.422	3.55	5.3266
47	2-Nitroaniline	0.245	0.558	0.564	0.560	0.574	0.525	0.572	0.557	3.86	5.4499
48	2,6-Dimethylnaphthalene	1.203	1.228	1.258	1.220	1.245	1.206	1.262	1.237	3.10	5.4967
49	1,4-Dinitrobenzene	0.147	0.188	0.177	0.178	0.188	0.184	0.181	0.179	7.96	5.6185
50	Dimethylphthalate	1.376	1.510	1.511	1.368	1.388	1.341	1.397	1.372	3.58	5.6970
51	1,3-Dinitrobenzene	0.293	0.310	0.311	0.308	0.316	0.290	0.311	0.307	1.79	5.7032
52	2,6-Dinitrotoluene	0.261	0.305	0.305	0.302	0.306	0.300	0.303	0.300	3.35	5.7252
53	1,2-Dinitrobenzene	0.116	0.133	0.133	0.132	0.134	0.124	0.131	0.130	5.07	5.7999
54	Acenaphthylene	1.868	2.001	1.993	1.953	1.955	1.922	2.002	1.962	2.63	5.8166
55	3-Nitroaniline	0.352	0.350	0.356	0.361	0.370	0.355	0.361	0.355	1.94	5.8334
56	Acenaphthene	1.335	1.375	1.355	1.325	1.326	1.328	1.337	1.337	1.83	6.0253
57	2,4-Dinitrophenol	0.111	0.169	0.175	0.186	0.197	0.183	0.188	0.173	16.61	6.0534
58	4-Nitrophenol	0.119	0.155	0.163	0.168	0.174	0.194	0.179	0.160	12.36	6.1334
59	2,4-Dinitrotoluene	0.353	0.397	0.385	0.395	0.405	0.377	0.392	0.386	3.39	6.2372
60	Dibenzofuran	1.697	1.798	1.753	1.720	1.743	1.674	1.733	1.728	4.33	6.2603
61	2,3,5,6-Tetrachlorophenol	0.252	0.273	0.272	0.266	0.273	0.293	0.279	0.272	3.71	6.3303
62	2,3,4,6-Tetrachlorophenol	0.331	0.341	0.346	0.336	0.343	0.326	0.347	0.336	1.91	6.3521
63	2,3,5-Trimethylnaphthalene	1.067	1.091	1.076	1.024	1.076	1.054	1.091	1.068	3.60	6.4653
64	Diethylphthalate	1.296	1.405	1.359	1.363	1.376	1.292	1.399	1.356	5.47	6.5320
65	Fluorene	1.326	1.448	1.417	1.392	1.409	1.346	1.392	1.397	2.37	6.6395
66	4-Chlorophenyl-phenylether	0.625	0.622	0.621	0.619	0.614	0.591	0.615	0.620	3.01	6.6535
67	4-Nitroaniline	0.300	0.355	0.345	0.358	0.361	0.330	0.343	0.342	6.16	6.6943
68	Phenanthrene-d10	1	1	1	1	1	1	1	1	0	7.2209
69	4,6-Dinitro-2-methylphenol	0.098	0.124	0.138	0.134	0.137	0.137	0.142	0.130	11.73	6.7037
70	N-Nitrosodiphenylamine	0.946	0.667	0.677	0.674	0.663	0.625	0.687	0.667	2.01	6.7949
71	Azobenzene	0.299	0.540	0.566	0.545	0.551	0.557	0.567	0.546	4.22	6.8420
72	2,4,6-Tribromophenol	0.098	0.109	0.111	0.108	0.111	0.112	0.114	0.109	4.84	6.9228
73	4-Bromophenyl-phenylether	0.188	0.207	0.204	0.191	0.195	0.202	0.208	0.192	3.81	6.9276
74	Hexachlorobenzene	0.227	0.234	0.231	0.226	0.229	0.228	0.231	0.227	1.31	7.5839
75	Pentachlorophenol	0.121	0.153	0.158	0.157	0.164	0.162	0.162	0.154	9.89	7.5091
76	Phenanthrene	1.137	1.190	1.174	1.140	1.183	1.144	1.164	1.159	1.71	7.7474
77	Dinoseb								0.000	0.00	0.0000
78	Anthracene	1.087	1.186	1.194	1.154	1.167	1.162	1.192	1.163	3.17	7.8040
79	Carbazole	1.013	1.171	1.020	1.072	1.098	1.059	1.085	1.075	2.99	7.9877
80	Di-n-butylphthalate	1.017	1.243	1.257	1.262	1.298	1.249	1.274	1.228	2.22	8.3955
81	1-Methylphenanthrene	0.808	0.871	0.856	0.843	0.840	0.822	0.831	0.839	2.55	8.7203
82	Fluoranthene	1.053	1.194	1.180	1.164	1.185	1.128	1.139	1.149	4.25	9.0230
83	Chrysene-d12	1	1	1	1	1	1	1	1	0	10.4506
84	Benzidine								0.000	0.00	0.0000
85	Pyrene	1.284	1.294	1.305	1.260	1.291	1.314	1.373	1.303	2.70	9.2571
86	Terphenyl-d14	0.695	0.714	0.708	0.707	0.710	0.722	0.751	0.715	2.49	9.4324
87	Butylbenzylphthalate	0.423	0.510	0.568	0.560	0.577	0.574	0.612	0.546	11.40	9.8475
88	bis(2-ethylhexyl)adipate	0.369	0.486	0.505	0.521	0.531	0.533	0.561	0.501	12.50	10.0314
89	3,3'-Dichlorobenzidine	0.308	0.388	0.412	0.412	0.435	0.408	0.426	0.398	10.64	10.4591
90	Benzo(a)anthracene	1.071	1.125	1.173	1.107	1.150	1.122	1.162	1.130	3.09	10.4796
91	Chrysene	1.068	1.118	1.115	1.098	1.088	1.055	1.094	1.092	2.09	10.5174
92	bis(2-Ethylhexyl)phthalate	0.602	0.799	0.842	0.828	0.852	0.830	0.877	0.804	11.52	10.5247
93	Perylene-d12	1	1	1	1	1	1	1	1	0	11.8386
94	Di-n-octylphthalate	0.966	1.319	1.431	1.421	1.499	1.482	1.563	1.380	14.17	11.1307
95	Benzo(b)fluoranthene	1.033	1.076	1.112	1.061	1.105	1.083	1.093	1.081	2.60	11.2876
96	Benzo(k)fluoranthene	1.031	1.132	1.083	1.090	1.096	1.074	1.110	1.084	3.00	11.5091
97	Benzo(e)pyrene	1.077	1.130	1.135	1.106	1.115	1.100	1.128	1.113	1.85	11.7242
98	Benzo(a)pyrene	0.975	1.053	1.078	1.040	1.075	1.051	1.085	1.050	3.57	11.7826
99	Perylene	1.155	1.122	1.159	1.138	1.145	1.131	1.156	1.153	1.71	11.8633
100	Indeno(1,2,3-cd)pyrene	1.132	1.265	1.302	1.288	1.302	1.281	1.326	1.267	5.01	12.9801
101	Dibenzo(a,h)anthracene	0.827	1.009	1.028	1.055	1.025	1.007	1.069	1.014	6.45	13.0001
102	Benzo(g,h,i)perylene	0.926	1.021	1.054	1.028	1.059	1.032	1.054	1.025	4.50	13.3183

Ave_%RSD : 4.1   Max_%RSD : 16.6

Use Least Square Linear Regression with weighting factor of inverse concentration
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
57	2,4-Dinitrophenol	-0.00963	0.19854	0.9988

Figure 3a: TYPICAL ICAL SUMMARY OF BENZIDINE

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :06/23/11 18:09
Spike Units :PPM
IC File :RFJ215

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :06/23/11 20:03
HPChem Method :SVE4F23A

		2	5	10	25	30	40	50			
		20:03	19:44	19:25	19:06	18:47	18:28	18:09			
IDX	Parameters	RFJ218	RFJ217	RFJ216	RFJ215	RFJ214	RFJ213	RFJ212	Av_RRF	%_RSD	Av_Rt_M
1	Phenanthrene-d10	1	1	1	1	1	1	1	1	0	7.7210
2	Benzidine	0.544	0.471	0.576	0.675	0.610	0.650	0.712	0.605	13.64	9.1755

Ave_%RSD : 13.6 Max_%RSD : 13.6

Figure 3b: **TYPICAL ICAL SUMMARY OF ADDITIONAL ANALYTES APPENDIX IX**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :01/18/11 19:43
Spike Units :PPM
IC File :RAJ114

Column Spec :28-5MS ID :0.18MM
Ending DateTime :01/18/11 21:29
HPChem Method :SVE4A18B

IDX	Parameters	5 19:43 RAJ111	10 20:00 RAJ112	20 20:18 RAJ113	25 20:36 RAJ114	30 20:53 RAJ115	40 21:11 RAJ116	50 21:29 RAJ117	Av_RRF	% RSD	Av Rt M
1	1,4-Dichlorobenzene-d4	1	1	1	1	1	1	1	1	0	2.8833
2	1,4-Dioxane	0.449	0.397	0.370	0.368	0.438	0.369	0.372	0.395	8.89	1.2940
3	Ethyl methacrylate	0.752	0.645	0.661	0.675	0.740	0.623	0.662	0.680	7.08	1.5618
4	2-Picoline	1.083	1.117	1.114	0.984	1.118	0.979	1.117	1.073	5.95	1.7228
5	N-nitrosomethylethylamine	0.414	0.419	0.471	0.481	0.433	0.468	0.480	0.452	6.45	1.7573
6	Methyl methanesulfonate	0.552	0.524	0.530	0.557	0.530	0.524	0.515	0.533	2.94	1.8955
7	2-Fluorophenol	1.034	1.055	1.061	1.080	1.059	1.060	1.079	1.061	1.45	1.9797
8	N-nitrosodiethylamine	0.412	0.439	0.457	0.475	0.465	0.462	0.468	0.454	4.77	2.1229
9	Ethyl methanesulfonate	0.740	0.733	0.726	0.754	0.747	0.723	0.727	0.736	1.57	2.2891
10	Pheno-d5	1.180	1.167	1.197	1.232	1.262	1.182	1.194	1.202	2.79	2.5447
11	Benzaldehyde								0.000	0.00	0.0000
12	Pentachloroethane	0.518	0.515	0.527	0.526	0.520	0.531	0.528	0.524	1.12	2.6685
13	1,2-Dichlorobenzene-d4	0.918	0.899	0.907	0.921	0.895	0.888	0.897	0.904	1.36	3.0144
14	N-nitrosopyrrolidine	0.396	0.424	0.461	0.480	0.509	0.486	0.488	0.463	8.60	3.1926
15	Naphthalene-d8	1	1	1	1	1	1	1	1	0	4.0783
16	Acetophenone	0.274	0.278	0.278	0.282	0.275	0.275	0.273	0.277	1.14	3.2164
17	N-nitrosomorpholine	0.169	0.171	0.173	0.181	0.181	0.170	0.170	0.174	2.96	3.2252
18	o-toluidine	0.430	0.444	0.460	0.471	0.464	0.457	0.460	0.455	3.03	3.2483
19	Nitrobenzene-d5	0.259	0.272	0.276	0.280	0.277	0.274	0.275	0.273	2.52	3.3599
20	N-nitrosopiperdine	0.125	0.138	0.140	0.145	0.145	0.143	0.142	0.140	4.95	3.5171
21	O,O,O-triethyl phosphorothioate	0.131	0.136	0.136	0.140	0.135	0.135	0.135	0.135	1.91	3.7774
22	a,a-dimethylphenethylamine	0.480	0.452	0.547	0.574	0.637	0.556	0.564	0.544	11.29	3.9683
23	3,4-Dimethylphenol	0.349	0.355	0.363	0.371	0.396	0.370	0.365	0.367	4.07	4.0139
24	2,6-Dichlorophenol	0.261	0.264	0.270	0.273	0.286	0.274	0.268	0.271	2.97	4.1566
25	Hexachloropropene	0.189	0.203	0.210	0.211	0.210	0.214	0.216	0.207	4.30	4.1958
26	Hydroquinone	0.253	0.221	0.237	0.258	0.332	0.269	0.272	0.263	13.36	4.4923
27	N-nitrosodi-n-butylamine	0.157	0.163	0.204	0.223	0.223	0.214	0.210	0.199	13.91	4.5163
28	p-phenylenediamine	0.230	0.272	0.224	0.238	0.282	0.248	0.253	0.250	8.59	4.5291
29	epsilon-Caprolactam								0.000	0.00	0.0000
30	Safrole	0.222	0.238	0.238	0.244	0.247	0.243	0.244	0.239	3.54	4.7589
31	1-Methylnaphthalene								0.000	0.00	0.0000
32	1,2,4,5-Tetrachlorobenzene	0.306	0.303	0.300	0.309	0.301	0.300	0.297	0.302	1.36	5.0486
33	Acenaphthene-d10	1	1	1	1	1	1	1	1	0	6.0736
34	2-Fluorobiphenyl	1.417	1.429	1.461	1.459	1.366	1.409	1.407	1.421	2.33	5.2830
35	Isosafrole	0.464	0.488	0.489	0.516	0.489	0.497	0.509	0.493	3.42	5.3587
36	Biphenyl	3.101	3.108	3.076	3.178	2.965	3.011	3.003	3.063	2.41	5.4000
37	1-Chloronaphthalene	1.142	1.125	1.144	1.170	1.116	1.124	1.113	1.133	1.76	5.4445
38	Diphenyl ether	0.816	0.806	0.814	0.840	0.783	0.810	0.816	0.812	2.07	5.5228
39	1,4-Naphthoquinone	0.351	0.405	0.454	0.456	0.475	0.441	0.441	0.432	9.58	5.6225
40	1,3-Dinitrobenzene								0.000	0.00	0.0000
41	Pentachlorobenzene	0.520	0.516	0.512	0.532	0.497	0.508	0.517	0.515	2.06	6.2690
42	1-Naphthylamine	0.932	1.006	1.065	1.114	1.187	1.075	1.088	1.067	7.55	6.4084
43	2,3,4,6-Tetrachlorophenol								0.000	0.00	0.0000
44	2-Naphthylamine	0.965	1.012	0.902	0.910	0.908	0.760	0.714	0.882	12.15	6.5031
45	Thionazin	0.140	0.167	0.185	0.189	0.198	0.189	0.191	0.180	11.16	6.7074
46	5-Nitro-o-toluidine	0.239	0.288	0.331	0.344	0.384	0.350	0.358	0.328	14.97	6.7435
47	Phenanthrene-d10	1	1	1	1	1	1	1	1	0	7.8096
48	2,4,6-Tribromophenol	0.080	0.089	0.095	0.100	0.099	0.099	0.103	0.095	8.29	7.0106
49	Sulfotepp	0.061	0.074	0.078	0.083	0.076	0.081	0.084	0.077	10.34	7.0871
50	1,3,5-Trinitrobenzene	0.037	0.049	0.063	0.069	0.073	0.071	0.074	0.062	22.64	7.1880
51	Phorate	0.279	0.313	0.327	0.340	0.318	0.330	0.331	0.319	6.24	7.2365
52	Phenacetin	0.209	0.261	0.292	0.301	0.318	0.314	0.316	0.287	13.91	7.2502
53	Diallate	0.041	0.043	0.041	0.038	0.034	0.036	0.038	0.039	8.50	7.3283
54	Dimethoate	0.164	0.193	0.209	0.210	0.215	0.200	0.198	0.198	8.50	7.4221
55	Atrazine	0.170	0.183	0.184	0.189	0.185	0.174	0.174	0.180	3.99	7.5118
56	Pentachloronitrobenzene	0.072	0.078	0.084	0.084	0.086	0.086	0.086	0.082	6.48	7.6118
57	4-Aminobiphenyl	0.621	0.658	0.678	0.701	0.710	0.690	0.697	0.679	4.53	7.6063
58	Pronamide	0.311	0.360	0.384	0.399	0.396	0.364	0.391	0.372	8.30	7.6871
59	Dinoseb	0.086	0.125	0.147	0.160	0.171	0.177	0.186	0.150	23.14	7.8156
60	Disulfoton	0.325	0.328	0.321	0.328	0.309	0.311	0.312	0.319	2.62	7.8293
61	Chrysene-d12	1	1	1	1	1	1	1	1	0	10.5753
62	Methyl parathion	0.132	0.178	0.203	0.213	0.194	0.206	0.199	0.189	14.65	8.2348
63	Ethyl parathion	0.078	0.111	0.126	0.134	0.126	0.140	0.137	0.122	17.71	8.6552
64	4-Nitroquinoline-N-oxide	0.028	0.037	0.045	0.050	0.053	0.055	0.054	0.046	22.14	8.6730
65	Methapyrilene	0.140	0.177	0.191	0.216	0.190	0.187	0.177	0.182	12.50	8.7700
66	Isodrin	0.117	0.123	0.123	0.126	0.108	0.121	0.122	0.120	5.02	8.9549
67	Terphenyl-d14	0.635	0.695	0.699	0.724	0.664	0.697	0.688	0.686	4.17	9.5139
68	Aramite	0.036	0.051	0.057	0.058	0.059	0.063	0.063	0.055	17.04	9.5803
69	p-Dimethylaminoazobenzene	0.174	0.238	0.265	0.278	0.267	0.278	0.282	0.255	15.04	9.6603
70	Chlorobenzilate	0.206	0.252	0.272	0.277	0.268	0.280	0.285	0.263	10.44	9.7110
71	3,3-Dimethylbenzidine	0.389	0.475	0.518	0.529	0.545	0.517	0.492	0.495	10.54	10.0017
72	Perylene-d12	1	1	1	1	1	1	1	1	0	11.9412
73	2-Acetylaminofluorene	0.199	0.286	0.373	0.401	0.432	0.445	0.457	0.370	25.67	10.2520
74	7,12-Dimethylben(a)anthracene	0.326	0.398	0.436	0.446	0.451	0.453	0.470	0.425	11.61	11.5658
75	3-Methylcholanthrene	0.340	0.401	0.454	0.468	0.484	0.487	0.496	0.447	12.72	12.2321
76	Dibenzo(a,j)acridine	0.674	0.654	0.751	0.798	0.832	0.820	0.812	0.763	9.49	12.9026

Ave_%RSD : 8 Max_%RSD : 25.7

Use Least Square Linear Regression with weighting factor of inverse concentration
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
50	1,3,5-Trinitrobenzene	-0.00583	0.07782	0.9991
59	Dinoseb	-0.01522	0.19089	0.9983
63	Ethyl parathion	-0.00840	0.14413	0.9992
64	4-Nitroquinoline-N-oxide	-0.00432	0.05753	0.9988
68	Aramite	-0.00381	0.06533	0.9995
73	2-Acetylaminofluorene	-0.04100	0.47999	0.9987

Figure 3b (cont.): TYPICAL ICAL SUMMARY OF ADDITIONAL ANALYTES APPENDIX IX

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E4
Beginning DateTime :01/18/11 17:00
Spike Units :PPM
IC File :RAJ105

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :01/18/11 18:49
HPChem Method :SVE4A18C

IDX	Parameters	20 17:00 RAJ102	40 17:20 RAJ103	50 17:38 RAJ104	80 17:56 RAJ105	100 18:14 RAJ106	120 18:31 RAJ107	140 18:49 RAJ108	Av_RRF	%_RSD	Av_Rt_M
1	1,4-Dichlorobenzene-d4	1	1	1	1	1	1	1	1	0	2.8828
2	Naphthalene-d8	1	1	1	1	1	1	1	1	0	4.0777
3	Acenaphthene-d10	1	1	1	1	1	1	1	1	0	6.0731
4	Phenanthrene-d10	1	1	1	1	1	1	1	1	0	7.8079
5	Chrysene-d12	1	1	1	1	1	1	1	1	0	10.5767
6	Famphur	0.350	0.395	0.401	0.417	0.418	0.436	0.429	0.407	7.04	9.9648
7	Kepone	0.066	0.072	0.075	0.077	0.079	0.079	0.079	0.075	6.67	10.0462
8	Perylene-d12	1	1	1	1	1	1	1	1	0	11.9444
9	Hexachlorophene	0.032	0.065	0.075	0.092	0.102	0.112	0.114	0.085	34.76	11.7377

Ave_%RSD : 16.2 Max_%RSD : 34.8

Use Least Square Linear Regression with weighting factor of inverse concentration
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
9	Hexachlorophene	-0.05382	0.12553	0.9970

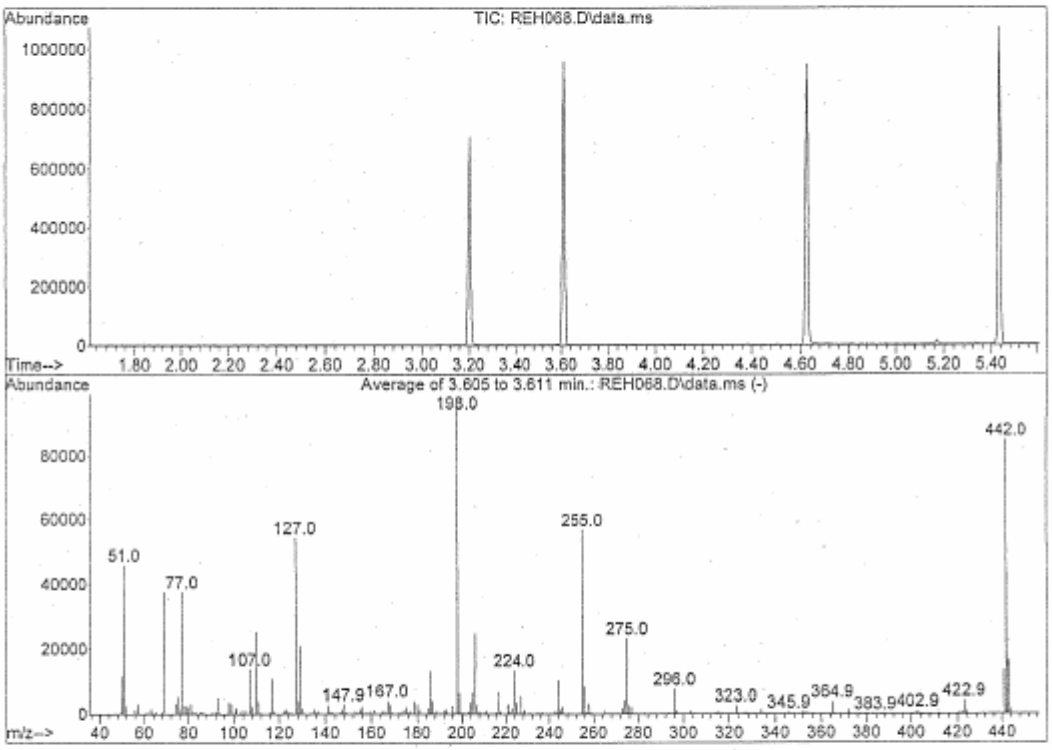
Figure 4A: TYPICAL DFTPP TUNE SUMMARY FOR 8270D

DFTPP

Data Path : D:\DATA\11E11\
Data File : REH068.D
Acq On : 11 May 2011 14:23
Operator : KV
Sample : DFTE7E1101
Misc :
ALS Vial : 2 Sample Multiplier: 1

Integration File: rteint.p

Method : C:\msdchem\1\METHODS\DFTPPD.M
Title : Semivolatiles DFTPP
Last Update : Wed May 11 16:53:22 2011



AutoFind: Scans 717, 718, 719; Background Corrected with Scan 710

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
51	198	10	80	48.5	45907	PASS
68	69	0.00	2	1.5	559	PASS
70	69	0.00	2	0.4	152	PASS
127	198	10	80	57.4	54259	PASS
197	198	0.00	2	0.4	418	PASS
198	198	100	100	100.0	94557	PASS
199	198	5	9	6.6	6247	PASS
275	198	10	60	24.5	23205	PASS
365	198	1	100	3.9	3675	PASS
441	442	0.01	24	15.8	13420	PASS
442	198	50	100	89.6	84768	PASS
443	442	15	24	19.4	16412	PASS

DFTPPD.M Wed May 11 16:53:34 2011 Page: 1

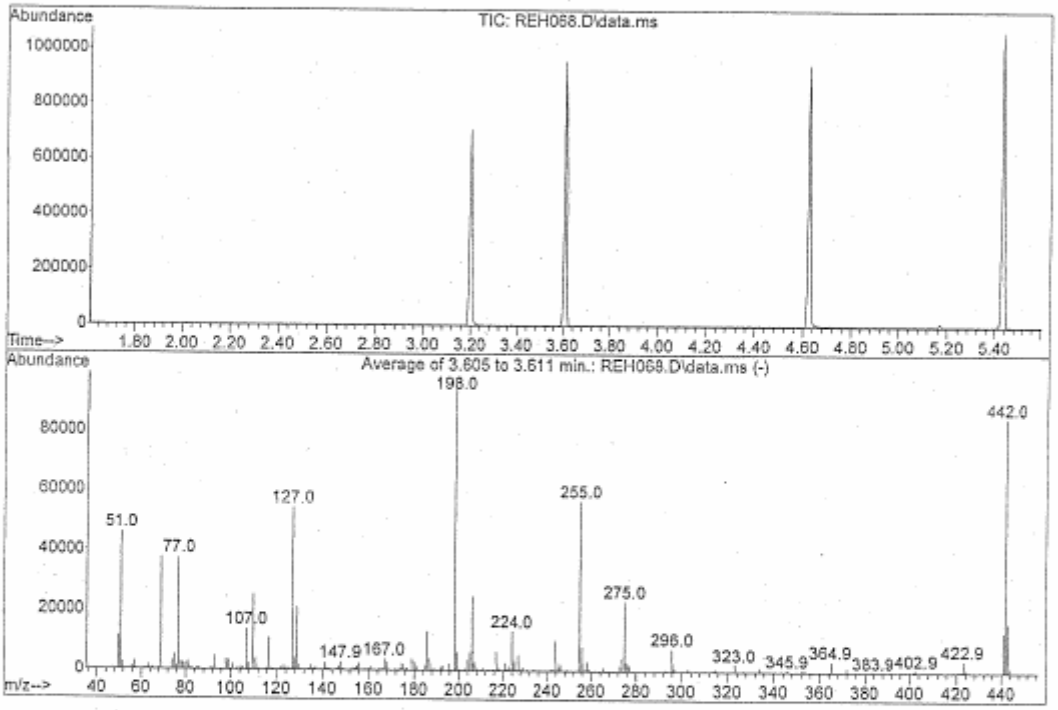
Figure 4B: TYPICAL DFTPP TUNE SUMMARY FOR 8270C

DFTPP

Data Path : D:\DATA\11E11\
Data File : REH068.D
Acq On : 11 May 2011 14:23
Operator : KV
Sample : DFTE7E1101
Misc :
ALS Vial : 2 Sample Multiplier: 1

Integration File: rteint.p

Method : C:\msdchem\1\METHODS\DFTPP.M
Title : DFTPP
Last Update : Wed May 11 16:54:14 2011



AutoFind: Scans 717, 718, 719; Background Corrected with Scan 710

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
51	198	30	60	48.5	45907	PASS
68	69	0.00	2	1.5	559	PASS
69	198	0.00	100	39.8	37600	PASS
70	69	0.00	2	0.4	152	PASS
127	198	40	60	57.4	54259	PASS
197	198	0.00	1	0.4	418	PASS
198	198	100	100	100.0	94557	PASS
199	198	5	9	6.6	6247	PASS
275	198	10	30	24.5	23205	PASS
365	198	1	100	3.9	3675	PASS
441	443	0.01	100	81.8	13420	PASS
442	198	40	100	89.6	84768	PASS
443	442	17	23	19.4	16412	PASS

DFTPP.M Wed May 11 16:54:26 2011 Page: 1

Figure 4a: TYPICAL INSTRUMENT PERFORMANCE CHECK FOR 8270D

5B
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REH06B
Instrument ID: TOE7

Project: ICAL
SDG No.: 11F083
DFTPP Injection Date: 05/11/11
DFTPP Injection Time: 14:23

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	10.0 - 80.0% of mass 198	48.55
68	Less than 2% of mass 69	0.59(1.5)1
69	% of mass 198	39.76
70	Less than 2% of mass 69	0.16(0.4)1
127	10.0 - 80.0% of mass 198	57.38
197	Less than 2.0% of mass 198	0.44
198	Base Peak, 100	100.00
199	5.0 - 9.0% of mass 198	6.61
275	10.0 - 60.0% of mass 198	24.54
365	Greater than 1.00% of mass 198	3.89
441	Present, but less than 24% of mass 442	14.19(15.8)2
442	Greater than 50% of mass 198	89.65
443	15.0 - 27.0% of mass 442	17.36(19.4)2

1-Value is % mass 69 2-Value is % mass 442

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
1	SSTD050	SVE7E111	REH069	05/11/11	14:33
2	SSTD040	SVE7E112	REH070	05/11/11	14:52
3	SSTD030	SVE7E113	REH071	05/11/11	15:10
4	SSTD025	SVE7E114	REH072	05/11/11	15:29
5	SSTD020	SVE7E115	REH073	05/11/11	15:47
6	SSTD010	SVE7E116	REH074	05/11/11	16:06
7	SSTD005	SVE7E117	REH075	05/11/11	16:25

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Figure 4b: TYPICAL INSTRUMENT PERFORMANCE CHECK FOR 8270C

5B
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REH068
Instrument ID: T-041

Project: ICAL
SDG No.: ICAL
DFTPP Injection Date: 05/11/11
DFTPP Injection Time: 14:23

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	48.55
68	Less than 2% of mass 69	0.59(1.5)1
69	Relative abundance of mass 198	39.76
70	Less than 2.0% of mass 69	0.16(0.4)1
127	40.0 - 60.0% of mass 198	57.38
197	Less than 1.0% of mass 198	0.44
198	Base Peak, 100% relative abundance	100.00
199	5.0 - 9.0% of mass 198	6.61
275	10.0 - 30.0% of mass 198	24.54
365	Greater than 1.00% of mass 198	3.89
441	Present, but less than mass 443	14.19(81.8)3
442	Greater than 40.0% of mass 198	89.65
443	17.0 - 23.0% of mass 442	17.36(19.4)2

1-Value is % mass 69 2-Value is % mass 442
3-Value is % mass 443

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
1	SSTD50	SVE7E111	REH069	05/11/11	14:33
2	SSTD40	SVE7E112	REH070	05/11/11	14:52
3	SSTD30	SVE7E113	REH071	05/11/11	15:10
4	SSTD25	SVE7E114	REH072	05/11/11	15:29
5	SSTD20	SVE7E115	REH073	05/11/11	15:47
6	SSTD10	SVE7E116	REH074	05/11/11	16:06
7	SSTD5	SVE7E117	REH075	05/11/11	16:25

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Figure 5: TYPICAL CONTINUING CALIBRATION SUMMARY

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC Beginning DateTime :06/23/11 20:40
Spike Amount :25 PPM
CC/CV File :BGJ080
IC File :RFJ223

Column Spec :ZB-5MS ID :0.18MM
IC Ending DateTime :06/23/11 22:33
HPChem Method :SVE4F23
Date_Time :07/08/11 14:52

M IDX	Parameters	CC_Con	CCX_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
1	1,4-Dichlorobenzene-d4	40.000	0	153989	1	1	2.821	2.821	0				
2	N-nitrosodimethylamine	26.856	7.3	52891	0.549	0.511	1.360	1.366	3.98				
3	Pyridine	25.626	2.5	96935	1.039	1.014	1.387	1.383	7.15				
4	2-Fluorophenol	25.589	2.4	111335	1.157	1.130	1.734	1.735	2.43				
5	Phenol-d5	24.996	-0.1	128218	1.332	1.334	2.482	2.485	2.37				
6	Phenol	25.496	1.9	132738	1.381	1.352	2.504	2.500	5.20				
7	Aniline	24.757	-1.0	155113	1.612	1.627	2.523	2.525	5.60				
8	bis(2-chloroethyl)ether	25.569	2.3	97428	1.015	0.990	2.596	2.595	5.69				
9	2-Chlorophenol	25.197	0.8	141441	1.470	1.458	2.654	2.652	3.47				
10	1,3-Dichlorobenzene	25.468	1.9	159100	1.653	1.623	2.780	2.779	3.15				
11	1,2-Dichlorobenzene-d4	25.564	2.3	98532	1.024	1.001	2.952	2.950	1.82				
12	1,4-Dichlorobenzene	25.131	0.5	157809	1.640	1.631	2.836	2.835	4.07				
13	Benzyl alcohol	25.598	2.4	75065	0.780	0.762	2.913	2.912	4.70				
14	1,2-Dichlorobenzene	24.920	-0.3	148703	1.545	1.550	2.963	2.963	1.72				
15	2-Methylphenol	26.360	5.4	94415	0.981	0.931	2.989	2.987	2.06				
16	bis(2-chloroisopropyl)ether	25.399	1.6	210818	2.190	2.156	3.030	3.029	6.96				
17	4-Methylphenol	28.721	14.9	137134	1.425	1.240	3.124	3.121	4.18				
18	N-Nitroso-di-n-propylamine	[illegible]	[illegible]	62380	0.648	0.592	3.145	3.153	3.35				
19	Hexachloroethane	25.525	2.1	55998	0.582	0.570	3.262	3.260	2.19				
20	Naphthalene-d8	40.000	0	599158	1	1	4.005	4.002	0				
21	Nitrobenzene-d5	27.130	8.5	106596	0.285	0.262	3.295	3.291	3.64				
22	Nitrobenzene	27.343	8.5	98189	0.265	0.245	3.310	3.309	3.23				
23	Isophorone	28.377	13.5	186900	0.499	0.440	3.534	3.533	3.79				
24	2-Nitrophenol	24.980	-0.1	71185	0.190	0.190	3.612	3.610	4.34				
25	2,4-Dimethylphenol	27.383	9.5	118959	0.318	0.290	3.938	3.933	3.25				
26	Benzoic acid	21.677	-13.3	65307	0.174	0.201	3.702	3.701	12.19				
27	bis(2-Chloroethoxy)methane	26.046	4.2	121893	0.326	0.312	3.742	3.740	2.24				
28	2,4-Dichlorophenol	25.031	0.1	112905	0.302	0.301	3.847	3.842	2.56				
29	1,2,4-Trichlorobenzene	25.747	3.0	131637	0.352	0.341	3.945	3.941	1.98				
30	3,4-Dimethylphenol	26.614	6.7	155737	0.416	0.390	3.935	3.935	1.79				
31	Naphthalene	25.413	1.7	386652	1.033	1.017	4.028	4.025	1.79				
32	4-Chloroaniline	25.380	1.5	164991	0.441	0.434	4.076	4.073	2.42				
33	Hexachlorobutadiene	25.372	1.5	67291	0.180	0.177	4.159	4.154	2.51				
34	Hydroquinone												
35	4-Chloro-3-methylphenol	27.046	8.2	101925	0.272	0.252	4.598	4.590	1.97				
36	2-Methylnaphthalene	25.565	2.3	256951	0.685	0.670	4.781	4.776	2.04				
37	1-Methylnaphthalene	25.555	2.2	245554	0.655	0.641	4.893	4.888	1.50				
38	Acenaphthene-d10	40.000	0	303368	1	1	5.890	5.886	0				
39	Hexachlorocyclopentadiene	24.113	-3.5	74417	0.392	0.407	4.964	4.957	4.69				
40	2,4,5-Trichlorophenol	23.983	-4.1	74749	0.394	0.411	4.997	4.992	2.28				
41	2,4,6-Trichlorophenol	24.590	-1.6	73200	0.386	0.392	5.029	5.022	3.50				
42	2,3,5-Trichlorophenol	24.629	-1.3	80433	0.424	0.430	5.133	5.127	4.34				
43	2,3,4-Trichlorophenol	26.437	5.7	76786	0.405	0.383	5.204	5.200	7.12				
44	2-Fluorobiphenyl	27.561	10.2	300616	1.585	1.438	5.205	5.200	5.07				
45	Biphenyl	25.130	0.5	333597	1.759	1.750	5.320	5.315	5.06				
46	2-Chloronaphthalene	24.975	-0.1	232097	1.224	1.227	5.335	5.332	5.86				
47	2-Nitroaniline	26.035	4.1	55156	0.621	0.597	5.453	5.450	3.80				
48	2,6-Dimethylnaphthalene	25.289	1.2	237155	1.251	1.237	5.503	5.497	5.10				
49	1,4-Dinitrobenzene	25.137	0.6	33545	0.177	0.176	5.623	5.619	1.62				
50	Dimethylphthalate	26.028	4.1	271844	1.432	1.377	5.690	5.684	3.29				
51	1,3-Dinitrobenzene	25.829	3.4	40237	0.212	0.207	5.701	5.702	3.27				
52	2,6-Dinitrotoluene	25.999	3.8	58470	0.308	0.306	5.751	5.745	2.35				
53	1,2-Dinitrobenzene	25.994	4.0	35056	0.132	0.130	5.807	5.800	5.07				
54	Acenaphthylene	25.537	2.1	380072	2.005	1.962	5.822	5.817	2.63				
55	3-Nitroaniline	25.974	3.8	69773	0.368	0.355	5.935	5.935	1.54				
56	Acenaphthene	25.301	1.2	254579	1.343	1.327	6.027	6.024	1.83				
57	2,4-Dinitrophenol	21.840	-12.6	23094	0.138	0.158	6.065	6.059	16.61	-0.0096	0.1985		0.9988
58	4-Nitrophenol	27.139	8.6	32899	0.174	0.160	6.143	6.133	12.76				
59	2,4-Dinitrotoluene	26.506	6.0	27991	0.410	0.386	6.225	6.220	9.49				
60	Dibenzofuran	24.992	1.8	334375	1.764	1.733	6.236	6.233	4.53				
61	2,3,5,6-Tetrachlorophenol	24.697	-1.2	30946	0.209	0.220	6.351	6.347	5.74				
62	2,3,4,6-Tetrachlorophenol	24.692	-1.3	66719	0.351	0.292	6.282	6.279	5.37				
63	2,3,5-Trimethylnaphthalene	25.424	1.7	206789	1.091	1.068	6.373	6.393	3.64				
64	Diethylphthalate	26.556	6.2	513327	1.706	1.378	6.573	6.570	3.00				
65	Fluorene	25.568	2.3	596223	1.926	1.797	6.629	6.624	3.37				
66	4-Chlorophenyl-phenylether	25.198	0.8	118415	0.625	0.620	6.659	6.654	3.01				
67	4-Nitroaniline	26.669	6.7	49080	0.364	0.342	6.669	6.664	6.16				
68	Phenanthrene-d10	40.000	0	532409	1	1	7.727	7.721	0				
69	4,6-Dinitro-2-methylphenol	24.410	-2.4	22847	0.127	0.130	6.709	6.704	11.73				
70	N-Nitrosodiphenylamine	24.699	-1.2	222311	0.659	0.667	6.802	6.795	2.01				
71	Azobenzene	27.657	10.6	203584	0.604	0.546	6.848	6.842	2.22				
72	2,4,6-Tribromophenol	24.851	-0.6	35550	0.108	0.109	6.928	6.923	4.84				
73	4-Bromophenyl-phenylether	25.037	0.1	67141	0.199	0.199	7.233	7.227	3.81				
74	Hexachlorobenzene	24.553	-1.8	75988	0.225	0.226	7.582	7.567	3.91				
75	Pentachlorophenol	24.876	-0.5	51685	0.153	0.157	7.512	7.509	0.80				
76	Phenanthrene	24.832	-0.7	368085	1.151	1.159	7.753	7.747	1.71				
77	Dinoseb												
78	Anthracene	25.121	0.5	394072	1.169	1.163	7.811	7.806	3.17				
79	Carbazole	25.524	2.3	370251	1.099	1.075	7.993	7.987	2.99				
80	Di-n-butylphthalate	27.572	10.3	252602	1.352	1.228	8.407	8.386	5.72				
81	1-Methylphenanthrene	25.128	0.5	284341	0.843	0.858	8.430	8.420	2.54				
82	Fluoranthene	25.854	3.4	400720	1.189	1.149	9.032	9.023	4.25				
83	Chrysene-d12	40.000	0	504934	1	1	10.507	10.491	0				
84	Benzidine												
85	Pyrene	25.115	0.5	413151	1.309	1.303	9.267	9.257	2.70				
86	Terphenyl-d14	25.612	2.4	231308	0.733	0.715	9.447	9.432	2.49				
87	Butylbenzylphthalate	28.673	14.7	192758	0.627	0.546	9.962	9.943	11.40				
88	bis(2-ethylhexyl)adipate	28.868	15.5	182621	0.572	0.501	10.054	10.031	12.50				
89	3,3'-Dichlorobenzidine	26.659	6.6	135067	0.425	0.398	10.277	10.259	10.64				
90	Benzo(a)anthracene	26.686	6.7	366182	1.161	1.130	10.496	10.479	3.09				
91	Chrysene	25.381	1.5	349827	1.109	1.092	10.530	10.514	2.09				
92	bis(2-Ethylhexyl)phthalate	28.640	14.6	320544	0.921	0.804	10.549	10.525	11.52				
93	Perylene-d12	40.000	0	480928	1	1	11.865	11.838	0				
94	Di-n-octylphthalate	29.132	16.5	483371	1.608	1.380	11.166	11.140	14.19				
95	Benzo(b)fluoranthene	26.488	6.0	422363	1.146	1.081	11.506	11.485	2.60				
96	Benzo(k)fluoranthene	24.906	-0.4	334520	1.088	1.093	11.532	11.509	3.00				
97	Benzo(e)pyrene	25.228	3.3	352181	1.198	1.113	11.752	11.734	1.85				
98	Benzo(a)pyrene	25.296	5.5	345895	1.087	1.050	11.808	11.783	3.57				
99	Perylene	25.956	0.2	324973	1.156	1.153	11.889	11.863	1.71				
100	Indeno(1,2,3-cd)pyrene	24.209	-3.2	326941	1.227	1.267	13.014	12.980	5.01				
101	Dibenzo(a,h)anthracene	24.996	-0.0	304828	1.014	1.014	13.033	13.000	6.45				
102	Benzo(g,h,i)perylene	25.389	1.6	312832	1.041	1.025	13.351	13.318	4.50				

Figure 5a: TYPICAL CONTINUING CALIBRATION SUMMARY OF BENZIDINE

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC_Beginning DateTime :06/23/11 18:09
Spike Amount :25 PPM
CC/CV File :RFJ412
IC File :RFJ215

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :06/23/11 20:03
HPChem Method :SVE4F23A
Date_Time :06/30/11 11:55

M IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
1	Phenanthrene-d10	40.000	0	562464	1	1	7.722	7.721	0				
2	Benzidine	28.402	13.6	241735	0.688	0.605	9.181	9.175	13.64				

Figure 5b: TYPICAL CONTINUING CALIBRATION SUMMARY OF ADDITIONAL ANALYTES APPENDIX IX

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC_Beginning DateTime :01/18/11 19:43
Spike Amount :25 PPM
CC/CV File :RAJ118
IC File :RAJ114

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :01/18/11 21:29
HPChem Method :SVE4A18B
Date_Time :01/18/11 21:47

M IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
1	1,4-Dichlorobenzene-d4	40.000	0	199800	1	1	2.883	2.883	0				
2	1,4-Dioxane	23.623	-5.5	46588	0.373	0.395	1.291	1.294	8.89				
3	Ethyl methacrylate	24.113	-3.5	81869	0.656	0.680	1.559	1.562	7.08				
4	2-Picoline	23.525	-5.9	126101	1.010	1.073	1.723	1.723	5.95				
5	N-nitrosomethylethylamine	28.137	12.5	63552	0.509	0.452	1.756	1.757	6.45				
6	Methyl methanesulfonate	25.184	0.7	67087	0.537	0.533	1.895	1.895	2.94				
7	2-Fluorophenol	25.994	4.0	137767	1.103	1.061	1.980	1.980	1.45				
8	N-nitrosodiethylamine	27.045	8.2	61368	0.491	0.454	2.122	2.123	4.77				
9	Ethyl methanesulfonate	25.788	3.2	94775	0.759	0.736	2.290	2.289	1.57				
10	Phenol-d5	25.723	2.9	154416	1.237	1.202	2.544	2.545	2.79				
11	Benzaldehyde												
12	Pentachloroethane	26.368	5.5	68980	0.552	0.524	2.669	2.668	1.12				
13	1,2-Dichlorobenzene-d4	25.945	3.8	117100	0.938	0.904	3.017	3.014	1.36				
14	N-nitrosopyrrolidine	27.251	9.0	63086	0.505	0.463	3.192	3.193	8.60				
15	Naphthalene-d8	40.000	0	737363	1	1	4.077	4.078	0				
16	Acetophenone	25.880	3.5	132005	0.286	0.277	3.216	3.216	1.14				
17	N-nitrosomorpholine	25.580	2.3	81882	0.178	0.174	3.226	3.225	2.96				
18	o-toluidine	26.746	7.0	224449	0.487	0.455	3.250	3.248	3.03				
19	Nitrobenzene-d5	26.542	6.2	133778	0.290	0.273	3.359	3.360	2.52				
20	N-nitrosopiperdine	26.490	6.0	68299	0.148	0.140	3.516	3.517	4.95				
21	O,O,O-triethyl phosphorothioate	26.528	6.1	66206	0.144	0.135	3.778	3.777	1.91				
22	a,a-dimethylphenethylamine	19.713	-21.1	197719	0.429	0.544	4.004	3.968	11.29				
23	3,4-Dimethylphenol	25.089	0.4	169634	0.368	0.367	4.016	4.014	4.07				
24	2,6-Dichlorophenol	25.846	3.4	128958	0.280	0.271	4.155	4.157	2.97				
25	Hexachloropropene	26.813	7.3	102529	0.222	0.207	4.196	4.196	4.30				
26	Hydroquinone	28.758	15.0	139523	0.303	0.263	4.495	4.492	13.36				
27	N-nitrosodi-n-butylamine	28.657	14.6	105194	0.228	0.199	4.516	4.516	13.91				
28	p-phenylenediamine	25.523	2.1	117403	0.255	0.250	4.528	4.529	8.59				
29	epsilon-Caprolactam												
30	Safrole	25.681	2.7	113270	0.246	0.239	4.757	4.759	3.54				
31	1-Methylnaphthalene												
32	1,2,4,5-Tetrachlorobenzene	25.923	3.7	144468	0.313	0.302	5.048	5.049	1.36				
33	Acenaphthene-d10	40.000	0	375113	1	1	6.074	6.074	0				
34	2-Fluorobiphenyl	25.808	3.2	343906	1.467	1.421	5.285	5.283	2.33				
35	Isosafrole	26.372	5.5	121959	0.520	0.493	5.361	5.359	3.42				
36	Biphenyl	25.105	0.4	721153	3.076	3.063	5.399	5.400	2.41				
37	1-Chloronaphthalene	26.017	4.1	276494	1.179	1.133	5.443	5.444	1.76				
38	Diphenyl ether	25.959	3.8	197723	0.843	0.812	5.524	5.523	2.07				
39	1,4-Naphthoquinone	27.033	8.1	109505	0.467	0.432	5.623	5.622	9.58				
40	1,3-Dinitrobenzene												
41	Pentachlorobenzene	25.904	3.6	125011	0.533	0.515	6.269	6.269	2.06				
42	1-Naphthylamine	26.126	4.5	261365	1.115	1.067	6.407	6.408	7.55				
43	2,3,4,6-Tetrachlorophenol												
44	2-Naphthylamine	24.216	-3.1	200201	0.854	0.882	6.503	6.503	12.15				
45	Thionazin	26.823	7.3	45239	0.193	0.180	6.710	6.707	11.16				
46	5-Nitro-o-toluidine	28.339	13.4	87100	0.372	0.328	6.743	6.744	14.97				
47	Phenanthrene-d10	40.000	0	682909	1	1	7.809	7.810	0				
48	2,4,6-Tribromophenol	27.319	9.3	44379	0.104	0.095	7.011	7.011	8.29				
49	Sulfotepp	27.360	9.4	35783	0.084	0.077	7.086	7.087	10.34				
50	1,3,5-Trinitrobenzene	26.783	7.1	31601	0.074	0.062	7.189	7.188	22.64	-0.0058	0.0778		0.9991
51	Phorate	27.401	9.6	149455	0.350	0.319	7.235	7.236	6.24				
52	Phenacetin	28.065	12.3	137698	0.323	0.287	7.249	7.250	13.91				
53	Diallate	25.975	3.9	17112	0.040	0.039	7.326	7.328	8.50				
54	Dimethoate	26.298	5.2	89108	0.209	0.198	7.422	7.422	8.50				
55	Atrazine	24.838	-0.6	76304	0.179	0.180	7.513	7.512	3.99				
56	Pentachloronitrobenzene	26.570	6.3	37306	0.087	0.082	7.614	7.612	6.48				
57	4-Aminobiphenyl	26.413	5.7	306408	0.718	0.679	7.609	7.606	4.53				
58	Pronamide	27.123	8.5	172295	0.404	0.372	7.686	7.687	8.30				
59	Dinoseb	25.550	2.2	72874	0.171	0.150	7.818	7.816	23.14	-0.0152	0.1909		0.9983
60	Disulfoton	25.726	2.9	140074	0.328	0.319	7.830	7.829	2.62				
61	Chrysene-d12	40.000	0	676909	1	1	10.575	10.575	0				
62	Methyl parathion	28.656	14.6	91794	0.217	0.189	8.234	8.235	14.65				
63	Ethyl parathion	26.458	5.8	58848	0.139	0.122	8.654	8.655	17.71	-0.0084	0.1441		0.9992
64	4-Nitroquinoline-N-oxide	27.281	9.1	23633	0.056	0.046	8.675	8.673	22.14	-0.0043	0.0575		0.9988
65	Methapyrilene	28.018	12.1	86511	0.204	0.182	8.771	8.770	12.50				
66	Isodrin	25.906	3.6	52722	0.125	0.120	8.954	8.955	5.02				
67	Terphenyl-d14	26.993	8.0	313376	0.741	0.686	9.513	9.514	4.17				
68	Aramite	26.523	6.1	26744	0.063	0.055	9.580	9.580	17.04	-0.0038	0.0653		0.9995
69	p-Dimethylaminoazobenzene	28.531	14.1	122985	0.291	0.255	9.661	9.660	15.04				
70	Chlorobenzilate	28.260	13.0	125699	0.297	0.263	9.709	9.711	10.44				
71	3,3-Dimethylbenzidine	25.150	0.6	210649	0.498	0.495	10.001	10.002	10.54				
72	Perylene-d12	40.000	0	641688	1	1	11.942	11.941	0				
73	2-Acetylaminofluorene	27.765	11.1	187485	0.467	0.370	10.250	10.252	25.67	-0.0410	0.4800		0.9987
74	7,12-Dimethylben(a)anthracene	26.752	7.0	182602	0.455	0.425	11.564	11.566	11.61				
75	3-Methylchlolanthrene	27.425	9.7	196702	0.490	0.447	12.231	12.232	12.72				
76	Dibenzo(a,j)acridine	27.845	11.4	340865	0.850	0.763	12.903	12.903	9.49				

Figure 5b (cont.): TYPICAL CONTINUING CALIBRATION SUMMARY OF ADDITIONAL ANALYTES APPENDIX IX

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E4
IC_Beginning DateTime :01/18/11 17:00
Spike Amount :50 PPM
CC/CV File :RAJ109
IC File :RAJ104

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :01/18/11 18:49
HPChem Method :SVE4A18C
Date_Time :01/18/11 19:07

M	IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
	1	1,4-Dichlorobenzene-d4	40.000	0	189741	1	1	2.882	2.883	0				
	2	Naphthalene-d8	40.000	0	690912	1	1	4.077	4.078	0				
	3	Acenaphthene-d10	40.000	0	337824	1	1	6.073	6.073	0				
	4	Phenanthrene-d10	40.000	0	623481	1	1	7.808	7.808	0				
	5	Chrysene-d12	40.000	0	647219	1	1	10.574	10.577	0				
	6	Famphur	47.504	-5.0	312530	0.386	0.407	9.957	9.965	7.04				
	7	Kepone	56.555	13.1	68833	0.085	0.075	10.043	10.046	6.67				
	8	Perylene-d12	40.000	0	622966	1	1	11.939	11.944	0				
	9	Hexachlorophene	51.182	2.4	66535	0.085	0.085	11.734	11.738	34.76	-0.0538	0.1255		0.9970

Figure 6A: TYPICAL INTERNAL STANDARD AREA AND RT SUMMARY SV-1

8B
SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REH072
Instrument ID: TOE7

Project:CLEAN PROJECT
SDG No.: 11H246
Date Analyzed: 05/11/11
Time Analyzed: 15:29

		IS1(DCB) AREA #	RT #	IS2(NPT) AREA #	RT #	IS3(ANT) AREA #	RT #
	12 HOUR STD	188510	2.89	705631	4.09	381743	6.08
	UPPER LIMIT	377020	3.39	1411262	4.59	763486	6.58
	LOWER LIMIT	94255	2.39	352816	3.59	190872	5.58
	SAMPLE ID						
1	SSTD025	234890	2.90	846239	4.10	472665	6.10
2	MBLK1S	204159	2.90	735582	4.10	409466	6.09
3	LCS1S	228604	2.90	820143	4.10	459314	6.09
4	LCD1S	204266	2.90	736721	4.10	419516	6.10
5	B130-2-SS-02-1.0MS	206009	2.90	746607	4.10	423721	6.10
6	B130-2-SS-02-1.0MSD	205745	2.90	743856	4.10	424818	6.09
7	B130-7-SS-01-1.0	201387	2.90	728130	4.10	412739	6.10
8	B130-1-SS-01-1.0	206032	2.90	741019	4.10	417616	6.09
9	B130-1-SS-02-1.0	202486	2.90	732759	4.10	413553	6.09
10	B130-2-SS-01-1.0	204268	2.90	735480	4.10	417055	6.09
11	B130-8-SS-01-1.0	206610	2.90	753043	4.10	423240	6.09
12	B130-8-SS-02-1.0	205711	2.90	748059	4.10	422335	6.09
13	B128-7-SS-01-1.0	204189	2.90	748393	4.10	427071	6.09
14	B128-7-SS-02-1.0	207283	2.90	760448	4.10	432508	6.09
15	B128-16-SS-01-1.0	204174	2.90	743235	4.10	426981	6.09
16	B128-16-SS-02-1.0	208906	2.90	758310	4.10	433378	6.10
17	B130-2-SS-02-1.0	209104	2.90	759703	4.10	434256	6.09
18	B128-12-SS-01-1.0	209381	2.90	768303	4.10	433533	6.09

IS1 (DCB) = 1,4-Dichlorobenzene-d4
IS2 (NPT) = Naphthalene-d8
IS3 (ANT) = Acenaphthene-d10

AREA UPPER LIMIT = +100% of internal satndard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

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FORM VIII SV-1 OLM02.0

Figure 6 (cont.): TYPICAL INTERNAL STANDARD AREA AND RT SUMMARY SV-2

8C
SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REH072
Instrument ID: TOE7

Project:CLEAN PROJECT
SDG No.: 11H246
Date Analyzed: 05/11/11
Time Analyzed: 15:29

		IS4(PHN) AREA #	RT #	IS5(CRY) AREA #	RT #	IS6(PRY) AREA #	RT #
	12 HOUR STD	652095	7.82	615563	10.59	547898	11.96
	UPPER LIMIT	1304190	8.32	1231126	11.09	1095796	12.46
	LOWER LIMIT	326048	7.32	307782	10.09	273949	11.46
	SAMPLE ID						
1	SSTD025	857878	7.83	784420	10.60	699718	11.97
2	MBLK1S	741708	7.83	682791	10.60	623774	11.96
3	LCS1S	884944	7.83	882189	10.60	831034	11.97
4	LCD1S	766533	7.83	698686	10.60	622032	11.96
5	B130-2-SS-02-1.0MS	775542	7.83	706149	10.60	628210	11.96
6	B130-2-SS-02-1.0MSD	783456	7.83	711625	10.60	628813	11.96
7	B130-7-SS-01-1.0	763631	7.83	698854	10.60	637586	11.96
8	B130-1-SS-01-1.0	757791	7.83	682945	10.60	609353	11.96
9	B130-1-SS-02-1.0	756098	7.83	702223	10.60	628752	11.96
10	B130-2-SS-01-1.0	765178	7.83	695466	10.60	634292	11.96
11	B130-8-SS-01-1.0	762421	7.83	693709	10.60	624496	11.96
12	B130-8-SS-02-1.0	773967	7.83	706557	10.60	642364	11.96
13	B128-7-SS-01-1.0	773260	7.83	709859	10.60	640993	11.96
14	B128-7-SS-02-1.0	791363	7.83	723442	10.60	643480	11.96
15	B128-16-SS-01-1.0	775825	7.83	712553	10.60	632510	11.96
16	B128-16-SS-02-1.0	797669	7.83	726766	10.59	653757	11.96
17	B130-2-SS-02-1.0	796144	7.83	725702	10.60	643351	11.96
18	B128-12-SS-01-1.0	791347	7.83	722024	10.60	639570	11.96

IS4 (PHN) = Phenanthrene-d10
IS5 (CRY) = Chrysene-d12
IS6 (PRY) = Perylene-d12

AREA UPPER LIMIT = +100% of internal satndard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

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FORM VIII SV-2 OLM02.0

Figure 7: TYPICAL SAMPLE RESULT

METHOD SW3550B/8270D
SEMI VOLATILE ORGANICS BY GC/MS

Client : XYZ, INC.	Date Collected: 08/30/11
Project : CLEAN PROJECT	Date Received: 08/31/11
Batch No. : 11H246	Date Extracted: 09/01/11 14:51
Sample ID: B130-7-SS-01-1.0	Date Analyzed: 09/02/11 11:53
Lab Samp ID: H246-01	Dilution Factor: 1
Lab File ID: RIH010	Matrix : SOIL
Ext Btch ID: SV1001S	% Moisture : 13.0
Calib. Ref.: REH072	Instrument ID : T-DE7

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
1,2,4-TRICHLOROBENZENE	ND	380	190
1,2-DICHLOROBENZENE	ND	380	190
1,2-DIPHENYLHYDRAZINE	ND	380	190
1,3-DICHLOROBENZENE	ND	380	190
1,4-DICHLOROBENZENE	ND	380	190
2,4,5-TRICHLOROPHENOL	ND	380	190
2,4,6-TRICHLOROPHENOL	ND	380	190
2,4-DICHLOROPHENOL	ND	380	190
2,4-DIMETHYLPHENOL	ND	380	190
2,4-DINITROPHENOL	ND	770	190
2,4-DINITROTOLUENE	ND	380	190
2,6-DINITROTOLUENE	ND	380	190
2-CHLORONAPHTHALENE	ND	380	190
2-CHLOROPHENOL	ND	380	190
2-METHYLNAPHTHALENE	ND	380	190
2-METHYLPHENOL	ND	380	190
2-NITROANILINE	ND	380	190
2-NITROPHENOL	ND	380	190
3,3'-DICHLOROBENZIDINE	ND	380	190
4-METHYLPHENOL (1)	ND	380	190
3-NITROANILINE	ND	380	190
4,6-DINITRO-2-METHYLPHENOL	ND	770	190
4-BROMOPHENYL-PHENYL ETHER	ND	380	190
4-CHLORO-3-METHYLPHENOL	ND	380	190
4-CHLOROANILINE	ND	380	190
4-CHLOROPHENYL-PHENYL ETHER	ND	380	190
4-NITROANILINE	ND	380	190
4-NITROPHENOL	ND	770	190
ACENAPHTHENE	ND	380	190
ACENAPHTHYLENE	ND	380	190
ANTHRACENE	ND	380	190
BENZO(A)ANTHRACENE	ND	380	190
BENZO(A)PYRENE	ND	380	190
BENZO(B)FLUORANTHENE	ND	380	190
BENZO(G,H,I)PERYLENE	ND	380	190
BENZO(K)FLUORANTHENE	ND	380	190
BENZOIC ACID	ND	1500	770
BENZYL ALCOHOL	ND	380	190
BIS(2-CHLOROISOPROPYL)ETHER	ND	380	190
BIS(2-CHLOROETHOXY)METHANE	ND	380	190
BIS(2-CHLOROETHYL)ETHER	ND	380	190
BIS(2-ETHYLHEXYL)PHTHALATE	ND	380	190
BUTYLBENZYLPHTHALATE	ND	380	190
CARBAZOLE	ND	380	190
CHRYSENE	ND	380	190
DIBENZO(A,H)ANTHRACENE	ND	380	190
DIBENZOFURAN	ND	380	190
DIETHYLPHTHALATE	ND	380	190
DIMETHYLPHTHALATE	ND	380	190
DI-N-BUTYLPHTHALATE	ND	380	190
DI-N-OCTYLPHTHALATE	ND	380	190
FLUORANTHENE	ND	380	190
FLUORENE	ND	380	190
HEXACHLOROBENZENE	ND	380	190
HEXACHLOROBUTADIENE	ND	380	190
HEXACHLOROETHANE	ND	380	190
INDENO(1,2,3-CD)PYRENE	ND	380	190
ISOPHORONE	ND	380	190
NAPHTHALENE	ND	380	190
NITROBENZENE	ND	380	190
N-NITROSODIMETHYLAMINE	ND	380	190
N-NITROSO-DI-N-PROPYLAMINE	ND	380	190
N-NITROSODIPHENYLAMINE (2)	ND	380	190
PENTACHLOROPHENOL	ND	770	190
PHENANTHRENE	ND	380	190
PHENOL	ND	380	190
PYRENE	ND	380	190

SURROGATE PARAMETERS	RESULTS	SPK AMT	% RECOVERY	QC LIMIT
2,4,6-TRIBROMOPHENOL	1430	2299	62.2	35-125
2-FLUOROBIPHENYL	557	766.3	72.7	45-105
2-FLUOROPHENOL	1540	2299	67.2	35-105
NITROBENZENE-D5	492	766.3	64.2	35-100
PHENOL-D5	1600	2299	69.5	40-100
TERPHENYL-D14	674	766.3	87.9	30-125

(1): Cannot be separated from 3-Methylphenol
(2): Cannot be separated from Diphenylamine

Figure 8: TYPICAL LCS/LCSD SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 11H246
METHOD: METHOD SW3550B/8270D

MATRIX:	SOIL			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1S				
LAB SAMP ID:	SV1001SB	SV1001SL	SV1001SC		
LAB FILE ID:	RIH005	RIH006	RIH007		
DATE EXTRACTED:	09/01/1114:51	09/01/1114:51	09/01/1114:51	DATE COLLECTED:	NA
DATE ANALYZED:	09/02/1110:18	09/02/1110:37	09/02/1110:56	DATE RECEIVED:	09/01/11
PREP. BATCH:	SV1001S	SV1001S	SV1001S		
CALIB. REF:	REH072	REH072	REH072		

ACCESSION:

PARAMETER	BLNK RSLT (ug/kg)	SPIKE AMT (ug/kg)	BS RSLT (ug/kg)	BS % REC	SPIKE AMT (ug/kg)	BSD RSLT (ug/kg)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,2,4-Trichlorobenzene	ND	1330	1200	90	1330	1220	91	2	45-110	30
1,2-Dichlorobenzene	ND	1330	1060	79	1330	1060	80	0	45-100	30
1,2-Diphenylhydrazine	ND	1330	1120	84	1330	1160	87	4	55-115	30
1,3-Dichlorobenzene	ND	1330	1050	79	1330	1050	79	0	40-100	30
1,4-Dichlorobenzene	ND	1330	1020	77	1330	1030	77	1	35-105	30
2,4,5-Trichlorophenol	ND	1330	1290	97	1330	1270	96	2	50-110	30
2,4,6-Trichlorophenol	ND	1330	1300	98	1330	1320	99	1	45-110	30
2,4-Dichlorophenol	ND	1330	1170	88	1330	1200	90	2	45-110	30
2,4-Dimethylphenol	ND	1330	1130	85	1330	1180	88	4	30-105	30
2,4-Dinitrophenol	ND	1330	1260	95	1330	1170	88	8	15-130	30
2,4-Dinitrotoluene	ND	1330	1520	114	1330	1440	108	6	50-115	30
2,6-Dinitrotoluene	ND	1330	1340	101	1330	1340	100	0	50-110	30
2-Chloronaphthalene	ND	1330	1180	88	1330	1190	89	1	45-105	30
2-Chlorophenol	ND	1330	1180	89	1330	1210	91	2	45-105	30
2-Methylnaphthalene	ND	1330	1260	95	1330	1290	97	3	45-105	30
2-Methylphenol	ND	1330	998	75	1330	1010	76	1	40-105	30
2-Nitroaniline	ND	1330	1250	94	1330	1220	92	2	45-120	30
2-Nitrophenol	ND	1330	1160	87	1330	1200	90	3	40-110	30
3,3'-Dichlorobenzidine	ND	1330	1360	102	1330	1280	96	6	10-130	30
4-Methylphenol	ND	1330	1090	82	1330	1220	92	11	40-105	30
3-Nitroaniline	ND	1330	1270	96	1330	1160	87	9	25-110	30
4,6-Dinitro-2-Methylphenol	ND	1330	1400	105	1330	1350	101	4	30-135	30
4-Bromophenyl-phenyl ether	ND	1330	1150	86	1330	1200	90	4	45-115	30
4-Chloro-3-Methylphenol	ND	1330	1190	89	1330	1220	92	3	45-115	30
4-Chloroaniline	ND	1330	1110	83	1330	1130	85	2	10-100	30
4-Chlorophenyl-phenyl ether	ND	1330	1300	98	1330	1290	96	1	45-110	30
4-Nitroaniline	ND	1330	1420	107	1330	1240	93	14	35-115	30
4-Nitrophenol	ND	1330	1250	94	1330	1080	81	15	15-140	30
Acenaphthene	ND	1330	1170	88	1330	1190	89	2	45-110	30
Acenaphthylene	ND	1330	1280	96	1330	1300	98	2	45-105	30
Anthracene	ND	1330	1130	85	1330	1120	84	1	35-105	30
Benzo(a)anthracene	ND	1330	1340	100	1330	1310	98	2	50-110	30
Benzo(a)pyrene	ND	1330	1200	90	1330	1180	89	2	50-110	30
Benzo(b)fluoranthene	ND	1330	1300	98	1330	1250	94	4	45-115	30
Benzo(g,h,i)perylene	ND	1330	1210	91	1330	1200	90	1	40-125	30
Benzo(k)fluoranthene	ND	1330	1360	102	1330	1340	101	1	45-125	30
Benzoic Acid	ND	2670	1760	66	2670	1800	68	2	20-110	30
Benzyl Alcohol	ND	1330	1110	84	1330	1160	87	4	20-125	30
bis(2-Chloroisopropyl)ether	ND	1330	1030	77	1330	1050	79	2	20-115	30
bis(2-Chloroethoxy)methane	ND	1330	1160	87	1330	1200	90	3	45-110	30
bis(2-Chloroethyl)ether	ND	1330	1120	84	1330	1140	85	2	40-105	30
bis(2-Ethylhexyl)phthalate	ND	1330	1270	95	1330	1290	97	2	45-125	30
Butylbenzylphthalate	ND	1330	1240	93	1330	1260	95	2	50-125	30
Carbazole	ND	1330	1260	95	1330	1190	90	6	45-115	30
Chrysene	ND	1330	1330	100	1330	1340	101	1	55-110	30
Dibenzo(a,h)anthracene	ND	1330	1200	90	1330	1180	89	1	40-125	30
Dibenzofuran	ND	1330	1220	92	1330	1230	93	1	50-105	30
Diethylphthalate	ND	1330	1260	95	1330	1230	92	2	50-115	30
Dimethylphthalate	ND	1330	1250	94	1330	1230	92	2	50-110	30
Di-n-butylphthalate	ND	1330	1220	92	1330	1180	89	3	55-110	30
Di-n-octylphthalate	ND	1330	1230	92	1330	1270	95	4	40-130	30
Fluoranthene	ND	1330	1440	108	1330	1360	102	5	55-115	30
Fluorene	ND	1330	1240	93	1330	1250	93	0	50-110	30
Hexachlorobenzene	ND	1330	1180	89	1330	1210	91	2	45-120	30
Hexachlorobutadiene	ND	1330	1240	93	1330	1250	94	1	40-115	30
Hexachloroethane	ND	1330	1060	80	1330	1080	81	2	35-110	30
Indeno(1,2,3-cd)pyrene	ND	1330	1220	91	1330	1200	90	1	40-120	30
Isophorone	ND	1330	1200	90	1330	1240	93	3	45-110	30
Naphthalene	ND	1330	1130	85	1330	1140	86	1	40-105	30
Nitrobenzene	ND	1330	1250	94	1330	1290	97	3	40-115	30
N-Nitrosodimethylamine	ND	1330	1120	84	1330	1170	88	5	20-115	30
n-Nitroso-di-n-propylamine	ND	1330	1150	86	1330	1180	88	3	40-115	30
n-Nitrosodiphenylamine	ND	1330	932	70	1330	963	72	3	50-115	30
Pentachlorophenol	ND	1330	1230	92	1330	1150	87	6	25-120	30
Phenanthrene	ND	1330	1160	87	1330	1140	86	1	50-110	30
Phenol	ND	1330	1140	85	1330	1170	87	3	40-100	30
Pyrene	ND	1330	1260	94	1330	1300	98	3	45-125	30

SURROGATE PARAMETER	SPIKE AMT (ug/kg)	BS RSLT (ug/kg)	BS % REC	SPIKE AMT (ug/kg)	BSD RSLT (ug/kg)	BSD % REC	QC LIMIT (%)
2,4,6-Tribromophenol	2000	1490	75	2000	1540	77	35-125
2-Fluorobiphenyl	667	528	79	667	559	84	45-105
2-Fluorophenol	2000	1520	76	2000	1590	80	35-105
Nitrobenzene-d5	667	495	74	667	533	80	35-100
Phenol-d5	2000	1550	78	2000	1670	84	40-100
Terphenyl-d14	667	604	91	667	650	98	30-125

Figure 9: TYPICAL MS/MSD SUMMARY

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 11H246
METHOD: METHOD SW3550B/8270D

MATRIX:	SOIL			% MOISTURE:	7.7
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	B130-2-SS-02-1.0				
LAB SAMP ID:	H246-14	H246-14M	H246-14S		
LAB FILE ID:	RIH020	RIH008	RIH009		
DATE EXTRACTED:	09/01/1114:51	09/01/1114:51	09/01/1114:51	DATE COLLECTED:	08/30/11
DATE ANALYZED:	09/02/1115:02	09/02/1111:15	09/02/1111:34	DATE RECEIVED:	08/31/11
PREP. BATCH:	SV1001S	SV1001S	SV1001S		
CALIB. REF:	REH072	REH072	REH072		

ACCESSION:

PARAMETER	SMPL RSLT (ug/kg)	SPIKE AMT (ug/kg)	MS RSLT (ug/kg)	MS % REC	SPIKE AMT (ug/kg)	MSD RSLT (ug/kg)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
1,2,4-Trichlorobenzene	ND	1440	1150	80	1440	1050	72	10	45-110	30
1,2-Dichlorobenzene	ND	1440	913	63	1440	828	57	10	45-100	30
1,2-Diphenylhydrazine	ND	1440	1180	82	1440	1140	79	3	55-115	30
1,3-Dichlorobenzene	ND	1440	860	60	1440	778	54	10	40-100	30
1,4-Dichlorobenzene	ND	1440	861	60	1440	779	54	10	35-105	30
2,4,5-Trichlorophenol	ND	1440	1320	91	1440	1250	87	5	50-110	30
2,4,6-Trichlorophenol	ND	1440	1330	92	1440	1260	87	5	45-110	30
2,4-Dichlorophenol	ND	1440	1200	83	1440	1110	77	8	45-110	30
2,4-Dimethylphenol	ND	1440	1160	80	1440	1060	73	9	30-105	30
2,4-Dinitrophenol	ND	1440	1050	73	1440	1060	73	1	15-130	30
2,4-Dinitrotoluene	ND	1440	1420	98	1440	1390	97	2	50-115	30
2,6-Dinitrotoluene	ND	1440	1370	95	1440	1300	90	5	50-110	30
2-Chloronaphthalene	ND	1440	1200	83	1440	1110	77	7	45-105	30
2-Chlorophenol	ND	1440	1180	82	1440	954	66	21	45-105	30
2-Methylnaphthalene	ND	1440	1270	88	1440	1170	81	8	45-105	30
2-Methylphenol	ND	1440	1020	71	1440	920	64	11	40-105	30
2-Nitroaniline	ND	1440	1240	86	1440	1200	83	4	45-120	30
2-Nitrophenol	ND	1440	1190	82	1440	1080	75	10	40-110	30
3,3'-Dichlorobenzidine	ND	1440	1240	86	1440	1210	84	3	10-130	30
4-Methylphenol	ND	1440	1130	78	1440	1030	72	9	40-105	30
3-Nitroaniline	ND	1440	1180	82	1440	1150	79	3	25-110	30
4,6-Dinitro-2-Methylphenol	ND	1440	1300	90	1440	1290	89	1	30-135	30
4-Bromophenyl-phenyl ether	ND	1440	1210	84	1440	1160	80	5	45-115	30
4-Chloro-3-Methylphenol	ND	1440	1230	85	1440	1170	81	5	45-115	30
4-Chloroaniline	ND	1440	1140	79	1440	1050	72	8	10-100	30
4-Chlorophenyl-phenyl ether	ND	1440	1310	90	1440	1260	87	4	45-110	30
4-Nitroaniline	ND	1440	1340	93	1440	1220	85	9	35-115	30
4-Nitrophenol	ND	1440	1110	77	1440	1090	75	2	15-140	30
Acenaphthene	ND	1440	1180	82	1440	1130	78	4	45-110	30
Acenaphthylene	ND	1440	1180	81	1440	1220	84	4	45-105	30
Anthracene	ND	1440	1110	77	1440	1100	76	2	55-105	30
Benzo(a)anthracene	ND	1440	1310	91	1440	1270	88	3	50-110	30
Benzo(a)pyrene	ND	1440	1170	81	1440	1130	78	3	50-110	30
Benzo(b)fluoranthene	ND	1440	1250	87	1440	1220	85	2	45-115	30
Benzo(g,h,i)perylene	ND	1440	1220	84	1440	1170	81	4	40-125	30
Benzo(k)fluoranthene	ND	1440	1350	94	1440	1300	90	4	45-125	30
Benzoic Acid	ND	2890	1910	66	2890	1800	62	5	20-110	30
Benzyl Alcohol	ND	1440	1170	81	1440	1050	73	11	20-125	30
bis(2-Chloroisopropyl)ether	ND	1440	1000	69	1440	911	63	9	20-115	30
bis(2-Chloroethoxy)methane	ND	1440	1190	82	1440	1080	75	10	45-110	30
bis(2-Chloroethyl)ether	ND	1440	1090	75	1440	982	68	10	40-105	30
bis(2-Ethylhexyl)phthalate	ND	1440	1280	89	1440	1230	85	4	45-125	30
Butylbenzylphthalate	ND	1440	1270	88	1440	1230	85	3	50-125	30
Carbazole	ND	1440	1210	84	1440	1170	81	3	45-115	30
Chrysene	ND	1440	1350	94	1440	1310	91	3	55-110	30
Dibenzo(a,h)anthracene	ND	1440	1170	81	1440	1130	78	3	40-125	30
Dibenzofuran	ND	1440	1250	86	1440	1190	82	5	50-105	30
Diethylphthalate	ND	1440	1240	86	1440	1210	84	2	50-115	30
Dimethylphthalate	ND	1440	1250	86	1440	1220	84	2	50-110	30
Di-n-butylphthalate	ND	1440	1190	83	1440	1160	80	3	55-110	30
Di-n-octylphthalate	ND	1440	1290	89	1440	1250	86	4	40-130	30
Fluoranthene	ND	1440	1280	89	1440	1230	85	4	55-115	30
Fluorene	ND	1440	1250	87	1440	1200	83	4	50-110	30
Hexachlorobenzene	ND	1440	1220	84	1440	1180	82	3	45-120	30
Hexachlorobutadiene	ND	1440	1180	81	1440	1060	73	11	40-115	30
Hexachloroethane	ND	1440	880	61	1440	790	55	11	35-110	30
Indeno(1,2,3-cd)pyrene	ND	1440	1190	83	1440	1150	79	4	40-120	30
Isophorone	ND	1440	1260	87	1440	1170	81	7	45-110	30
Naphthalene	ND	1440	1100	76	1440	999	69	9	40-105	30
Nitrobenzene	ND	1440	1250	86	1440	1140	79	9	40-115	30
N-Nitrosodimethylamine	ND	1440	1160	80	1440	1050	73	10	20-115	30
n-Nitroso-di-n-propylamine	ND	1440	1190	83	1440	1070	74	11	40-115	30
n-Nitrosodiphenylamine	ND	1440	956	66	1440	933	65	2	50-115	30
Pentachlorophenol	ND	1440	1160	80	1440	1100	76	5	25-120	30
Phenanthrene	ND	1440	1150	80	1440	1120	78	3	50-110	30
Phenol	ND	1440	1180	82	1440	1060	74	10	40-100	30
Pyrene	ND	1440	1310	91	1440	1280	88	2	45-125	30

SURROGATE PARAMETER	SPIKE AMT (ug/kg)	MS RSLT (ug/kg)	MS % REC	SPIKE AMT (ug/kg)	MSD RSLT (ug/kg)	MSD % REC	QC LIMIT (%)
2,4,6-Tribromophenol	2170	1560	72	2170	1570	73	35-125
2-Fluorobiphenyl	722	554	77	722	534	74	45-105
2-Fluorophenol	2170	1560	72	2170	1460	67	35-105
Nitrobenzene-d5	722	519	72	722	500	69	35-100
Phenol-d5	2170	1660	77	2170	1550	72	40-100
Terphenyl-d14	722	657	91	722	653	90	30-125

Figure 10: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 11H246

METHOD SW3550B/8270D
SEMI VOLATILE ORGANICS BY GC/MS

A total of twelve (12) soil samples were received on 08/31/11 for Semi Volatile Organics by GC/MS analysis, Method SW3550B/8270D in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios as well as DDT breakdown were evaluated. Results were within acceptance criteria. Tailing factor for Benzidine and Pentachlorophenol were also verified and results were within the method limits. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for SVI001SL/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for H246-14M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
DFTPP Tune Check	Prior to calibration (ICAL, ICV or CCV)	Refer to criteria listed in the method description (Table 4)	Re-tune instrument and verify		
Breakdown Check	Prior to calibration (ICAL, ICV or CCV)	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Clean the injection port and repeat breakdown check. If problem persist cut or replace column.		
ICAL: At least multi point calibration for all analytes	Initially; as needed	Min. RF: Refer to Table 6 %RSD ≤ 20% or r=0.99 with a min. of 6 ICAL points	Rule out outlier(s)/ bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
ICV: Second-source calibration verification	After initial calibration	Min. RF: Refer to Table 6 All analytes within ±30% of expected value	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
DCC: Calibration Check	Daily, before sample analysis and every 12 hours of analysis time	Min. RF: Refer to Table 6 All analytes ≤ 20% diff.	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within ± 0.06 RRT units of the RRT	Correct the problem then re-analyze all samples analyzed since the last retention time check		
Internal Standard	Every sample, spiked sample, standard, and method blank	Retention time ±30 seconds from retention time of the mid-point std. In the ICAL. EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		
Method blank	One per preparation batch (≤ 20 samples per matrix)	In the absence of PSR apply No analytes detected > ½ LOQ	Rule out instrument contamination by re-analyzing the MB. If problem persist refer to PSR. In the absence of PSR, report NDs and results > 10X of the MB concentration. Otherwise, cure contamination source, re-prep and re-analyze method blank and all associated samples.		
LCS	One LCS per preparation (≤ 20 samples per matrix)	In the absence of PSR default to EMAX QC Limits	Cure probable source of LCS failure, re-prep and re-analyze the LCS and all associated samples		
MS/MSD	One MS/MSD per every 20 project samples per matrix	In the absence of PSR default to EMAX QC Limits	Ensure that spike concentration and spike addition was accurate. If chromatogram exhibits matrix interference narrate observation in the case narrative.		
Surrogate spike	Every sample, spiked sample, standard, and method blank	In the absence of PSR default to 2 out of 3 Acid and 2 out of 3 BN surrogates should be within EMAX QC Limits.	If non-compliant and no apparent matrix interference is observed, re-extract and analyze sample. Otherwise inform the client for further instruction.		
Comments: Project specific requirements (PSR) supersede EMAX QCP. In the absence of PSR, apply "J" flag to results between LOD and LOQ, "B" flag to results associated with MB contamination. Analytes known to have erratic chromatographic behavior: Benzidine, 4,6-dinitro-2-methylphenol, 4-chroanaline, benzyl alcohol, n-Nitrosodimethylamine, 4-nitrophenol, 2-nitroaniline, Pyridine, Benzoic Acid, and 3-nitroaniline			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 8270

Sample Prep SOP: EMAX-3550
Analytical SOP: EMAX-8270
Conc Unit: µg/Kg
Sample Amt(gm): 30
Extract Volume (mL): 2

Instrument ID: E4
Extraction date: 2/1/2011
Extracted by: J. Villena
Analysis date: 2/1/2011
Analyzed by: D. Cheung

PARAMETER	RBJ011	RBJ012	RBJ014	RBJ015	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SVB002SL	SVB002SC	SVB001SL	SVB001SC							
Acenaphthene	1069	1091	1115	1159	1333	1108	83	38.7	3	50 - 130	PASSED
Acenaphthylene	1082	1094	1122	1166	1333	1116	84	37.3	3	40 - 130	PASSED
Aniline	908	922	956	970	1333	939	70	28.9	3	40 - 130	PASSED
Anthracene	1120	1111	1132	1179	1333	1136	85	30.2	3	40 - 130	PASSED
Azobenzene	1241	1244	1293	1275	1333	1263	95	25.2	2	30 - 130	PASSED
Benzo(a)anthracene	1136	1146	1174	1202	1333	1164	87	29.5	3	50 - 130	PASSED
benzo(a)pyrene	1124	1149	1177	1184	1333	1159	87	27.4	2	50 - 130	PASSED
Benzo(b)fluoranthene	1139	1141	1184	1233	1333	1174	88	44.4	4	50 - 130	PASSED
Benzo(g,h,i)perylene	1142	1135	1166	1180	1333	1156	87	21.0	2	50 - 130	PASSED
Benzo(k)fluoranthene	1152	1204	1220	1238	1333	1204	90	37.0	3	50 - 130	PASSED
Benzoic Acid	511	536	599	628	1333	569	43	54.2	10	10 - 130	PASSED
Benzyl Alcohol	1019	1018	1072	1116	1333	1056	79	47.0	4	50 - 130	PASSED
bis(2-chloroethoxy)methane	1040	1084	1105	1138	1333	1092	82	41.0	4	50 - 130	PASSED
bis(2-chloroethyl)ether	971	1000	1029	1042	1333	1011	76	31.8	3	50 - 130	PASSED
bis(2-chloroisopropyl)ether	861	873	906	910	1333	888	67	24.4	3	40 - 130	PASSED
bis(2-Ethylhexyl)phthalate	1322	1321	1401	1406	1333	1363	102	47.4	3	50 - 130	PASSED
4-Bromophenyl-phenylether	1146	1149	1202	1192	1333	1172	88	28.7	2	40 - 130	PASSED
Butylbenzylphthalate	1301	1319	1381	1385	1333	1347	101	42.6	3	50 - 130	PASSED
Carbazole	1176	1165	1175	1246	1333	1190	89	37.1	3	40 - 130	PASSED
4-Chloro-3-methylphenol	1164	1155	1143	1249	1333	1178	88	48.2	4	50 - 130	PASSED
4-Chloroaniline	1033	1060	1081	1127	1333	1075	81	39.9	4	40 - 130	PASSED
2-Chloronaphthalene	1066	1097	1119	1132	1333	1104	83	29.0	3	50 - 130	PASSED
2-Chlorophenol	1033	1055	1079	1092	1333	1065	80	25.9	2	40 - 130	PASSED
4-Chlorophenyl-phenylether	1149	1150	1190	1253	1333	1186	89	49.1	4	50 - 130	PASSED
Chrysene	1132	1139	1183	1201	1333	1164	87	33.7	3	50 - 130	PASSED
Dibenzo(a,h)anthracene	1170	1195	1211	1247	1333	1205	90	32.4	3	50 - 130	PASSED
Dibenzofuran	1100	1125	1145	1193	1333	1141	86	39.6	3	40 - 130	PASSED
1,2-Dichlorobenzene	996	1000	1040	1043	1333	1020	76	25.0	2	50 - 130	PASSED
1,3-Dichlorobenzene	972	999	1039	1051	1333	1015	76	36.3	4	50 - 130	PASSED
1,4-Dichlorobenzene	973	982	1026	1030	1333	1003	75	29.4	3	40 - 130	PASSED
3,3'-Dichlorobenzidine	1123	1145	1166	1171	1333	1151	86	21.8	2	40 - 130	PASSED
2,4-Dichlorophenol	1025	1070	1064	1112	1333	1068	80	35.7	3	50 - 130	PASSED
Diethylphthalate	1251	1252	1266	1327	1333	1274	96	35.9	3	50 - 130	PASSED
2,4-Dimethylphenol	1066	1077	1104	1130	1333	1094	82	28.8	3	50 - 130	PASSED
Dimethylphthalate	1158	1165	1191	1249	1333	1191	89	41.3	3	50 - 130	PASSED
Di-n-butylphthalate	1285	1299	1326	1365	1333	1319	99	35.1	3	50 - 130	PASSED
4,6-Dinitro-2-methylphenol	1109	1099	1123	1162	1333	1123	84	27.6	2	30 - 130	PASSED
2,4-Dinitrophenol	907	898	920	1017	1333	936	70	54.6	6	20 - 130	PASSED
2,4-Dinitrotoluene	1412	1403	1401	1519	1333	1434	108	57.0	4	50 - 140	PASSED
2,6-Dinitrotoluene	1312	1299	1333	1397	1333	1335	100	43.5	3	40 - 130	PASSED
Di-n-octylphthalate	1303	1322	1351	1397	1333	1343	101	41.0	3	40 - 140	PASSED

Reviewed by: _____

Date: _____

Appendix 2 (cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 8270

Sample Prep SOP: EMAX-3550
Analytical SOP: EMAX-8270
Conc Unit: µg/Kg
Sample Amt(gm): 30
Extract Volume (mL): 2

Instrument ID: E4
Extraction date: 2/1/2011
Extracted by: J. Villena
Analysis date: 2/1/2011
Analyzed by: D. Cheung

PARAMETER	RBJ011	RBJ012	RBJ014	RBJ015	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SVB002SL	SVB002SC	SVB001SL	SVB001SC							
Fluoranthene	1216	1188	1204	1284	1333	1223	92	42.2	3	50 - 130	PASSED
Fluorene	1115	1147	1170	1210	1333	1161	87	40.0	3	50 - 130	PASSED
Hexachlorobenzene	1171	1213	1235	1254	1333	1218	91	35.8	3	40 - 130	PASSED
Hexachlorobutadiene	1078	1082	1114	1131	1333	1101	83	25.9	2	40 - 130	PASSED
Hexachlorocyclopentadiene	832	884	910	930	1333	889	67	42.4	5	20 - 130	PASSED
Hexachloroethane	1072	1109	1142	1156	1333	1120	84	37.7	3	50 - 130	PASSED
Indeno(1,2,3-cd)pyrene	1161	1190	1203	1224	1333	1194	90	26.3	2	50 - 130	PASSED
Isophorone	1195	1246	1245	1289	1333	1244	93	38.5	3	50 - 130	PASSED
1-Methylnaphthalene	1064	1070	1074	1123	1333	1083	81	27.3	3	50 - 130	PASSED
2-Methylnaphthalene	1163	1192	1206	1257	1333	1204	90	39.3	3	50 - 130	PASSED
2-Methylphenol	925	951	967	1016	1333	965	72	38.4	4	40 - 130	PASSED
4-Methylphenol	895	930	935	988	1333	937	70	38.4	4	40 - 130	PASSED
Naphthalene	1040	1047	1075	1091	1333	1063	80	23.8	2	50 - 130	PASSED
2-Nitroaniline	1090	1096	1106	1185	1333	1119	84	44.3	4	40 - 130	PASSED
3-Nitroaniline	1101	1116	1141	1216	1333	1143	86	51.1	4	40 - 130	PASSED
4-Nitroaniline	1289	1163	1144	1299	1333	1224	92	81.8	7	50 - 130	PASSED
Nitrobenzene	1226	1241	1279	1287	1333	1258	94	29.5	2	50 - 130	PASSED
2-Nitrophenol	1024	1056	1059	1116	1333	1064	80	38.1	4	50 - 130	PASSED
4-Nitrophenol	1351	1326	1318	1474	1333	1367	103	72.4	5	30 - 130	PASSED
n-Nitrosodimethylamine	897	922	925	981	1333	931	70	35.6	4	40 - 130	PASSED
n-Nitroso-di-n-propylamine	1010	1040	1034	1086	1333	1043	78	31.9	3	40 - 130	PASSED
n-Nitrosodiphenylamine	914	906	939	955	1333	928	70	22.7	2	30 - 130	PASSED
Pentachlorophenol	1175	1139	1218	1231	1333	1191	89	41.7	4	40 - 130	PASSED
Phenanthrene	1138	1135	1152	1208	1333	1159	87	33.8	3	50 - 130	PASSED
Phenol	997	1012	1045	1061	1333	1029	77	29.5	3	50 - 130	PASSED
Pyrene	1131	1141	1202	1197	1333	1168	88	36.8	3	50 - 130	PASSED
Pyridine	679	722	748	751	1333	725	54	33.3	5	10 - 150	PASSED
2,3,4,6-Tetrachlorophenol	1078	1078	1103	1186	1333	1111	83	50.9	5	30 - 130	PASSED
1,2,4-Trichlorobenzene	1040	1035	1079	1095	1333	1062	80	29.4	3	40 - 130	PASSED
2,4,5-Trichlorophenol	1084	1122	1163	1206	1333	1144	86	52.7	5	40 - 130	PASSED
2,4,6-Trichlorophenol	1074	1096	1142	1153	1333	1116	84	37.1	3	40 - 130	PASSED
2-Fluorophenol	1551	1602	1634	1711	2000	1624	81	66.9	4	40 - 130	PASSED
Phenol-d5	1684	1721	1762	1861	2000	1757	88	76.1	4	40 - 130	PASSED
2,4,6-Tribromophenol	1822	1817	1864	1977	2000	1870	93	74.4	4	30 - 140	PASSED
2-Fluorobiphenyl	517	542	544	572	667	544	82	22.4	4	30 - 130	PASSED
Nitrobenzene-d5	555	562	552	589	667	564	85	17.0	3	40 - 130	PASSED
Terphenyl-d14	669	673	693	707	667	685	103	18.1	3	40 - 140	PASSED

Reviewed by: _____

Date: _____

Appendix 3: DEMONSTRATION OF CAPABILITY FOR APPENDIX IX COMPOUNDS

DEMONSTRATION OF CAPABILITY
METHOD: SW 3550C / SW 8270C/D
APPENDIX IX COMPOUNDS

Sample Prep SOP: EMAX-3550
Analytical SOP: EMAX-8270
Conc Unit: µg/Kg
Sample Amt(gm): 30
Extract Volume (mL): 2

Instrument ID: E4
Extraction date: 6/24/2011
Extracted by: J. Villena
Analysis date: 6/27 & 6/28/11
Analyzed by: D. Cheung

PARAMETER	RFJ303	RFJ304	RFJ343	RFJ344	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	A9F0445L	A9F0445C	A9F0455L	A9F0455C							
Acetophenone	1225	1231	1632	1204	1600	1323	83	206.5	16	30 - 150	PASSED
2-acetylaminofluorene	1433	1485	1884	1669	1600	1618	101	204.7	13	30 - 150	PASSED
4-Aminobiphenyl	1502	1589	1895	1650	1600	1659	104	168.6	10	30 - 150	PASSED
Aramite	1526	1586	2057	1770	1600	1735	108	238.9	14	30 - 150	PASSED
Atrazine	1508	1500	1858	1643	1600	1627	102	167.2	10	30 - 150	PASSED
Biphenyl	1235	1256	1600	1247	1600	1334	83	177.5	13	30 - 130	PASSED
Chlorobenzilate	1390	1454	1825	1541	1600	1553	97	192.1	12	30 - 150	PASSED
1-Chloronaphthalene	1266	1295	1616	1277	1600	1363	85	168.7	12	30 - 150	PASSED
Diallate	1272	1303	1638	1490	1600	1426	89	171.3	12	30 - 150	PASSED
Dibenzo(a,j)acridine	1272	1319	1660	1385	1600	1409	88	173.5	12	30 - 150	PASSED
2,6-Dichlorophenol	1228	1225	1633	1248	1600	1334	83	200.0	15	30 - 150	PASSED
Dimethoate	1563	1616	2017	1741	1600	1734	108	202.6	12	30 - 150	PASSED
p-Dimethylaminoazobenze	1374	1394	1776	1544	1600	1522	95	185.8	12	30 - 150	PASSED
7,12-Dimethylben(a)anthracene	1383	1428	1764	1547	1600	1530	96	170.5	11	30 - 150	PASSED
3,3-Dimethylbenzidine	1383	1427	988	1516	1600	1329	83	233.7	18	10 - 150	PASSED
3,4-Dimethylphenol	1172	1194	1610	1291	1600	1317	82	202.2	15	30 - 150	PASSED
Dinoseb	1324	1419	1836	1556	1600	1534	96	222.8	15	30 - 150	PASSED
1,4-Dioxane	1097	1122	1376	1041	1600	1159	72	148.7	13	30 - 150	PASSED
Diphenyl ether	1219	1237	1565	1243	1600	1316	82	166.2	13	30 - 150	PASSED
Disulfoton	1356	1414	1782	1554	1600	1526	95	189.7	12	30 - 150	PASSED
Ethyl methacrylate	1121	1170	1440	1082	1600	1203	75	162.0	13	30 - 150	PASSED
Ethyl methanesulfonate	1217	1252	1589	1202	1600	1315	82	184.0	14	30 - 150	PASSED
Ethyl parathion	1364	1445	1880	1525	1600	1554	97	227.6	15	30 - 150	PASSED
Hexachloropropene	1226	1261	1578	1201	1600	1317	82	176.0	13	30 - 150	PASSED
Isodrin	1308	1276	1642	1449	1600	1419	89	166.5	12	30 - 150	PASSED
Isosafrole	1427	1445	1867	1473	1600	1553	97	210.5	14	30 - 150	PASSED
3-Methylchlolanthrene	1407	1445	1811	1579	1600	1561	98	182.6	12	30 - 150	PASSED
Methyl methanesulfonate	1219	1216	1423	1154	1600	1253	78	117.3	9	30 - 150	PASSED
Methyl parathion	1418	1509	1923	1667	1600	1630	102	221.1	14	30 - 150	PASSED
1,4-Naphthoquinone	1337	1376	1702	1517	1600	1483	93	165.3	11	10 - 150	PASSED
1-Naphthylamine	1285	1288	1660	1396	1600	1407	88	176.1	13	30 - 150	PASSED
2-Naphthylamine	1425	1418	1806	1586	1600	1559	97	182.3	12	30 - 150	PASSED
N-nitrosodiethylamine	1207	1253	1604	1202	1600	1317	82	192.9	15	30 - 150	PASSED
N-Nitrosomethylethylamine	1187	1252	1577	1171	1600	1297	81	190.0	15	30 - 150	PASSED
N-Nitrosomorpholine	1206	1249	1627	1210	1600	1323	83	203.4	15	30 - 150	PASSED
N-Nitrosodi-n-butylamine	1263	1295	1764	1399	1600	1430	89	230.0	16	30 - 150	PASSED
N-Nitrosopiperdine	1231	1247	1647	1266	1600	1348	84	200.2	15	30 - 150	PASSED
N-Nitrosopyrrolidine	1194	1242	1678	1267	1600	1345	84	224.0	17	30 - 150	PASSED
5-Nitro-o-toluidine	1425	1465	1829	1506	1600	1556	97	185.0	12	30 - 150	PASSED
4-Nitroquinoline-N-oxide	1402	1493	1737	1567	1600	1550	97	142.1	9	10 - 150	PASSED
Pentachlorobenzene	1257	1306	1656	1355	1600	1393	87	179.7	13	30 - 150	PASSED

Appendix 3 (cont.): DEMONSTRATION OF CAPABILITY FOR APPENDIX IX COMPOUNDS

DEMONSTRATION OF CAPABILITY
METHOD: SW 3550C / SW 8270C/D
APPENDIX IX COMPOUNDS

Sample Prep SOP: EMAX-3550
Analytical SOP: EMAX-8270
Conc Unit: µg/Kg
Sample Amt(gm): 30
Extract Volume (mL): 2

Instrument ID: E4
Extraction date: 6/24/2011
Extracted by: J. Villena
Analysis date: 6/27 & 6/28/11
Analyzed by: D. Cheung

PARAMETER	RFJ303	RFJ304	RFJ343	RFJ344	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	A9F0445L	A9F0445C	A9F0455L	A9F0455C							
Pentachloroethane	1203	1195	1487	1106	1600	1248	78	165.2	13	30 - 150	PASSED
Pentachloronitrobenzene	1354	1424	1721	1553	1600	1513	95	161.4	11	30 - 150	PASSED
Phenacetin	1476	1527	1853	1585	1600	1610	101	167.8	10	30 - 150	PASSED
p-phenylenediamine	826	886	1211	844	1600	942	59	180.9	19	10 - 150	PASSED
Phorate	1340	1377	1752	1524	1600	1498	94	186.8	12	30 - 150	PASSED
2-Picoline	1036	1063	1338	956	1600	1098	69	165.9	15	10 - 150	PASSED
pronamide	1456	1506	1877	1625	1600	1616	101	187.7	12	30 - 150	PASSED
Safrole	1221	1263	1667	1277	1600	1357	85	208.0	15	30 - 150	PASSED
Sulfotepp	1317	1376	1723	1534	1600	1487	93	181.8	12	30 - 150	PASSED
1,2,4,5-Tetrachlorobenzene	1233	1269	1624	1246	1600	1343	84	187.8	14	30 - 150	PASSED
Thionazin	1364	1365	1809	1540	1600	1520	95	210.1	14	30 - 150	PASSED
o-toluidine	1387	1401	1769	1345	1600	1475	92	196.9	13	30 - 150	PASSED
O,O,O-triethyl phosphorothi	1218	1230	1612	1237	1600	1324	83	192.2	15	30 - 150	PASSED
1,3,5-Trinitrobenzene	1432	1566	1952	1464	1600	1604	100	239.1	15	10 - 150	PASSED
2-Fluorophenol	1602	1611	1767	1545	2000	1632	82	95.0	6	40 - 130	PASSED
Pheno-d5	1584	1616	1876	1623	2000	1675	84	135.3	8	50 - 130	PASSED
Nitrobenzene-d5	522	519	605	531	667	544	82	40.5	7	40 - 130	PASSED
2-Fluorobiphenyl	527	534	617	545	667	556	83	41.2	7	50 - 130	PASSED
2,4,6-Tribromophenol	1788	1860	2086	2059	2000	1948	97	147.2	8	50 - 130	PASSED
Terphenyl-d14	658	678	764	742	667	710	106	50.3	7	50 - 130	PASSED

8270FS: SAMPLE PREPARATION LOG

EMAX LABORATORIES, INC.

EXTRACTION LOG
for
SEMIVOLATILES

Page 1

SOP	Rev. #
☐ EMAX-3510	
☐ EMAX-3520	
☐ EMAX-3540	
☐ EMAX-3550	
☐ EMAX-3580	
☐ EMAX-CLP-SVOA	
☐ EMAX-	

Note: For samples and relevant QCs/Standards extracted, refer to attached extraction sequence.

Comments:

Book #:	ESV-062
Preparation Batch:	
Matrix:	
Micropipette ID:	
Micropipette ID:	

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		
LCS/MS		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO_4	
H_2SO_4	
NaOH	
Silica Sand	
Silica Gel	

Lab Sample ID	Sonicator #	Concentrator # (35°C)

TUNING

Sonicator #	Reading

Concentrator	Water Bath Temperature Setting (°C)	Thermometer Reading (°C)
1		
2		
3		
4		
5		
6		

Thermometer ID = T_1

Prepared By:	Witnessed By:
Standard Added By:	Checked By:
Extract Received By:	Location:
Disposed By:	Disposed On:

8270FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

Page 1

ANALYSIS LOG FOR SEMIVOLATILES

SOP ☐ EMAX-8270 Rev. No. _ ☐ EMAX-8270SIM Rev. No. _ ☐ EMAX-CLPSVOA ☐ EMAX-M8270SIM Rev. No. _ ☐ EMAX-625 Rev. No. _ ☐ Book #AE7 -006

Method File: Tune File: Start Date/Time: End Date/Time:

ANALYTICAL BATCH : _____

Preparative Batch	Data File Name	Run ID	DF	Matrix S	Matrix W	Notes

Instrument No:	E7
INITIAL CALIBRATION REFERENCE	
Date	
ICAL ID	

Standards		
Name	ID	Conc. (mg/L)
DFTPP		
INT. STD.		
ICV		
DCC		
BENZIDINE		
APP 9		
APP 9 ADD		

Solvent	ID	
CH_2Cl_2		

DATA FILE	

Electronic Data Archival	
Location	Date
HPCHEM_SVOA/TOE7	

Comments: _____

Analyzed By: _____

Date Disposed: _____

Disposed By: _____

This page is checked during data review.

8270FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: E7 Month: Year: 201_ Book #: ME7 -003

Date							
Column Head Pressure: 70 - 100 (KPa)							
Run Instrument Blank							
Column Temperature							
Autosampler							
Calibration curve updated							
Verify computer date & clock							
Check printer paper							
Change Septa							
Clean Linear							
Analyst Initial							
TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

SOP REVIEW FORM

EMAX-6020	Rev. 8	TRACE METAL BY ICP-MS
SOP No.	Revision Number	Title

Document the review process and comment. Check the "NA" box if it is not applicable to the SOP, check the "Yes" box if you have fully understood the section, check "No" if you have any questions or if there are discrepancies with the current practice. Discuss the issue with the mentor/supervisor. If you need more space use the allocated space below or attach additional page.

SECTION	Yes	No	NA	COMMENTS
Scope & Application	✓			
Summary of Method	✓			
Detection Limits	✓			
Dynamic Range	✓			
Sample Holding Time & Preservation	✓			
Associated SOPs	✓			
Safety	✓			I have read all SDS of chemicals listed in this SOP.
Instruments, Chemicals & Reagents	✓			
Standards	✓			
Procedures	✓			
- Sample Preparation	✓			
- Instrument Parameters	✓			
- Calibration	✓			
- Analysis	✓			
- Calculations	✓			
- Data Reduction	✓			
- Report Generation	✓			
- Data Review	✓			
- Preventive Maintenance	✓			
Quality Control	✓			
Corrective Action	✓			
Pollution Prevention	✓			
Waste Management	✓			
Supplementary Notes	✓			
References	✓			
Appendices	✓			

This is to acknowledge that I have read, understood and agree to perform the procedures set forth in this SOP. Print your name & affix your signature.

Reviewed By Mary Jane Mendoza Date: 7/8/14

STANDARD OPERATING PROCEDURES

TRACE METALS BY ICP-MS

SOP No.:	EMAX-6020	Revision No.	8	Effective Date:	27-Jun-13
Prepared By:	Mary Jane Mendoza			Date:	06.27.13
Approved By:	Kenette Pimentel QA Manager			Date:	06-27-13
Approved By:	Caspar Pang Laboratory Director			Date:	06-27-13
				Control Number:	**6020-08**

1.0 SCOPE AND APPLICATION

1.1. This procedure is applicable for the determination of sub-µg/L concentrations of a large number of elements in wastewater, groundwater, aqueous, extract, soil, sludge, and sediment samples using the Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) method. All matrices require proper sample preparation prior to analysis.

1.2. The elements and their corresponding isotopes are listed in Table 1.

1.3. This SOP is an adaptation of the SW846 Method 6020A.

2.0 SUMMARY OF METHOD

2.1. Metal analytes in water are acid digested from a pre-measured sample. Nitric acid and hydrochloric acid are added to the sample and heated without boiling until the volume is substantially reduced. The digestate is diluted back to its original sample volume using reagent water.

2.2. Metal analytes in soil are acid digested from a pre-measured sample. Nitric acid is added to the sample and heated to initialize digestion. It is further oxidized with 30% hydrogen peroxide and the acid used for final reflux is hydrochloric acid.

2.3. Digestates are introduced by pneumatic nebulization resulting aerosol into a high temperature argon plasma, where they are decomposed, atomized and ionized. The ions produced are extracted from the plasma via the sample and skimmer orifices in the interface region of the mass spectrometer. The extracted ions are guided by an off-axis Lens System to reduce background noise, passes through an Octopole Reaction System (ORS) where some ions require a simple reaction with H_2 or He to eliminate matrix interference prior to entering the Quadrupole Mass Filter (QMF). The QMF separates ions based on their mass-to-charge ratios and ions are counted by electron multiplier detector.

2.4. Quantitation is accomplished by comparing the response of a major ion relative to an internal standard using a calibration curve.

2.5. **Interference**

2.5.1. Isobaric Elemental Interference. Are caused by isotopes of different elements which form singly or doubly charge ions of the same nominal mass-to-charge ratio. The signal of an isotope of an interfering element is determined and subtracted from the analyte isotope signal.

2.5.2. Isobaric Polyatomic Ion Interference. Are caused by ions consisting of more than one atom which have the same nominal mass-to-charge ratio as the isotope of interest. To correct for isobaric polyatomic ion interferences, optimize the cell gas pressure on each analyte so that when the ORS employs simple reaction gases (H_2 and He) side reactions create new and unpredictable interferences. The ORS is equipped with notch filters and by using scanning voltages the created interferences are prevented from reaching the analyzer.

2.5.3. Physical Interference. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. An internal standard can be used to correct physical interference if carefully matched to the analyte so that the two elements are similarly affected by matrix changes. When the intensity level of the internal standard is less than 70% of the intensity of the first standard used during calibration, the sample must be diluted and re-analyzed.

2.5.4. Memory Interference. Contamination by carry-over can occur whenever high concentrations are analyzed in sequence with a low concentration sample. To reduce potential carry-over the rinse period between samples must be long enough to eliminate significant memory effect.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Established limits are shown in Table 5.

4.0 DYNAMIC RANGE

4.1. Linear Dynamic Range (LDR) is the concentration over which the instrument response remains linear.

4.2. Establish LDR of each analyte by determining the signal response from a minimum of three preferably five different concentration across the range. The upper limit should be within 10% (± 10%) of the true value.

4.3. Verify the established LDR every six months or when there is a significant change in the instrument signal, whichever comes first.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. Analyze all samples within 180 days from collection date.

5.2. **Preservation**

5.2.1. Expected sample condition when received in the lab:

- water samples in HDPE, preserved to pH < 2 with HNO_3
- soil samples in glass jar or brass tubes

5.2.2. When water sample preservation is requested to be done in the lab, preserve the sample to pH < 2 with HNO_3 and observe at least 24 hours from the time preservative is added before sample digestion.

5.2.3. Store water samples in the same condition as received unless specified in the project requirement.

5.2.4. Store soil samples at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA04 Detection Limit (DL)

6.3. EMAX-QA05 Training

6.4. EMAX-QA08 Corrective Action

6.5. EMAX-QC01 Quality Control for Chemicals

6.6. EMAX-QC02 Analytical Standard Preparation

6.7. EMAX-QC04 Balance Calibration

6.8. EMAX-QC05 Calibration of Thermometers

6.9. EMAX-QC06 Calibration of Micropipettes

6.10. EMAX-QC07 Glassware Cleaning

6.11. EMAX-SM03 Waste Disposal

6.12. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all SDS of chemicals listed in this SOP.

7.2. Observe the following precautions during operation or maintenance of the instrument:

- Close the instruments hoods and panels prior to operation.
- Check the exhaust system for a positive extraction at the exhaust duct.
- Handle acids properly.
- Check the drain vessels frequently.
- Make sure that the argon tank is chained.
- Wait for the instrument interface region to cool down prior to instrument maintenance.
- Observe all cautions and warnings stipulated in the Agilent 7500 ICPMS CE/CX Manuals.

7.3. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Observe all chemical hygiene procedures as mentioned in the Chemical Hygiene Plan.

7.4. DO NOT DISPOSE ACIDIC WASTE IN THE TRASH CAN OR IN THE SINK.

7.5. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. ICP-MS: Agilent 7500CE Octopole Reaction System : Agilent 7500CX Octopole Reaction System

8.1.2. Autosampler: CETAC ASX-520

8.1.3. Computer: IBM Compatible

8.1.4. RF Generator: Agilent RF Generators

8.1.5. Data Acquisition: Agilent Chemstation version B.03.04 or as updated : Agilent Chemstation version B.04.00 or as updated

8.1.6. Autosampler rack(s): 17 x 100 mm, 60 positions

8.1.7. Culture tubes: 17 x 100 mm, polypropylene

8.1.8. Volumetric Flask: 10 ml, 50 ml, 500 ml, 1000 ml

8.1.9. Micropipettes: 1 ml, 0.100 ml, 5 ml

8.1.10. Pipet Tips: 100 - 1000 µl

8.1.11. Polyethylene bottles: 250, 500, 1000 ml

8.1.12. Liquid argon

8.1.13. Hydrogen, Compressed: Ultra-high purity

8.1.14. Helium, compressed: Ultra-high purity

8.1.15. Balance: Sartorius LC 620 S or equivalent

8.1.16. Spatula: Stainless steel or equivalent

8.1.17. Digestion vessel: 50 ml, 100 ml snap seal

8.1.18. Digestion block: Aluminum blocks or equivalent

8.1.19. Thermometer: Range 0 - 110°C

8.1.20. Filter: Whatman #41 or equivalent

8.1.21. Digestate Container: 50 ml polyethylene vessel, 100 ml Corning snap seal or equivalent

8.1.22. Disposable watch glass

8.1.23. ASX press Rapid Sample Introduction System

8.2. **Chemicals and Reagents**

8.2.1. DI water, ASTM Type II or equivalent

8.2.2. Nitric Acid, Trace high purity grade, concentrated

8.2.3. Hydrochloric acid, Trace high purity grade, concentrated

8.2.4. Hydrogen Peroxide, ACS grade (e.g., VW3690-5 from VWR) or equivalent

9.0 STANDARDS

9.1. **Tune Check Standard**

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
Tuning Solution	Agilent	Li, Y, Ce, Tl, Co	0.01	2% HNO_3
Tuning Check	High Purity	Co, In, Li, Tl	10	2% HNO_3

Standard	Standard			

9.1.1. Prepare tuning check standard at concentration level suggested below.

STANDARD	Aliquot, (ml)	Final volume (ml)	Final Concentration (mg/L)
Intermediate tuning check standard	0.5	50	0.100

9.2. **Internal Standard (IS)**

9.2.1. Purchase stock internal standard as certified standard at concentration listed below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
IS	Agilent	Li6, Sc, Ge, Rh, In, Tb, Bi, Lu	100	10% HNO_3

9.3. **Calibration Standards**

9.3.1. Calibration Stock Standard

9.3.1.1. Purchase custom-made certified individual and mixed stock standards as listed in the table below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (µg/ml)	MATRIX
ICAL 1	High Purity	As, B, Se, Sr, Tl, Ti, V, Zn, Sb, Mo, Sn	10	2% HNO_3 and Trace HF Acid
ICAL 2	High Purity	Ba, Be, Cd, Cr, Co, Cu, Pb, Li, Mn, Ni, Ag, U	10	2% HNO_3
ICAL 3	High Purity	Al, Fe, K, Ca, Mg, Na	1000	4% HNO_3
Phosphorus	AccuStandard	P	100	Water
Tungsten	AccuStandard	W	100	Water and trace NH_4OH
Zirconium	AccuStandard	Zr	100	2-5% HNO_3
Zinc	High Purity	Zn	1000	2% HNO_3

9.3.2. Calibration Working Standard

9.3.2.1. Prepare working standards as suggested in the table below or equivalent.

Working Standard	Stock Standard Name	Conc. (µg/ml)	Source	Preparation		
				Aliquot (ml)	Final vol. (ml)	Final conc. (µg/ml)
Trace mix	ICAL 1	10	High Purity	1.0	10	1.0
	ICAL 2	10	High Purity	1.0		1.0
Cation Mix	Al	10,000	AccuStandard	2.5	500	50
	Ca	10,000	AccuStandard	2.5		50
	Fe	10,000	AccuStandard	2.5		50

	Mg	10,000	AccuStandard	2.5		50
	K	10,000	AccuStandard	2.5		50
	Na	10,000	AccuStandard	1.25		25
Zn – 10 ppm	Zn	1000	High Purity	0.5	50	10
Zr – 1 ppm	Zr	100	AccuStandard	0.5	50	1.0
W – 1 ppm	W	100	AccuStandard	0.5	50	1.0
Mix 7A	ICAL 1	10	High Purity	1.0	10	1.0
	ICAL 2	10	High Purity	1.0		1.0
	ICAL 3	1000	High Purity	1.0		100

9.3.3. Matrix Acid Blank (S0)

9.3.3.1. Prepare matrix acid solution by mixing 3% by volume nitric acid and 1% by volume hydrochloric acid in reagent water. Transfer into a clean HDPE bottle and identify the solution as S0.

9.3.3.2. Use this solution for standards or digestate dilutions.

9.3.4. Initial Calibration Standard

9.3.4.1. The initial calibration consists of a blank (S0) and four standards (S1, S2, S3 and S4). Prepare the standards as suggested below. Refer to Table 3 for final concentrations for each analyte. Please note: More standard points may be added at the discretion of the analyst.

Standard Name	ICAL 1 (ml)	ICAL 2 (ml)	Cation Mix (ml)	Trace Mix (ml)	Zn - 10 ppm (ml)	W / Zr – 1 ppm (ml)	P – 100 ppm (ml)	W / Zr – 100 ppm (ml)	Final volume (ml)	Final Concentration (µg/L)
S1	NA	NA	0.050	0.025	0.0025	0.025	0.0125	NA	50	0.5/25/50/1
S2	0.025	0.025	0.500	NA	0.025	0.250	0.025	NA		5/250/500/10/50
S3	0.125	0.125	2.5	NA	0.125	NA	0.125	0.0125		25/1250/2500/50/250
S4	0.250	0.250	5.0	NA	0.250	NA	0.250	0.0250		50/2500/5000/100/500

9.3.5. Continuing Calibration Verification (CCV) Standard

9.3.5.1. Prepare CCV using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

Stock Standard	Aliquot (ml)	Final volume (ml)	CCV Final Concentration (µg/ml)
ICAL 1	0.125	50	0.025
ICAL 2	0.125		0.025
Cation Mix	2.500		2.5/1.250
Zn – 10 ppm	0.125		0.050
P	0.125		0.250
Zr	0.0125		0.025
W	0.0125		0.025

9.3.5.2. Prepare intermediate solution for Low Level CCV (LLCCV) using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations of each analyte.

	Aliquot (ml)	Final volume (ml)	LLCCV Final Concentration (µg/L)
MIX 7A	0.050	50	1.0/100
B – 1 ppm	0.450		9
P – 100 ppm	0.025		50
Sr – 1 ppm	0.050		1
Zn – 10 ppm	0.045		10
Zr – 1 ppm	0.250		5
W – 1 ppm	0.250		5

9.4. **Secondary Source Standard**

9.4.1. Purchase secondary stock standard from a different source as certified standards or equivalent. Refer to list below.

SOURCE	STANDARD	ELEMENTS	CONC. (mg/L)	MATRIX
CPI	EMAX MIX 2	As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Sr, Tl, Ti, V, Zn, Ag, Sb, Mo, Li, U, Sn	10	5% HNO_3 + Tr HF
	EMAX MIX 3	Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3
Phosphorus	CPI	P	1000	0.05% HNO_3
Zirconium	CPI	Zr	100	2% HNO_3
Tungsten	Ultra Scientific	W	10	Water

9.4.2. Secondary Source Working Standard – Prepare a secondary source working standard using S0 as suggested below or equivalent.

Standard	Element	Stock Conc. (mg/L)	Source	Aliquot (ml)	Final Volume (ml)	Final Conc. (mg/L)
Cation Mix 2	Al	10,000	CPI	2.5	500	50
	Ca	10,000	CPI	2.5		50
	Fe	10,000	CPI	2.5		50
	Mg	10,000	CPI	2.5		50
	K	10,000	CPI	2.5		50
	Na	10,000	CPI	1.25		25

9.4.3. Refer to EMAX-QC02 for detailed procedure of standard preparation and labeling.

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV using the secondary stock working standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

Stock Standard	Aliquot (ml)	Final Volume (ml)	ICV Final conc. (µg/ml)
ICV1	0.150	50	0.030/0.060
Cation Mix 2	3.000		3.000/1.500
P	0.015		0.300
Zr	0.015		0.030
W	0.015		0.030

9.6. **Interference Standards (ICSA/ICSAB)**

9.6.1. Purchase ICS stock standard as mix certified standards at concentration levels listed below.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
6020ICS-0A (ICSA)	Inorganic Ventures	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	
6020ICS-0A + (ICSAB) ICAL 1 + ICAL 2	6020ICS-0A	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	
	ICAL 1	As, B, Se, Tl, Ti, V, Zn, Sb, Mo, Sn	10	5% HNO_3 + Tr HF
	ICAL 2	Ba, Be, Cd, Cr, Co, Cu, Pb, Li, Mn, Ni, Ag, U	10	5% HNO_3 + Tr HF

9.6.2. Prepare Intermediate ICSA and ICSAB standards at concentration levels suggested below. Refer to Table 3 final concentrations.

Standard	Parent Standard	Aliquot (ml)	Final Volume (ml)	Final Concentration (mg/L)
Intermediate ICSA	6020ICS-0A	5	50	Varied
Intermediate ICSAB	6020ICS-0A	5	50	Varied
	ICAL 1	0.10		
	ICAL 2	0.10		
	Zr	0.010		
	W	0.010		

9.7. **LCS/MS Spike Standard**

9.7.1. Purchase LCS/MS standards as certified custom-mixed.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
ICV 1	CPI	B, Sr, As, Ba, Be, Ag, Cd, Cr, Co, Cu, Tl, Pb, Mn, Ni, Se, V, Zn, Ti, Sb, Mo, Li, U, Sn	10	5% HNO_3+ Tr HF
ICV 2		Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3
Phosphorus	CPI	P	1000	0.05% HNO_3
Zirconium	CPI	Zr	100	2% HNO_3
Tungsten	High Purity	W	10	Water

9.8. **P/A Tuning Standard**

9.8.1. Using the calibration stock standard from 9.3.1, prepare a 50 μg/L and 100 μg/L mixed standard. These standards should also include 50 μg/L and 100 μg/L of internal standard, which can be prepared by using the internal standard stock from 9.2.1.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Water Samples

10.1.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 samples per preparative batch). Withdraw the sample(s) from the sample control room and bring them to the preparation area. Allow the samples to equilibrate at room temperature.

10.1.1.2. Shake the sample container. Pour a small amount of sample into the sample cap and trickle just enough to wet the pH indicator strip. Compare the color of the wet strip to the indicator chart displayed in the pH indicator box. Record the pH in the digestion log. If the pH value is <2, proceed to 10.1.3. If the pH value is ≥2, check if special instruction is written on the analysis folder or in the COC. Otherwise, fill out an NCR and inform the supervisor immediately. DO NOT PROCEED WITH THE DIGESTION. WAIT FOR FURTHER INSTRUCTION.

10.1.1.3. Line up the samples chronologically under the hood. Check and record the lot number of the digestion vessels if it has been verified for accuracy. Take digestion vessels and label each one corresponding to the samples withdrawn and place them in front of each sample making sure that their labels agree. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.1.4. Mix the sample thoroughly to achieve homogeneity. Fill each digestion vessel up to the 50-ml mark. (The reduction of the volume is due to waste minimization).

10.1.1.5. Record the volume in the digestion log. Use reagent water for blank and LCS.

10.1.1.6. Take another digestion vessel; fill it with tap water to 50 ml mark. Put a thermometer inside and let it sit on the digestion block. Turn the thermostat to a pre-determined mark to deliver heat at 90°C - 95°C. Record the temperature reading in the digestion log.

10.1.1.7. **Standard Addition**

10.1.1.7.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.1.1.7.2. Add 0.125 ml of each from EMAX MIX 2 and 3 (see Section 9.4.1) solutions to matrix spike samples and LCS. If Phosphorus, Zirconium and Tungsten are target analytes, add 0.0125 ml of each standard.

10.1.1.8. **Acid Digestion for Dissolved Metals**

10.1.1.8.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.1.8.2. Cap the digestion vessels with disposable watch glass.

10.1.1.8.3. Check that the temperature of the digestion block is ≈ 95°C (covered vessel) and adjust if necessary.

10.1.1.8.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.1.8.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion plate and allow the vessels to cool down.

10.1.1.8.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.1.8.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new polyethylene container.

10.1.1.9. **Acid Digestion for Total Recoverable Metals**

10.1.1.9.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.1.9.2. Cap the digestion vessels with disposable watch glass.

10.1.1.9.3. Check that the temperature of the digestion block is ≈ 95°C (covered vessel) and adjust if necessary.

10.1.1.9.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.1.9.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion block and allow the vessels to cool down.

10.1.1.9.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.1.9.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new

polyethylene container.

10.1.2. Soil Samples

10.1.2.1. **Sample Handling**

10.1.2.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 field samples). Withdraw the sample(s) from the sample control room designated for metals analysis (passing # 10 sieve) and bring them to the weighing area. Allow the samples to equilibrate at room temperature.

Note: *Sample homogeneity is crucial in metals analysis. If sample is not solely designated for metals analysis (i.e., sample is to be used for other analysis) and it is apparent that sample particles contain > #10 sieve, inform the Supervisor for further instruction.*

10.1.2.1.2. Take digestion vessels and label each one corresponding to the samples withdrawn. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.2.1.3. Check project sub-sampling requirement. If multi-incremental sub-sampling (MIS) is required, refer to EMAX-SM01, section 5.13.2 for details. Otherwise follow the steps described in EMAX-SM01, section 5.13.1.

10.1.2.1.4. Scoop 1-2 g sub-sample and transfer into a properly labeled digestion vessel. Record the weight to the nearest 0.01 g.

10.1.2.2. **Pre-heating the Digestion Block**

10.1.2.2.1. Place a digestion vessel with reagent water and a temperature monitoring thermometer on the digestion block.

10.1.2.2.2. Turn the digestion block on and set the thermostat to ~95°C or to a predetermined temperature to obtain approximately 95°C once the digestion vessel is covered with a watch glass.

10.1.2.2.3. When the temperature reading is about 90°-95°C, the digestion block is now ready for digestion.

10.1.2.3. **Standard Addition**

10.1.2.3.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.1.2.3.2. Add 2.5 ml of EMAX MIX 2 & 3 (Sec. 9.4.1) to LCS and matrix spike samples. If Phosphorus and Zirconium are target analytes, add 0.25 ml of each standard. If Tungsten is a target analyte, add 0.025 mL of standard.

10.1.2.4. **Acid Digestion**

10.1.2.4.1. Add 10 ml of reagent water and 5 ml of concentrated HCL[1] into each vessel, swirl the vessel to mix the acid and the sample. Add same amount of acid into a clean and empty vessel and designate it as blank. Insert the vessels in the digestion block(s). Cap the vessels with conical watch glass.

10.1.2.4.2. Check the temperature of the digestion block 90°C-95°C, adjust if necessary. If temperature happens to be ≥ 100°C, adjust the thermostat and wait until temperature falls within 90°C-95°C. Record the temperature reading in the digestion log.

10.1.2.4.3. Place the digestion vessels on the digestion block and reflux for 15 minutes without boiling.

10.1.2.4.4. Transfer the vessels into unheated digestion block and allow the vessels to cool down for at least 5 minutes. Lift the watch glass and add 10-mL of concentrated HNO_3. Place the watch glass back before working on the next vessel.

10.1.2.4.5. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.2.4.6. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes. Lift the water glass and add 10 ml 1:1 HNO_3. Place the water glass back before working on the next vessel.

10.1.2.4.7. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.2.4.8. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes.

10.1.2.4.9. Add 2 ml of reagent water. Then add 3 ml of 30% hydrogen peroxide (H_2O_2) to each vessel, swirling each one of them after every addition to initiate peroxide reaction. Continue to add H_2O_2 until the amount added reaches 10 ml.

10.1.2.4.10. Return the vessels to the heated digestion block. Care must be taken to ensure that losses do not occur due to excessive effervescence.

10.1.2.4.11. Continue to reflux the mixture at 90°C-95°C for 15 minutes. Remove the digestion vessels from the digestion block and allow the vessel to cool down for at least 5 mins.

10.1.2.4.12. Lift the watch glass, add 5 ml of concentrated HCl. Swirl the vessel until added reagents are properly mixed with the solution. Place the watch glass before working on the next vessel. Return the vessels into the heated digestion block. Reflux for additional 15 minutes. Subsequently, remove the digestion vessels from the digestion block and allow the vessels to cool down and dilute to 100 ml final volume with reagent water.

[1] Addition of 5 ml HCl is a modification from Method 3050B to enhance recovery of antimony. Refer to Appendix 3 for the comparative study done on ICP-MS.

10.1.2.4.13. Let the digestate settle and centrifuge or filter with Whatman #41 (see 10.1.5) if necessary otherwise digestates are now ready for analysis.

10.1.2.5. **Digestate Filtration**

10.1.2.5.1. Place Whatman #41 filter paper into each funnel resting on holders. Rinse the filter papers with reagent water.

10.1.2.5.2. Place a pre-labeled digestate container under each funnel making sure that the labels are visible.

10.1.2.5.3. Check the labels to make sure that they agree. Pour the digestate into the filter.

10.1.2.5.4. Filter and collect the digestates in the labeled container. The digestates are now ready for analysis.

10.2. **Instrument Parameters**

10.2.1. Set instrument parameters as suggested below.

10.2.2. Plasma Condition

- RF Power: 1500 W
- RF Matching: 1.68 V
- Sample Depth: 8.0 mm
- Torch Height: -0.4 mm
- Torch Vertical: 0 mm
- Carrier Gas: 0.9 L/min
- Make-up Gas: 0.15 L/min Note: Total Carrier and Make-up gas not to exceed 1.1 L/min.
- Peristaltic pump: 0.1 rps
- Spray Chamber (S/C) Temp: 2°C

10.2.3. Ion Lenses

- Extract 1: 0 V
- Extract 2 : -140V
- Omega Bias-ce: -22 V
- Omega Lens-ce: -1.2 V
- Cell Entrance: -26 V
- QP Focus: 2 V
- Cell Exit: -30 V

10.2.4. Octopole Parameters

- Octopole RF: 150 V
- Octopole Bias: -6 V

10.2.5. Q-Pole Parameters

- AMU Gain: 127
- AMU Offset: 125
- Axis Gain: 0.9996
- Axis Offset: 0.04
- QP Bias: -3 V

10.2.6. Detector Parameters

- Discriminator: 8 mV
- Analog HV: 1630 V
- Pulse HV: 990 V

10.2.7. Reaction Cell

- H_2 Gas: 3.0 ml/min
- He Gas: 4 ml/min

10.2.8. Adjust the instrument parameters to optimize the instrument performance in conformance to the tuning requirement.

10.2.9. Print the most current instrument parameters and place in the appropriate binder for easy reference. Replaced instrument parameter set-up should be archived chronologically for future reference and historical record.

10.3. **Calibration**

10.3.1. Instrument Set-Up

10.3.1.1. Set up the ICP-MS with proper operating parameters. Refer to Section 10.3.

10.3.1.2. Ignite the plasma and allow the instrument to become thermally stable for at least 30 minutes.

10.3.1.3. Check the peristaltic pump to deliver a steady flow.

10.3.2. Tuning the Instrument

10.3.2.1. Tune the instrument according to Normal Mode, Hydrogen Mode and Helium Mode without the internal standard. Refer to Section 10.3 for parameters. On the ICP-MS main Menu, go to Instrument and click Tune and run the tuning solution without the internal standard. After about 60 seconds (making sure the solution is in the system) click start and evaluate the counts of the isotopes according to the table below.

Mode	**Range**		
Normal	Li6 ≥ 6400 counts	Y89 ≥ 16000 counts	Tl205 ≥ 9600 counts
Hydrogen	Ar/Ar78 < 10	Y89 ≥ 3000 counts	
Helium	V51/Co59 < 0.6	Co59 ≥ 7000 counts	ArCl-75 < 10 counts

10.3.2.2. If non-compliant, adjust parameters (e.g. Torch height, Torch vertical, Octopole Bias and QP Bias) and repeat the tune process until the required range is met.

10.3.2.3. Click Generate report for a full scan of the tune. Save all tune values to the current method.

10.3.3. Perform a P/A Factor Evaluation

10.3.3.1. Analyze the 50 µg/L P/A Tuning Standard.

10.3.3.2. Under "Tune," access "P/A Factor."

10.3.3.3. Select "Load masses from the acquisition method". Select and delete Ca, $(Cd)^{106}$, $(Cd)^{108}$, $(Pb)^{206}$, $(Pb)^{207}$ from the list of elements.

10.3.3.4. Select "run."

10.3.3.5. When complete accept the changes.

10.3.3.6. Print out P/A Factor and store the printout with the tuning data.

10.3.3.7. Accept the new P/A Factors.

10.3.3.8. Under "file" select "copy tune parameters" and copy the P/A Factors to both the H2 and He modes.

10.3.3.9. Save file as "norm.u".

10.3.4. Perform Tune Check

10.3.4.1. Analyze the intermediate tune check solution (9.1.1) using 4 replicates.

10.3.4.2. Evaluate the tune check so that the mass calibration differs no more than 0.1 AMU of the true value and the resolution to be less than 0.9 AMU full width at 10% peak height RSD should less than or equal to 5% for the 4 replicate analysis.

10.3.5. Initial Calibration (ICAL)

10.3.5.1. Analyze a calibration blank (S0) and a multi-point calibration standard (Section 9.3.3.1).

10.3.5.2. Set the instrument rinse time to 90 seconds between each standard solution.

10.3.5.3. Refer to Appendix 1 for ICAL acceptance criteria and /or corrective action.

10.3.6. Initial Calibration Verification (ICV)/ Instrument Calibration Blank (ICB)

10.3.6.1. Analyze the ICV (Section 9.5.1) from a second source to verify the concentration of the ICAL.

10.3.6.2. Analyze a low-level ICV (LLICV) from the same source as the calibration standard to verify the lower limit of quantitation (RL).

10.3.6.3. Analyze an ICB after LLICV to demonstrate absence of instrument contamination.

10.3.6.4. Refer to Appendix 1 for ICV, LLICVand ICB acceptance criteria and /or corrective action.

10.3.7. Continuing Calibration Verification (CCV)/ Continuing Calibration Blank (CCB)

10.3.7.1. Analyze CCV to check the validity of the ICAL every 10 samples and at the end of the analytical sequence.

10.3.7.2. Analyze low-level CCV (LLCCV) to check the system stability at low end of ICAL at the end of the analytical sequence.

10.3.7.3. Analyze a CCB every after LLCCV to demonstrate the absence of instrument contamination.

10.3.7.4. Refer to Appendix 1 for CCV, LLCCV and CCB acceptance criteria and/or corrective action.

10.3.8. ICSA and ICSAB

10.3.8.1. Analyze ICSA and ICSAB at the beginning of each analytical run and every 12 hours thereafter.

10.3.9. Establishing Instrument Detection Limit (IDL)

10.3.9.1. Analyze a minimum of seven consecutive method blanks.

10.3.9.2. Repeat the process within three non-consecutive days.

10.3.9.3. Calculate the standard deviation of each run.

10.3.9.4. The average of the standard deviation of the three runs determines the IDL for each analyte.

10.3.9.5. Establish IDL at least every 3 months.

10.3.10. Verifying Linear Dynamic Range (LDR)

10.3.10.1. Verify the LDR by preparing a standard at the upper limit of the LDR. Analyze and quantitate against the normal calibration curve. Percent recovery must be within ± 10% of expected value. If non-complaint re-establish LDR.

10.3.10.2. At a minimum perform LDR verification every six months.

10.4. **Analysis**

10.4.1. Analytical Sequence

10.4.1.1. From the main menu of the ICPMS top window, go to Sequence and create the analytical sequence by editing the sample log table. Refer to Table 4.

10.4.1.2. Set QC limits on QC samples for easy verification while analytical samples are running.

10.4.1.3. Using the sample log table, input the standards and the digestates to be analyzed. Samples are analyzed in the order they appear in the scanner.

10.4.1.4. Transfer about 5 ml of its content into the autosampler tubes placing them on the autosampler rack in the same order as the analytical sequence. A dilution of x10 for soil samples is required due to the high acid content of the digestate.

10.4.1.5. Dilution Test sample is prepared at 5 times dilution. Seal the tube with Parafilm and invert the tube several times to ensure adequate mixing.

10.4.1.6. Prepare a Post Digestion Spike test sample. Using the un-spiked sample digestate (preferably the QC sample), add MS standard to maintain the same spike level as the MS sample digestate.

10.4.1.7. A 100 µg/L internal standard shall be spiked into each sample.

10.4.1.8. Set the prepared analytical samples into the auto-sampler and start the analytical run.

10.4.2. Sample Result Evaluation

10.4.2.1. Check QC parameters as soon as the data is available.

- Check the initial calibration verification (ICV, LLICV and ICB) against Appendix 1.
- Check MB, LCS against Appendix 1. Perform specified corrective action if necessary.
- Check the MS, duplicate sample, serial dilution and post digestion spike results. If matrix interference is indicated, dilute the sample and re-analyzed.
- Check intensity of internal standard on each sample.
- If any of the above checkpoints is non-compliant, perform the specified corrective action in Appendix 1. If results indicate digestion problem, order re-digestion for affected samples. If unresolved, consult the Supervisor for further action.

10.4.2.2. Check the sample rack to ensure that the Autosampler did not skip any sample.

10.4.2.3. Check concentration of target analytes. If the response exceeds LDR, dilute and reanalyze the sample at a concentration within the LDR.

10.4.2.4. Check other QC requirements like ICSA, ICSAB, CCV, LLCCV, CCB against Appendix 1.

10.5. **Calculations**

10.5.1. The computer software is designed to calculate the concentration in the digestate, based on the assumption that the initial calibration is linear through the origin. Thus, for aqueous samples, the computer-generated result represent the concentration of the sample.

10.5.2. For water samples

$$C_s = C_i\left(\frac{ExpAmt}{Aliquot}\right)\left(\frac{Vd}{ExpVd}\right)DF \qquad \text{Eq.-10.5.2}$$

where:

C_s – Concentration in the sample, µg/L

C_i – Concentration in the digestate, (computer-generated), µg/L

V_d – Digestion volume, ml

ExpVd – Expected digestion volume, ml

DF – Dilution factor

ExpAmt – Expected amount for digestion, ml

Aliquot – Amount digested, ml

10.5.3. For solids, use the following equation to calculate the concentration

$$Cs = C_i\left(\frac{ExpAmt}{Aliquot}\right)\left(\frac{V_d}{ExpVd}\right)\left(\frac{100}{100-\%H_2O}\right)\times DF\times 0.1 \qquad \text{Eq.-10.5.3}$$

where:

C_s – Concentration in the sample, mg/Kg

C_l – Concentration in the digestate (computer-generated), µg/L

V_d – Digestion volume, ml

ExpVd – Expected digestion volume, ml

ExpAmt – Expected amount for digestion, g

Aliquot – Amount digested, g

$\% H_2O$ – Percent moisture of the sample

DF – Dilution factor

0.1 – Conversion factor

10.5.4. Calculate the percent recovery (%R)

$$\% \ Recovery = \frac{Cf - C}{Cs} * 100 \qquad \text{Eq.-10.5.4}$$

where:

C_f – Concentration found, µg/ L

C – Concentration of sample, µg/L

C_s – Concentration of spike, µg/L

10.5.5. Relative Percent Difference (%RPD)

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.5}$$

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Make a copy of the analytical run log and sample preparation log.

10.6.2. Highlight the data to be reported.

10.6.3. Print a copy of the raw data and the QC report.

10.6.4. Keep all other data generated with the analytical folder marked with “For record only” for traceability purpose.

10.7. **Report Generation**

10.7.1. Print the summary of the analytical run, perform a data transfer into a disk, and convert the instrument electronic output file into a CSV file format.

10.7.2. Run the ICPCHK.exe program for calibration check.

10.7.3. Identify samples that need to be re-analyzed, if any, and report all samples that met the analytical requirements.

10.7.4. Generate the report using the following reporting program:

Executable Files	Required Support Files	Output
WDBX[2].exe	Login File (requires network), project.pln, seq_name.sq, seq_name.ckv, seq_name.ckb, seq_name.csv, seq_name.qck, EXCLCMP.LST	Method.txt [this file integrates the login sample information and the analytical sample information]
IF1VX.exe	method.txt, method.met, method.crf, project.pln, project code.txt, qcell.txt	Sample Results (Form1)
IQCICP.exe	method.txt, method.crf, method.qc, project.pln, project code.txt, qcell.txt	QC Summary for LCS and MS (Form 3)
QCX.exe	method.txt, method.crf, method.qc, project.pln, qcell.txt	Summary for Dilution Test (Form 3)
LABCHRNX.exe	method.txt	Lab Chronicle
CN2.exe	Login File, method.txt, Form 1, Form 3	Case Narrative

10.7. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below.

- Case Narrative
- Lab Chronicle
- Sample Results
- LCS/LCSD Summary
- MS/MSD Summary
- Sample Duplicate Summary
- Analytical Run Log
- ICAL Summary
- ICV Summary
- CCV Summary

X[2] – latest program version

- Sample Preparation Log
- Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- Review the ICPCHK.exe output file to ensure that it agrees with the instrument output. Check Project Specific Requirement (PSR) or Appendix 1 for acceptance criteria.
- Check frequency of calibration verification. Verify results to be within acceptance limits.
- Check of target analytes concentration to be within linear range.
- Verify interference check results to be within acceptance limits.

10.8.3. If any of the above checkpoints is non-compliant, re-analysis is required.

10.8.4. Review the attached logs that they are properly filled.

10.8.5. Check the generated reports against the raw data. Check that the analytical data generated indicating positive results are qualitatively and quantitatively correct.

10.8.6. Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.7. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Instruments shall receive routine preventive maintenance that is properly recorded in the instrument-specific maintenance logs. The list of maintenance is summarized in Form 6020FM. The practice ensures optimum operating condition of the equipment thus reducing the possibility of frequent instrument malfunction.

Maintenance Activity	Description	Frequency
Verification	Verify instrument parameters to ensure normal operating conditions. Change tubings as necessary. Perform system tune check. Check instrument performance (e.g., ICV/ICB)	Daily prior to analysis
Vacuum System Maintenance	Inspect vacuum hoses and exhaust tubes for possible problems. Check pump for evidence of leakage	Daily prior to analysis
Documentation	Record all instrument maintenance performed in the instrument maintenance log.	Daily prior to analysis
Ion Lens Cleaning	Remove and clean surfaces of the ion lens. Sonicate ion lens parts	As necessary
System Cleaning	Remove covers and clean dust from fans and vent covers	Every 6 months or as necessary
Pump Maintenance	Replace oil mist filter, drain and replace mechanical pump oil. Verify proper	Every 6 months

	pump operation	
Inspection	Perform general inspection of the complete system	Once a year

11.0 QUALITY CONTROL

11.1. Sample Preparation QC

11.1.1. All labwares used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.1.2. A preparative batch consists of 20 or fewer samples of the same matrix that are prepared for analysis simultaneously or sequentially, using the same lots of all reagents.

11.1.3. Every preparative batch shall have at least one method blank, one LCS and a set of MS/MSD unless otherwise specified by the project. These QC samples shall be digested together with the field samples.

11.1.4. All reagents shall be subjected to QC check prior to its use. Refer to EMAX-QC01 for details.

11.2. Sample Analysis QC

11.2.1. Perform a tune check before every analytical run, an initial calibration and initial calibration verification (ICV / LLICV). Obtain the ICV standard from a different source from that of the initial calibration and LLICV from the same source as the ICAL. Analyze an instrument calibration blank (ICB) after the LLICV. No further analysis shall be valid unless acceptance criteria are met.

11.2.2. Monitor the intensities of all internal standards for every analysis. Refer to Appendix 1 for acceptance criteria.

11.2.3. Verify inter-element and background correction factors with ICSA and ICSAB standards after ICB every 12 hours.

11.2.4. Verify calibration with continuing calibration verification (CCV) standard and continuing calibration blank (CCB) after every ten samples and at the end of the analytical run. Also verify LLCCV at the end of the analytical run.

11.2.5. Evaluate results of MS/MSD to document matrix interference.

11.2.6. Perform Post Digestion Spike whenever recoveries for MS/MSD failed.

11.2.7. Evaluate Dilution Test result if post digestion spike result failed to meet the acceptance criteria. Failure typically happens when analyte concentrations are high.

11.2.8. Refer to Appendix 1 for acceptance criteria.

11.3. Method QC

11.3.1. A valid DL and LOD must exist prior to sample analysis. Refer to EMAX-QA04 for details.

11.3.2. Perform dynamic range study at least every six months or whenever there is a significant change in instrument response unless otherwise specified by the project.

11.3.3. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05.

12.0 CORRECTIVE ACTION

12.1. Quality control procedures and corresponding corrective actions are summarized in Appendix 1.

12.2. If tune is non-compliant, consider the following suggestions to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check argon gas flow.
- Perform auto tune or visual optimization
- If the problem persists, inform the Supervisor.

12.3. If correlation coefficient (R) of ICAL is non-compliant, consider the following suggestions to help you correct the problem:

- Check the calibration points for possible presence of out-lier. If out-lier is present, prepare a fresh standard and repeat the calibration.
- Check the connections and make sure that they are air-tight. Perform maintenance as needed.
  - Presence of bubbles is indicative of poor connection between the sipper and the nebulizer.
  - Poor precision to inability to light the plasma is a symptom of a poor drain tube connection
  - Poor precision and carry-over problems are indicative of a dirty spray chamber.
  - Relative increase in the sensitivity ratio of the higher: lower atomic number elements are indicative of stretched pump tubing. The sample flow rate decreases as the tubing stretches.
- Check the argon gas flow. Loss of signal is indicative of low or no argon gas flow.
- Poor precision and a gradual loss of signal is indicative of “salting-out” in the nebulizer and/or spray chamber due to samples with high dissolved or suspended solids. This problem will necessitate nebulizer and spray chamber cleaning.
- If the problem persists, inform the Supervisor.

12.4. If ICV is non-compliant, consider the following suggestions to help you correct the problem:

- If the RSD is high it is indicative that the carry-over might be present in the spray chamber.
- If result is bias high, prepare a fresh standards and repeat calibration.
- If the problem persists, inform the Supervisor.

12.5. If ICB/CCB is non-compliant, consider the following suggestions to correct the problem:

- Prepare a fresh calibration blank solution. Perform instrument rinsing and repeat the ICB/CCB prior to re-analysis of associated sample(s).
- Carry-over problem is indicative of dirty spray chamber, nebulizer and/or torch. Perform instrument maintenance and repeat the calibration.
- If the problem persists, inform the Supervisor.

12.6. If CCV or LLICV or LLCCV is non-compliant, consider the following suggestions to correct the problem:

- Check the connections prior to re-running the ICAL. Refer to Section 12.3.
- Prepare a new standard and repeat the ICAL.

12.7. If the intensity of the Internal Standard is non-compliant, consider the following suggestions to correct the problem:

- Check for drift occurrence by observing the internal standard intensities in the calibration blank.
- If drift has occurred, terminate the analysis, recalibrate, verify the new calibration and reanalyze the affected samples.
- If drift has not occurred, dilute affected samples five fold and reanalyze with the addition of appropriate amounts of internal standards.

12.8. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

- Rule-out instrument contamination by checking the CCBs. Refer to Section 12.5.
- Rule-out reagent contamination by testing each reagent as described in EMAX-QC01.
- Rule-out digestate vessel contamination by adding verified reagents heating the vessels prior to testing.
  - Common environmental contaminants – Ca, Si, Fe, Na, Mg, K, Tl, Cu, Mn, can be minimized by maintaining the lab clean.
- Other sources of contamination:
  - Sweat contains Ca, Mg, Pb, K, NH_4^+ , SO_4^{-2}, PO_4^{-3}, and Cd (for those who smoke).
  - Cosmetics can contain high concentrations of Al, Be, Ca, Cu, Cr, K, Fe, Mn, Ti, and Zn.
  - Some hair dyes contain $Pb(OAC)_2$.
  - Dandruff shampoo can contain significant levels of Se.
  - Eye make-up may contain Hg as a preservative.
  - Calamine lotion is almost pure ZnO.
  - Watches and jewelry contain an assortment of elements and should not be worn in the laboratory.
- Re-digest MB and the associated samples with reagents free of contamination or with newly opened reagents.
- If the problem persists, inform the Supervisor.

12.9. If LCS is non-compliant, consider the following suggestions to correct the problem:

- If result is bias-high, check the LCS standard by analyzing at the spike level.

  If the LCS check is within 80-120 % of the expected value, check the calibration of the micropipette use for spiking. Re-digest and re-analyze the LCS and the associated samples.

  If the LCS check is not within 80-120%, prepare a fresh LCS standard, re-digest and re-analyze LCS and the associated samples.
- Common Problems with Ag, As, Ba, Pb, and Cr, indicating stock standard degradation, are as follows:

  Low Silver (Ag) recovery is indicative of Chloride contamination causing AgCl precipitation

  Low Arsenic (As) recovery is indicative of loss during sample preparation as volatile oxides (AsO_3) or precipitation as $AsCl_3$

  Low Barium (Ba) recovery is indicative of SO_4or CrO_4 contamination. Barium will form precipitates with HF and H_2SO_4.

High Lead (Pb) recovery is indicative of environmental contamination.

12.10. A Non-Conformance Report (NCR) is required when the following circumstances occur:

- Anomalies other than those specified in Appendix 1 are observed.
- Sample is out of technical holding time.

12.10.1. Refer to EMAX-QA08 for NCR details.

13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standards in fume hoods.

14.0 WASTE MANAGEMENT

14.1. No sample may be dumped in the laboratory sink.

14.2. Separate and properly identify all unused and expired analytical standards for proper disposal.

14.3. Place all waste generated during the analytical process in properly labeled satellite waste containers for proper collection.

14.4. Dispose all unused samples, digestates, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1 **Preparation Batch** - is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.1 **Analytical batch -** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Detection Limit (DL) – The lowest concentration or amount of the target analyte that can be identified, measured and reported with confidence that the analyte concentration is not a false positive.

15.1.3. Limit of Detection (LOD) – An estimate of the minimum amount of substance that an analytical process can reliably detect.

15.1.4. Limit of Quantitation (LOQ) – The minimum levels, concentrations or quantities of target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

15.1.5. Safety Data Sheet (SDS) – is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.6. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.7. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.8. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.9. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical procedure to monitor contamination.

15.1.10. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.11. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.12. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.13. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.14. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.15. Matrix – is a physical state of a sample. Most of environmental samples are classified as water, soil or air.

15.1.16. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.17. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.18. Re-analysis – is a repeated analysis from the same extract/digestate or sample, identified with the Lab Sample ID suffixed with "W".

15.1.19. Re-extract/digest – is a repeated sample preparation process identified with the Lab Sample ID suffixed with "R".

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing metals analysis. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Update IV, Method 6020A.

16.2. Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, Method 200.8 Rev. 5.4, 1994.

16.3. USEPA SW846, Method 3050B, Revision 2, December 1996.

16.4. Title 40 Code of Federal Regulations, Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants, latest edition.

16.5. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Tables**

17.1.1. Table 1 ICP-MS Elements & Isotopes

17.1.2. Table 2 Calibration Standard and Verification Preparation

17.1.3. Table 3 Calibration Standards Concentration and Reporting Limit

17.1.4. Table 4 ICP-MS Analytical Sequence

17.1.5. Table 5 DL, LOD, LOQ and Linear Range Concentration Levels

17.2. **Figures**

17.2.1. Figure 1 Typical Sample Report

17.2.2. Figure 2 Typical LCS/LCD Summary

17.2.3. Figure 3 Typical MS/MSD Summary

17.2.4. Figure 4 Typical Case Narrative

17.3. **Appendices**

17.3.1. Appendix 1 Summary of Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.3.3. Appendix 3 Comparative Study of Modified 3050B

17.4. **Forms**

17.4.1. 6020FS Sample Preparation Log

17.4.2. 6020FA Analytical Run Log

17.4.3. 6020FM Instrument Maintenance Log

Table 1: ICP-MS ELEMENTS & ISOTOPES

ELEMENT	SYMBOL	MASS	Tune Mode	Internal Standard
Aluminum	Al	27	3	Sc45
Antimony	Sb	121	3	In115
Arsenic	As	75	2	Ge72
Barium	Ba	137	3	In115
Beryllium	Be	9	3	Li6
Boron	B	11	3	Li6
Cadmium	Cd	111	3	In115
Calcium	Ca	43	1	Sc45
Chromium	Cr	53	2	Sc45
Cobalt	Co	59	3	Sc45
Copper	Cu	63	2	Sc45
Iron	Fe	57	1	Sc45
Lead	Pb	208	3	Tb159
Lithium	Li	7	3	Li6
Magnesium	Mg	24	3	Sc45
Manganese	Mn	55	3	Sc45
Molybdenum	Mo	95	3	In115
Nickel	Ni	60	2	Sc45
Phosphorus	P	31	3	Sc45
Potassium	K	39	3	Sc45
Selenium	Se	78	1	Ge72
Silver	Ag	107	3	In115
Sodium	Na	23	1	Sc45
Strontium	Sr	88	3	Y89
Thallium	Tl	205	3	Tb159
Tin	Sn	118	3	In115
Titanium	Ti	47	3	Sc45
Tungsten	W	182	3	Tb159
Uranium	U	238	3	Tb159
Vanadium	V	50	2	Sc45
Zinc	Zn	66	3	Ge72
Zirconium	Zr	90	3	Ge72

Tune Mode: 1=Reaction H_2 Mode; 2=Collision He Mode; 3= Normal Mode

Table 2 : CALIBRATION STANDARD AND VERIFICATION PREPARATION

Standard #	Mixed Standard Name	Conc. (µg/ml)	Source	Preparation		
				Aliquot (ml)	Final Vol. (ml)	Final Conc. (µg/ml)
S1	Trace Mix	1	High Purity	0.025	50	0.0005
	Cation Mix	50/25	AccuStandard	0.050		0.050/0.025
	Zn	10	High Purity	0.0025		0.001
	W	1	AccuStandard	0.025		0.0005
	P	100	AccuStandard	0.0125		0.025
	Zr	1	AccuStandard	0.025		0.0005
S2	ICAL 1	10	High Purity	0.025	50	0.005
	ICAL 2	10	High Purity	0.025		0.005
	Cation Mix	50/25	AccuStandard	0.500		0.500/0.250
	Zn	10	High Purity	0.025		0.010
	W	1	AccuStandard	0.250		0.005
	P	100	AccuStandard	0.025		0.050
	Zr	1	AccuStandart	0.250		0.005
S3	ICAL 1	10	High Purity	0.125	50	0.025
	ICAL 2	10	High Purity	0.125		0.025
	Cation Mix	50/25	AccuStandard	2.500		2.500/1.250
	Zn	10	High Purity	0.125		0.050
	W	100	AccuStandard	0.0125		0.025
	P	100	AccuStandard	0.125		0.250
	Zr	100	AccuStandard	0.0125		0.025
S4	ICAL 1	10	High Purity	0.250	50	0.050
	ICAL 2	10	High Purity	0.250		0.050
	Cation Mix	50/25	AccuStandard	5.000		5.000/2.500
	Zn	10	High Purity	0.250		0.100
	W	100	AccuStandard	0.025		0.050
	P	100	AccuStandard	0.250		0.500
	Zr	100	AccuStandard	0.025		0.050
ICV	ICV 1	10	CPI	0.150	50	0.030/0.060
	Cation Mix 2	50/25	CPI	3.000		3.000/1.500
	W	10	Ultra Scientific	0.150		0.030
	P	1000	CPI	0.015		0.300
	Zr	100	CPI	0.015		0.030
CCV	ICAL 1	10	High Purity	0.125	50	0.025
	ICAL 2	10	High Purity	0.125		0.025
	Cation Mix	50/25	AccuStandard	2.500		2.500/1.250
	W	100	AccuStandard	0.0125		0.025
	Zn	10	High Purity	0.125		0.050
	P	100	AccuStandard	0.125		0.250
	Zr	100	AccuStandard	0.0125		0.025
LLICV / LLCCV (water)	Mix 7	1/100	High Purity	0.05	50	0.001/0.1
	Zn	10	AccuStandard	0.045		0.01
	W	1	AccuStandard	0.100		0.002
	P	100	AccuStandard	0.025		0.050
	Zr	1	AccuStandard	0.25		0.005
LLICV / LLCCV (soil)	Mix 7	1/100	High Purity	0.025	50	0.0005/0.05
	Zn	10	AccuStandard	0.0025		0.001
	W	1	AccuStandard	0.100		0.002
	P	100	AccuStandard	0.025		0.050
	Zr	1	AccuStandard	0.250		0.005

Table 3: CALIBRATION STANDARDS CONCENTRATION AND REPORTING LIMIT

ELEMENT	ICAL (µg/L)				ICV (µg/L)	CCV (µg/L)	ICSA (µg/L)	ICSAB (µg/L)	LLICV,LLCCV, LOQ (Water) (µg/L)	LLICV,LLCCV, LOQ (Soil) (mg/Kg)
	S1	S2	S3	S4						
Aluminum	50	500	2500	5000	3000	2500	100000	100000	100	100
Antimony	0.5	5	25	50	30	25	0	20	1	0.5
Arsenic	0.5	5	25	50	30	25	0	20	1	0.5
Barium	0.5	5	25	50	30	25	0	20	1	0.5
Beryllium	0.5	5	25	50	30	25	0	20	1	0.5
Boron	0.5	5	25	50	30	25	0	200	10	10
Cadmium	0.5	5	25	50	30	25	0	20	1	0.5
Calcium	50	500	2500	5000	3000	2500	100000	100000	100	100
Chromium	0.5	5	25	50	30	25	0	20	1	0.5
Cobalt	0.5	5	25	50	30	25	0	20	1	0.5
Copper	0.5	5	25	50	30	25	0	20	1	0.5
Iron	50	500	2500	5000	3000	2500	100000	100000	100	100
Lead	0.5	5	25	50	30	25	0	20	1	0.5
Lithium	0.5	5	25	50	30	25	0	20	2	0.5
Magnesium	50	500	2500	5000	3000	2500	100000	100000	100	100
Manganese	0.5	5	25	50	30	25	0	20	1	0.5
Molybdenum	0.5	5	25	50	30	25	2000	2000	2	0.5
Nickel	0.5	5	25	50	30	25	0	20	1	0.5
Phosphorus	25	50	250	500	300	250	100000	100000	50	50
Potassium	50	500	2500	5000	3000	2500	100000	100000	100	100
Selenium	0.5	5	25	50	30	25	0	20	1	0.5
Silver	0.5	5	25	50	30	25	0	20	1	0.5
Sodium	25	500	2500	5000	3000	2500	100000	100000	100	100
Strontium	0.5	5	25	50	30	25	0	20	2	0.5
Thallium	0.5	5	25	50	30	25	0	20	1	0.5
Tin	0.5	5	25	50	30	25	0	20	1	20
Titanium	0.5	5	25	50	30	25	2000	2000	2	0.5
Uranium	0.5	5	25	50	30	25	0	20	1	0.5
Vanadium	0.5	5	25	50	30	25	0	20	1	0.5
Zinc	1	10	50	1000	60	50	0	20	20	2
Zirconium	0. 5	5	25	50	30	25	0	20	5	5
Tungsten	0.5	5	25	50	30	25	0	20	2	2

Table 4: ICP-MS ANALYTICAL SEQUENCE

RUN ID LABEL	SAMPLE DESCRIPTION	SOLUTION ID LABEL
S0	Calibration Standard 1 (blank)	S0
S3, S4, S5	ICAL Standards	S3, S4, S5
ICV	Initial Calibration Verification	ICV
LLICV	Low Level Initial Calibration Verification	LLICV
ICB	Initial Calibration Blank	ICB
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution A and B	ICSAB
CCV1	Continuing Calibration Verification #1	CCV
CCB1	Continuing Calibration Blank #1	S0
IMSSSSB[3]	Preparation Blank	
IMSSSSL/C	Lab Control Sample	
Sample 1	Sample 1	
Sample 1M	Sample 1 Matrix Spike	
Sample 1S	Sample 1 Matrix Spike Duplicate	
Sample 1J	Sample 1 Serial Dilution(5x dilution sample 1)	
Sample 1A	Sample 1 Post Digestion spike	
Samples 2 to 4	Sample 2 to Sample 5	
CCV2	Continuing Calibration Verification #2	CCV
CCB2	Continuing Calibration Blank #2	S0
Samples 5 to 14	Maximum of 10 Samples	
CCV3	Continuing Calibration Verification #3	CCV
CCB3	Continuing Calibration Blank #3	S0
Samples 15 to 20	Sample 15 to 20 or a maximum of 10 samples (sample 15 to 24)	
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution B	ICSAB
CCV4	Continuing Calibration Verification #4	CCV
LLCCV	Low Level Continuing Calibration Verification	LLCCV
CCB4	Continuing Calibration Blank #4	S0

[3] where IMSSSS is the digestion batch reference.

Table 5: DL, LOD, LOQ AND LINEAR RANGE CONCENTRATION LEVELS

ELEMENT	WATER (µg/L)			SOIL (mg/kg)			LINEAR RANGE µg/L
	DL	LOD	LOQ	DL	LOD	LOQ	
Aluminum	10	20	100	5	10	100	125000
Antimony	0.25	0.5	1	0.1	0.2	0.5	3000
Arsenic	0.1	0.2	1	0.05	0.1	0.5	3000
Barium	0.25	0.5	1	0.072	0.1	0.5	3000
Beryllium	0.05	0.1	1	0.05	0.1	0.5	500
Boron	2.5	5	10	2.5	5	10	250
Cadmium	0.1	0.2	1	0.057	0.1	0.5	3000
Calcium	13	25	100	17	20	100	400000
Chromium	0.1	0.2	1	0.05	0.1	0.5	3000
Cobalt	0.1	0.2	1	0.05	0.1	0.5	3000
Copper	0.25	0.5	1	0.1	0.2	0.5	3000
Iron	5	10	100	5	10	100	300000
Lead	0.05	0.1	1	0.05	0.1	0.5	3000
Lithium	0.25	0.5	2	0.139	0.2	0.5	500
Magnesium	5	10	100	10	20	100	150000
Manganese	0.1	0.2	1	0.153	0.2	0.5	3000
Molybdenum	0.25	0.5	2	0.1	0.2	0.5	3000
Nickel	0.1	0.2	1	0.063	0.1	0.5	3000
Potassium	10	20	100	10	20	100	400000
Phosphorus	12.5	25	50	12.5	25	50	400000
Selenium	0.15	0.3	1	0.05	0.1	0.5	3000
Silver	0.1	0.2	1	0.05	0.1	0.5	250
Sodium	25	50	100	10	20	100	300000
Strontium	0.5	1	2	0.05	0.1	0.5	3000
Thallium	0.1	0.2	1	0.05	0.1	0.5	3000
Tin	0.1	0.2	1	5	10	20	3000
Titanium	0.25	0.5	2	0.125	0.25	0.5	3000
Tungsten	0.5	1	2	0.5	1	2	1000
Uranium	0.05	0.1	1	0.05	0.1	0.5	3000
Vanadium	0.25	0.5	1	0.19	0.3	0.5	3000
Zinc	5	10	20	0.683	1	2	3000
Zirconium	1	2	5	1	2	5	2000

Figure 1: **TYPICAL SAMPLE REPORT**

METHOD 6020A
METALS BY ICP-MS

Client	: XYZ, INC.	Date Collected:	11/17/10
Project	: CLEAN PROJECT	Date Received:	11/19/10
SDG NO.	: 10K283	Date Extracted:	11/30/10 17:15
Sample ID:	YWB10-2578	Date Analyzed:	12/03/10 18:05
Lab Samp ID:	K283-10	Dilution Factor:	0.991
Lab File ID:	98L04043	Matrix :	SOIL
Ext Btch ID:	IMK029S	% Moisture :	11.6
Calib. Ref.:	98L04035	Instrument ID :	EMAXTI98

PARAMETERS	RESULTS (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Aluminum	18000	112	22.4
Antimony	ND	0.561	0.112
Arsenic	2.03	0.561	0.112
Barium	51.9	0.561	0.112
Beryllium	0.344J	0.561	0.112
Cadmium	ND	0.336	0.112
Calcium	618	112	22.4
Chromium	5.01	0.561	0.112
Cobalt	3.29	0.561	0.112
Copper	3.12	0.561	0.224
Iron	13300	112	22.4
Lead	4.34	0.561	0.112
Magnesium	2750	112	22.4
Manganese	227	0.561	0.112
Molybdenum	1.24	0.561	0.112
Nickel	3.33	0.561	0.112
Potassium	2050	112	22.4
Selenium	0.188J	0.561	0.112
Silver	ND	0.561	0.112
Sodium	ND	112	22.4
Thallium	0.236J	0.561	0.112
Vanadium	30.0	0.561	0.112
Zinc	28.9	1.12	0.561

Figure 2: **TYPICAL LCS/LCD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	NA
DILTN FACTR:	1	1	1		
SAMPLE ID:	MBLK1S				
CONTROL NO.:	IMK029SB	IMK029SL	IMK029SC		
LAB FILE ID:	98L04037	98L04038	98L04039		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	NA
DATIME ANALYZD:	12/03/1017:41	12/03/1017:45	12/03/1017:49	DATE RECEIVED:	11/30/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	BLNK RSLT mg/kg	SPIKE AMT mg/kg	BS RSLT mg/kg	BS % REC	SPIKE AMT mg/kg	BSD RSLT mg/kg	BSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	ND	2500	2370	95	2500	2400	96	1	80-120	20
Antimony	ND	25.0	23.7	95	25.0	23.8	95	1	80-120	20
Arsenic	ND	25.0	23.8	95	25.0	23.5	94	1	80-120	20
Barium	ND	25.0	24.2	97	25.0	24.6	98	2	80-120	20
Beryllium	ND	25.0	23.8	95	25.0	23.9	96	1	80-120	20
Cadmium	ND	25.0	23.5	94	25.0	23.8	95	1	80-120	20
Calcium	ND	2500	2490	99	2500	2490	99	0	80-120	20
Chromium	ND	25.0	24.4	98	25.0	24.7	99	1	80-120	20
Cobalt	ND	25.0	23.8	95	25.0	24.1	96	1	80-120	20
Copper	ND	25.0	24.2	97	25.0	24.4	98	1	80-120	20
Iron	ND	2500	2440	98	2500	2450	98	0	80-120	20
Lead	ND	25.0	24.5	98	25.0	24.4	97	0	80-120	20
Magnesium	ND	2500	2370	95	2500	2390	95	1	80-120	20
Manganese	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Molybdenum	ND	25.0	24.2	97	25.0	24.2	97	0	80-120	20
Nickel	ND	25.0	24.3	97	25.0	24.6	98	1	80-120	20
Potassium	ND	2500	2440	98	2500	2450	98	0	80-120	20
Selenium	ND	25.0	23.8	95	25.0	23.9	95	0	80-120	20
Silver	ND	25.0	23.6	94	25.0	23.9	96	1	80-120	20
Sodium	ND	2500	2460	98	2500	2440	98	1	80-120	20
Thallium	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Vanadium	ND	25.0	24.3	97	25.0	24.5	98	1	80-120	20
Zinc	ND	25.0	25.0	100	25.0	24.7	99	1	80-120	20

Figure 3: **TYPICAL MS/MSD SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	11.6
DILTN FACTR:	0.991	0.992	0.992		
SAMPLE ID:	YWB10-2578				
CONTROL NO.:	K283-10	K283-10M	K283-10S		
LAB FILE ID:	98L04043	98L04040	98L04041		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	11/17/10
DATIME ANALYZD:	12/03/1018:05	12/03/1017:53	12/03/1017:57	DATE RECEIVED:	11/19/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	SMPL RSLT mg/kg	SPIKE AMT mg/kg	MS RSLT mg/kg	MS % REC	SPIKE AMT mg/kg	MSD RSLT mg/kg	MSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	18000	2810	21900	139*	2810	23200	187*	6	80-120	20
Antimony	ND	28.1	23.5	84	28.1	24.5	87	4	80-120	20
Arsenic	2.03	28.1	26.7	88	28.1	27.9	92	5	80-120	20
Barium	51.9	28.1	84.3	116	28.1	90.1	136*	7	80-120	20
Beryllium	0.344J	28.1	26.5	93	28.1	27.0	95	2	80-120	20
Cadmium	ND	28.1	25.8	92	28.1	26.8	95	3	80-120	20
Calcium	618	2810	3330	97	2810	3360	98	1	80-120	20
Chromium	5.01	28.1	31.4	94	28.1	33.1	100	5	80-120	20
Cobalt	3.29	28.1	28.5	90	28.1	29.5	93	3	80-120	20
Copper	3.12	28.1	28.6	91	28.1	29.7	95	4	80-120	20
Iron	13300	2810	17000	131*	2810	18300	176*	7	80-120	20
Lead	4.34	28.1	30.8	94	28.1	32.6	101	6	80-120	20
Magnesium	2750	2810	5550	100	2810	5770	108	4	80-120	20
Manganese	227	28.1	274	170*	28.1	285	207*	4	80-120	20
Molybdenum	1.24	28.1	27.2	93	28.1	28.5	97	5	80-120	20
Nickel	3.33	28.1	29.3	92	28.1	30.7	98	5	80-120	20
Potassium	2050	2810	5000	105	2810	5170	111	3	80-120	20
Selenium	0.188J	28.1	24.4	86	28.1	25.1	89	3	80-120	20
Silver	ND	28.1	26.1	93	28.1	27.0	96	3	80-120	20
Sodium	ND	2810	2620	93	2810	2680	96	2	80-120	20
Thallium	0.236J	28.1	25.9	92	28.1	27.3	96	5	80-120	20
Vanadium	30.0	28.1	58.0	100	28.1	63.4	119	9	80-120	20
Zinc	28.9	28.1	57.7	103	28.1	60.5	113	5	80-120	20

Figure 4: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 10K283

METHOD 6020A
METALS BY ICP-MS

A total of twelve (12) soil samples were received on 11/19/10 for Total Metals by ICP-MS analysis, Method 6020A in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Initial Calibration was established as prescribed by the method and was verified using a secondary source. Interference checks were performed and results were within required limits. Continuing calibration verifications and continuing calibration blanks were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for IMK029SL/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries were within project QC limits except for results qualified with [*] in K283-10M/S summary form, most likely due to matrix interference.
Check QC summaries form for details.
In addition Analytical spike and serial dilution were analyzed for matrix interference evaluation. Results were within method acceptance criteria.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURES	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Tune Check (Mass calibration and resolution check)	Daily before ICAL.	±0.10 AMU (Mass of Isotope) <0.9 AMU full width resolution RSD of 4 replicates : ≤5%	Correct problem and repeat tune check.		
Initial Calibration (multi-point)	Daily initial calibration prior to sample analysis.	r ≥ 0.998	Correct the problem and repeat the initial calibration.		
Initial Calibration Verifications (ICV) Second Source	Daily after the initial calibration.	All analytes within ±10% of expected value RSD of Replicate integrations: < 5%	Correct the problem and repeat the initial calibration.		
Low Level Calibration Verification (LLICV / LLCCV)	LLICV: Daily after initial calibration. LLCCV: At the end of the analysis sequence	All analytes with ± 30% of expected value.	Correct the problem and repeat the initial calibration.		
Calibration Verifications (CCV)	Daily before sample analysis, after every 10 samples and at the end of the analysis sequence.	All analytes within ±10% of expected value. RSD of replicate integrations < 5%.	Repeat calibration and reanalyze all samples since last successful calibration.		
Calibration Blanks (ICB/CCB)	After every calibration verification	All target analytes < LOQ.	Correct problem then reanalyze calibration blank and previous samples.		
Interference Check Sample (ICSA/ICSAB)	Analyze at the beginning of each analytical run or once every 12 hours , whichever is more frequent.	Within ±20% of expected value	Terminate analysis, correct the problem, reanalyze ICS, and reanalyze all affected samples		
Internal Standard (IS)	ICV, LLICV, CCV, LLCCV, CCBs, MB, LCS, every sample	IS Intensities > 70% from Initial Calibration Blank IS Intensity	Correct problem then re-analyze		
Method Blank	One per preparation batch	All target analytes < ½ LOQ.	Re-digest and reanalyze method blank and all samples processed with the contaminated blank.		
Laboratory Control Sample (LCS)	One per preparation batch	% Recovery: 80% - 120%	Re-digest and reanalyze LCS and all associated samples		
Matrix Spikes (MS/MSD)	One MS/MSD every 20 project samples per matrix	% Recovery: 75% - 125% RPD ≤20%	Evaluate post spike and dilution test: • If parent sample result is "ND", evaluate post spike. • If parent sample result is high (i.e., 4x of spike concentration) and post spike failed, evaluate dilution test.		
Post Digestion Spike Addition	When MS fails.	Recovery within 80-120% of expected value	Correct the problem then reanalyze post digestion spike addition		
Dilution Test (5X)	When MS fails.	1:5 dilution must agree within ±10% of the original determination	Evaluate. Discuss in case narrative.		
Instrument Detection Limit (IDL)	Every three months		Correct the problem and repeat the IDL determination.		
Comments: Refer to PSR for flagging criteria.			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: µg/L
Sample Amt(ml): 50

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : WATER

PARAMETER	98A04019	98A04020	98A04021	98A04022	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA006WL	IMA006WC	IMA006WX	IMA006WY							
Aluminum	2513	2514	2516	2513	2500	2514	101	1.41	0.06	80 - 120	PASSED
Antimony	25.1	25.1	25.2	25.0	25	25	100	0.09	0.36	80 - 120	PASSED
Arsenic	24.6	25.0	24.8	24.8	25	25	99	0.17	0.67	80 - 120	PASSED
Barium	25.7	25.6	25.7	25.4	25	26	102	0.15	0.58	80 - 120	PASSED
Beryllium	26.2	26.4	26.0	26.4	25	26	105	0.18	0.67	80 - 120	PASSED
Boron	27.3	27.8	27.2	27.7	25	28	110	0.31	1.13	80 - 120	PASSED
Cadmium	25.4	25.3	25.5	25.2	25	25	101	0.13	0.50	80 - 120	PASSED
Calcium	2578	2555	2563	2585	2500	2570	103	13.70	0.53	80 - 120	PASSED
Chromium	25.4	25.4	25.3	25.0	25	25	101	0.18	0.72	80 - 120	PASSED
Cobalt	25.4	26.0	25.6	25.6	25	26	103	0.22	0.87	80 - 120	PASSED
Copper	25.6	25.8	25.7	25.3	25	26	102	0.22	0.86	80 - 120	PASSED
Iron	2600	2583	2596	2594	2500	2593	104	7.27	0.28	80 - 120	PASSED
Lead	25.7	25.8	25.5	25.6	25	26	103	0.10	0.40	80 - 120	PASSED
Lithium	24.6	24.9	24.7	25.1	25	25	99	0.22	0.88	80 - 120	PASSED
Magnesium	2510	2516	2492	2506	2500	2506	100	10.20	0.41	80 - 120	PASSED
Manganese	25.6	25.7	25.7	25.4	25	26	102	0.15	0.59	80 - 120	PASSED
Molybdenum	25.1	25.1	25.1	24.7	25	25	100	0.19	0.74	80 - 120	PASSED
Nickel	25.3	25.6	25.4	25.0	25	25	101	0.23	0.91	80 - 120	PASSED
Potassium	2602	2593	2602	2558	2500	2589	104	20.93	0.81	80 - 120	PASSED
Selenium	25.4	25.1	25.3	25.0	25	25	101	0.16	0.62	80 - 120	PASSED
Silver	25.4	25.6	25.5	25.0	25	25	101	0.27	1.05	80 - 120	PASSED
Sodium	2507	2502	2507	2544	2500	2515	101	19.48	0.77	80 - 120	PASSED
Strontium	25.3	25.4	25.3	25.2	25	25	101	0.09	0.35	80 - 120	PASSED
Thallium	25.5	25.9	25.7	25.7	25	26	103	0.16	0.63	80 - 120	PASSED
Tin	25.1	25.2	25.5	25.3	25	25	101	0.15	0.59	80 - 120	PASSED
Titanium	25.2	25.0	25.2	24.8	25	25	100	0.17	0.66	80 - 120	PASSED
Uranium	26.1	26.1	25.9	25.9	25	26	104	0.13	0.50	80 - 120	PASSED
Vanadium	25.3	25.4	25.2	24.8	25	25	101	0.26	1.03	80 - 120	PASSED
Zinc	25.3	25.4	25.6	25.2	25	25	101	0.15	0.59	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

Analytical SOP: EMAX-6020
Conc Unit: µg/L
Sample Amt(ml): 50

Analysis date: 5/9/2011
Extracted by: C. Capulong
Analyzed by: C. Capulong

PARAMETER	98E05041	98E05042	98E05043	98E05044	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IME016WL	IME016WC	IME016WX	IME016WY							
Phosphorus	236.9	244.8	236.5	237.6	250	239	96	3.93	1.64	80 - 120	PASSED
Zirconium	25.0	27.2	25.8	26.3	25	26.1	104	0.93	3.55	80 - 120	PASSED

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: µg/L
Sample Amount(mL): 50

Instrument ID: 98
Analysis date: 6/25/2013
Analyzed by: C. Capulong

PARAMETER	98F06024	98F06025	98F06026	98F06027	TV	Ave. Conc.	Ave. %Rec	SD	RSD	QC Criteria	COMMENTS
	IMF012WL	IMF012WC	IMF012WX	IMF012WY							
Tungsten	26.8	26.7	26.4	26.6	25	26.3	105	0.15	0.6	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amt(gm): 1

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : SOIL

PARAMETER	98A04027	98A04028	98A04029	98A04030	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA007SL	IMA007SC	IMA007SX	IMA007SY							
Aluminum	2439	2397	2422	2435	2500	2423	97	18.95	0.78	80 - 120	PASSED
Antimony	21.1	20.9	20.8	20.8	25	21	84	0.13	0.61	80 - 120	PASSED
Arsenic	20.7	20.5	20.9	20.9	25	21	83	0.22	1.04	80 - 120	PASSED
Barium	21.6	21.5	21.4	21.7	25	22	86	0.12	0.54	80 - 120	PASSED
Beryllium	21.7	21.7	21.7	21.6	25	22	87	0.05	0.23	80 - 120	PASSED
Boron	23.0	23.2	23.4	23.5	25	23	93	0.23	1.00	80 - 120	PASSED
Cadmium	21.1	20.8	20.7	21.0	25	21	83	0.19	0.92	80 - 120	PASSED
Calcium	2535	2511	2502	2524	2500	2518	101	14.49	0.58	80 - 120	PASSED
Chromium	21.3	21.3	21.5	21.2	25	21	85	0.11	0.51	80 - 120	PASSED
Cobalt	21.5	21.2	21.6	21.5	25	21	86	0.20	0.95	80 - 120	PASSED
Copper	21.1	21.2	21.2	20.8	25	21	84	0.17	0.82	80 - 120	PASSED
Iron	2509	2501	2470	2525	2500	2501	100	23.10	0.92	80 - 120	PASSED
Lead	21.8	21.6	21.5	21.6	25	22	87	0.13	0.59	80 - 120	PASSED
Lithium	20.9	21.1	21.1	21.1	25	21	84	0.07	0.31	80 - 120	PASSED
Magnesium	2424	2401	2413	2427	2500	2416	97	11.81	0.49	80 - 120	PASSED
Manganese	21.5	21.5	21.6	21.5	25	22	86	0.06	0.29	80 - 120	PASSED
Molybdenum	21.4	21.2	21.3	21.4	25	21	85	0.11	0.53	80 - 120	PASSED
Nickel	20.9	20.8	21.0	20.8	25	21	83	0.08	0.36	80 - 120	PASSED
Potassium	2493	2499	2495	2483	2500	2493	100	6.81	0.27	80 - 120	PASSED
Selenium	21.1	20.8	21.3	21.1	25	21	84	0.19	0.92	80 - 120	PASSED
Silver	21.6	21.4	21.5	21.8	25	22	86	0.17	0.80	80 - 120	PASSED
Sodium	2440	2435	2390	2464	2500	2432	97	30.88	1.27	80 - 120	PASSED
Strontium	21.5	21.3	21.5	21.7	25	21	86	0.17	0.80	80 - 120	PASSED
Thallium	21.6	21.4	21.4	21.5	25	21	86	0.08	0.39	80 - 120	PASSED
Tin	24.6	24.2	24.1	24.3	25	24	97	0.24	1.00	80 - 120	PASSED
Titanium	21.6	21.4	21.5	21.5	25	22	86	0.08	0.38	80 - 120	PASSED
Uranium	22.4	22.0	22.4	22.4	25	22	89	0.21	0.96	80 - 120	PASSED
Vanadium	21.4	21.2	21.3	21.1	25	21	85	0.12	0.57	80 - 120	PASSED
Zinc	22.6	21.8	21.9	22.7	25	22	89	0.47	2.11	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

Analytical SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amt(ml): 1

Analysis date: 5/9/2011
Extracted by: C. Capulong
Analyzed by: C. Capulong

PARAMETER	98E05021	98E05022	98E05023	98E05024	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IME012SL	IME012SC	IME012SX	IME012SY							
Phosphorus	257	255	255	252	250	255	102	2.25	0.88	80 - 120	PASSED
Zirconium	27.3	29.3	29.7	29.5	25	28.9	116	1.12	3.87	80 - 120	PASSED

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amount(g): 1

Instrument ID: 98
Analysis date: 6/25/2013
Analyzed by: C. Capulong

PARAMETER	98F06019	98F06020	98F06021	98F06022	TV	Ave. Conc.	Ave. %Rec	SD	RSD	QC Criteria	COMMENTS
	IMF014SL	IMF014SC	IMF014SX	IMF014SY							
Tungsten	25.8	25.9	26.1	26.1	25	25.8	103	0.15	0.6	80 - 120	PASSED

Appendix 3: COMPARATIVE STUDY OF MODIFIED 3050B

ANALYTICAL METHOD: SW 6020A
PREPARATION BATCH: IMG031S - Modified Method 3050B
IMG032S - Reference Method 3050B
ANALYTICAL BATCH: I98H01
QC STANDARD: 09G281-02

Preparation Date: 7/27/2010
Extracted by: M. Mendoza
Analytical Run Date: 8/3/2010
Analyzed by: C. Capulong

COMPOUND	TRUE VALUES (mg/Kg)	ACCEPTANCE LIMITS (mg/Kg)	RECOVERY LIMITS (%)	REFERENCE METHOD 3050B				MODIFIED METHOD 3050B			
				Concentration (mg/Kg)		Recovery		Concentration (mg/Kg)		Recovery	
				98H01041 G281-02	98H01043 G281-02D	98H01041 G281-02	98H01043 G281-02D	98H01030 G281-02	98H01032 G281-02D	98H01030 G281-02	98H01032 G281-02D
Aluminum	7320	4940 - 16400	67 - 224	10900	10700	149%	146%	10700	10700	146%	146%
Antimony	110	11.0 - 121	10 - 110	20.0	19	18%	17%	61.4	66.6	56%	61%
Arsenic	84.2	42.8 - 92.7	51 - 110	61.2	61.7	73%	73%	63.6	65.3	76%	78%
Barium	247	186 - 318	75 - 129	255	260	103%	105%	275	273	111%	111%
Beryllium	49.0	29.0 - 53.9	59 - 110	39.7	39.6	81%	81%	42	41.7	86%	85%
Boron	130	61.8 - 149	48 - 115	104	104	80%	80%	126	126	97%	97%
Cadmium	76.5	48.7 - 84.4	64 - 110	65.3	66.7	85%	87%	69.9	69.8	91%	91%
Calcium	10200	7860 - 12900	77 - 126	9360	10700	92%	105%	10200	10300	100%	101%
Chromium	116	74.8 - 140	64 - 121	99.5	98.4	86%	85%	107	110	92%	95%
Cobalt	64.6	47.2 - 79.7	73 - 123	62.1	61.3	96%	95%	63.8	64	99%	99%
Copper	143	99.7 - 166	70 - 116	116	115	81%	80%	127	126	89%	88%
Iron	23300	11500 - 36200	49 - 155	23900	23700	103%	102%	24800	24800	106%	106%
Lead	82.0	41.9 - 90.2	51 - 110	63.3	64.9	77%	79%	67.5	67.6	82%	82%
Magnesium	7400	5300 - 9060	72 - 122	6770	6760	91%	91%	6930	7100	94%	96%
Manganese	475	428 - 724	90 - 152	546	562	115%	118%	584	571	123%	120%
Molybdenum	66.1	36.0 - 72.7	54 - 110	54.9	53.5	83%	81%	60.1	59.4	91%	90%
Nickel	144	88.8 - 158	62 - 110	112	113	78%	78%	122	122	85%	85%
Potassium	3740	2360 - 4990	63 - 133	3620	3600	97%	96%	3690	3560	99%	95%
Selenium	189	97.2 - 208	51 - 110	142	148	75%	78%	154	157	81%	83%
Silver	40.6	21.2 - 44.6	52 - 110	30.9	32.7	76%	81%	34.2	34.9	84%	86%
Sodium	200	31.4 - 324	16 - 162	292	197	146%	99%	192	200	96%	100%
Strontium	135	88.1 - 162	65 - 120	123	121	91%	90%	129	128	96%	95%
Thallium	127	73.2 - 144	58 - 113	110	114	87%	90%	117	112	92%	88%
Tin	250	39.5 - 275	16 - 110	71.2	73.2	28%	29%	84.7	85.2	34%	34%
Titanium	609	426 - 792	70 - 130	737	744	121%	122%	772	760	127%	125%
Uranium	1.12	0.784 - 1.46	70 - 130	0.93	1.1	83%	98%	1.03	1.01	92%	90%
Vanadium	61.8	55.6 - 123	90 - 199	90.2	89.7	146%	145%	92.8	93.1	150%	151%
Zinc	208	145 - 270	70 - 130	208	207	100%	100%	225	214	108%	103%

** Note: Modified 3050B procedure is specified in EMAX-3050 Rev. 4*

6020FS: SAMPLE PREPARATION LOG

EMAX LABORATORIES, INC.

DIGESTION LOG
for
ICP-MS

Page 1

Note: For samples, relevant QCs/Standards digested, refer to attached digestion sequence.

Comments:

Book #: EIM-033
Batch:
Matrix:
Digestor ID:

SOP #	Rev. #
☐ EMAX-200.8	
☐ EMAX-6020	
☐ EMAX-	

Start	Temp	End	Temp
	°C		°C

Standards	ID	Amount Added (ml)
LCS-1		
LCS-2		
MS		
Reagent	**Lot# / ID**	**Amount Added (ml)**
HNO_3		
HCl		
H_2O_2		
HNO3(1:1)		

Digestate Location	
Extract Location	

☐ Soil Samples: -diluted 1 ml of digestate to 10 ml reagent water (DF=100X)

☐ Reagent Water ID:

☐ Thermometer ID:

☐ Pipette ID:

☐ Pipette ID:

☐ Pipette ID:

☐ HNO_3 dispenser checked @ 5.0 ml with Class A volumetric flask

☐ HCl dispenser checked @ 5.0 ml with Class A volumetric flask

Prepared By:

Standard Added By: Witnessed By:

Extract Rcvd By: Checked By:

6020FA: ANALYSIS RUN LOG

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
ICP-MS

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Start Date:

End Date:

Comments:

Book #: A98-030

Instrument No.: 98

Analytical Batch:

Analytical Sequence:

Method File:

SOP #	Rev. #
☐ EMAX-6020	
☐ EMAX-200.8	
☐ EMAX-	

STANDARDS ID	
S0	
S1	
S2	
S3	
S4	
S5	
S6	
S7	
ICV	
CCV	
ICSA	
ICSAB	
6020 TUNE SOLN.	
200.8 TUNE SOLN.	
MRL1	
MRL2	
MRL3	

Analyzed By:

Date:

6020FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

ICP-MS MAINTENANCE LOG

Instrument No: 98 Month: Year: 201_ Book # M98-007

Date							
Argon, Hydrogen, Helium							
Instrument Discharge							
Pump Tubings							
Rinse Bottle							
Printer Paper							
Autosampler							
Cooling Water							
Peri Pump Rate (0.08-0.12 RPS)							
Nebulizer Gas (0.8-1.30 L/min)							
Makeup Gas (0.1-0.3 L/min)							
ICP-MS TUNE							
Li - 7 (≥ 6400 Counts)							
Y - 89 (≥ 16000 Counts)							
Tl - 205 (≥ 9600 Counts)							
Oxides (MO^+) ≤ 2%							
Double Charge (M^{++}) ≤ 2%							
Analyst Initials							
ICP-MS TUNE							
Problem(s) Encountered							
Corrective Action							
Return To Specs (Analyst Initials)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURES

TRACE METALS BY ICP-MS

SOP No.:	EMAX-6020	Revision No.	8	Effective Date:	27-Jun-13
Prepared By:	Mary Jane Mendoza			Date:	06.27.13
Approved By:	Kenette Pimentel QA Manager			Date:	06-27-13
Approved By:	Caspar Pang Laboratory Director			Date:	06-27-13
				Control Number:	**6020-08**

1.0 SCOPE AND APPLICATION

1.1. This procedure is applicable for the determination of sub-µg/L concentrations of a large number of elements in wastewater, groundwater, aqueous, extract, soil, sludge, and sediment samples using the Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) method. All matrices require proper sample preparation prior to analysis.

1.2. The elements and their corresponding isotopes are listed in Table 1.

1.3. This SOP is an adaptation of the SW846 Method 6020A.

2.0 SUMMARY OF METHOD

2.1. Metal analytes in water are acid digested from a pre-measured sample. Nitric acid and hydrochloric acid are added to the sample and heated without boiling until the volume is substantially reduced. The digestate is diluted back to its original sample volume using reagent water.

2.2. Metal analytes in soil are acid digested from a pre-measured sample. Nitric acid is added to the sample and heated to initialize digestion. It is further oxidized with 30% hydrogen peroxide and the acid used for final reflux is hydrochloric acid.

2.3. Digestates are introduced by pneumatic nebulization resulting aerosol into a high temperature argon plasma, where they are decomposed, atomized and ionized. The ions produced are extracted from the plasma via the sample and skimmer orifices in the interface region of the mass spectrometer. The extracted ions are guided by an off-axis Lens System to reduce background noise, passes through an Octopole Reaction System (ORS) where some ions require a simple reaction with H_2 or He to eliminate matrix interference prior to entering the Quadrupole Mass Filter (QMF). The QMF separates ions based on their mass-to-charge ratios and ions are counted by electron multiplier detector.

2.4. Quantitation is accomplished by comparing the response of a major ion relative to an internal standard using a calibration curve.

2.5. **Interference**

2.5.1. Isobaric Elemental Interference. Are caused by isotopes of different elements which form singly or doubly charge ions of the same nominal mass-to-charge ratio. The signal of an isotope of an interfering element is determined and subtracted from the analyte isotope signal.

2.5.2. Isobaric Polyatomic Ion Interference. Are caused by ions consisting of more than one atom which have the same nominal mass-to-charge ratio as the isotope of interest. To correct for isobaric polyatomic ion interferences, optimize the cell gas pressure on each analyte so that when the ORS employs simple reaction gases (H_2 and He) side reactions create new and unpredictable interferences. The ORS is equipped with notch filters and by using scanning voltages the created interferences are prevented from reaching the analyzer.

2.5.3. Physical Interference. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. An internal standard can be used to correct physical interference if carefully matched to the analyte so that the two elements are similarly affected by matrix changes. When the intensity level of the internal standard is less than 70% of the intensity of the first standard used during calibration, the sample must be diluted and re-analyzed.

2.5.4. Memory Interference. Contamination by carry-over can occur whenever high concentrations are analyzed in sequence with a low concentration sample. To reduce potential carry-over the rinse period between samples must be long enough to eliminate significant memory effect.

3.0 DETECTION LIMITS

3.1. Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Established limits are shown in Table 5.

4.0 DYNAMIC RANGE

4.1. Linear Dynamic Range (LDR) is the concentration over which the instrument response remains linear.

4.2. Establish LDR of each analyte by determining the signal response from a minimum of three preferably five different concentration across the range. The upper limit should be within 10% (± 10%) of the true value.

4.3. Verify the established LDR every six months or when there is a significant change in the instrument signal, whichever comes first.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. Holding Time

5.1.1. Analyze all samples within 180 days from collection date.

5.2. Preservation

5.2.1. Expected sample condition when received in the lab:

- water samples in HDPE, preserved to pH < 2 with HNO_3
- soil samples in glass jar or brass tubes

5.2.2. When water sample preservation is requested to be done in the lab, preserve the sample to pH < 2 with HNO_3 and observe at least 24 hours from the time preservative is added before sample digestion.

5.2.3. Store water samples in the same condition as received unless specified in the project requirement.

5.2.4. Store soil samples at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA04 Detection Limit (DL)

6.3. EMAX-QA05 Training

6.4. EMAX-QA08 Corrective Action

6.5. EMAX-QC01 Quality Control for Chemicals

6.6. EMAX-QC02 Analytical Standard Preparation

6.7. EMAX-QC04 Balance Calibration

6.8. EMAX-QC05 Calibration of Thermometers

6.9. EMAX-QC06 Calibration of Micropipettes

6.10. EMAX-QC07 Glassware Cleaning

6.11. EMAX-SM03 Waste Disposal

6.12. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all SDS of chemicals listed in this SOP.

7.2. Observe the following precautions during operation or maintenance of the instrument:

- Close the instruments hoods and panels prior to operation.
- Check the exhaust system for a positive extraction at the exhaust duct.
- Handle acids properly.
- Check the drain vessels frequently.
- Make sure that the argon tank is chained.
- Wait for the instrument interface region to cool down prior to instrument maintenance.
- Observe all cautions and warnings stipulated in the Agilent 7500 ICPMS CE/CX Manuals.

7.3. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Observe all chemical hygiene procedures as mentioned in the Chemical Hygiene Plan.

7.4. DO NOT DISPOSE ACIDIC WASTE IN THE TRASH CAN OR IN THE SINK.

7.5. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. ICP-MS: Agilent 7500CE Octopole Reaction System : Agilent 7500CX Octopole Reaction System

8.1.2. Autosampler: CETAC ASX-520

8.1.3. Computer: IBM Compatible

8.1.4. RF Generator: Agilent RF Generators

8.1.5. Data Acquisition: Agilent Chemstation version B.03.04 or as updated : Agilent Chemstation version B.04.00 or as updated

8.1.6. Autosampler rack(s): 17 x 100 mm, 60 positions

8.1.7. Culture tubes: 17 x 100 mm, polypropylene

8.1.8. Volumetric Flask: 10 ml, 50 ml, 500 ml, 1000 ml

8.1.9. Micropipettes: 1 ml, 0.100 ml, 5 ml

8.1.10. Pipet Tips: 100 - 1000 µl

8.1.11. Polyethylene bottles: 250, 500, 1000 ml

8.1.12. Liquid argon

8.1.13. Hydrogen, Compressed: Ultra-high purity

8.1.14. Helium, compressed: Ultra-high purity

8.1.15. Balance: Sartorius LC 620 S or equivalent

8.1.16. Spatula: Stainless steel or equivalent

8.1.17. Digestion vessel: 50 ml, 100 ml snap seal

8.1.18. Digestion block: Aluminum blocks or equivalent

8.1.19. Thermometer: Range 0 - 110°C

8.1.20. Filter: Whatman #41 or equivalent

8.1.21. Digestate Container: 50 ml polyethylene vessel, 100 ml Corning snap seal or equivalent

8.1.22. Disposable watch glass

8.1.23. ASX press Rapid Sample Introduction System

8.2. **Chemicals and Reagents**

8.2.1. DI water, ASTM Type II or equivalent

8.2.2. Nitric Acid, Trace high purity grade, concentrated

8.2.3. Hydrochloric acid, Trace high purity grade, concentrated

8.2.4. Hydrogen Peroxide, ACS grade (e.g., VW3690-5 from VWR) or equivalent

9.0 STANDARDS

9.1. **Tune Check Standard**

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
Tuning Solution	Agilent	Li, Y, Ce, Tl, Co	0.01	2% HNO_3
Tuning Check	High Purity	Co, In, Li, Tl	10	2% HNO_3

Standard	Standard			

9.1.1. Prepare tuning check standard at concentration level suggested below.

STANDARD	Aliquot, (ml)	Final volume (ml)	Final Concentration (mg/L)
Intermediate tuning check standard	0.5	50	0.100

9.2. **Internal Standard (IS)**

9.2.1. Purchase stock internal standard as certified standard at concentration listed below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
IS	Agilent	Li6, Sc, Ge, Rh, In, Tb, Bi, Lu	100	10% HNO_3

9.3. **Calibration Standards**

9.3.1. Calibration Stock Standard

9.3.1.1. Purchase custom-made certified individual and mixed stock standards as listed in the table below or equivalent.

STANDARD	SOURCE	ELEMENTS	CONC. (µg/ml)	MATRIX
ICAL 1	High Purity	As, B, Se, Sr, Tl, Ti, V, Zn, Sb, Mo, Sn	10	2% HNO_3 and Trace HF Acid
ICAL 2	High Purity	Ba, Be, Cd, Cr, Co, Cu, Pb, Li, Mn, Ni, Ag, U	10	2% HNO_3
ICAL 3	High Purity	Al, Fe, K, Ca, Mg, Na	1000	4% HNO_3
Phosphorus	AccuStandard	P	100	Water
Tungsten	AccuStandard	W	100	Water and trace NH_4OH
Zirconium	AccuStandard	Zr	100	2-5% HNO_3
Zinc	High Purity	Zn	1000	2% HNO_3

9.3.2. Calibration Working Standard

9.3.2.1. Prepare working standards as suggested in the table below or equivalent.

Working Standard	Stock Standard Name	Conc. (µg/ml)	Source	Preparation		
				Aliquot (ml)	Final vol. (ml)	Final conc. (µg/ml)
Trace mix	ICAL 1	10	High Purity	1.0	10	1.0
	ICAL 2	10	High Purity	1.0		1.0
Cation Mix	Al	10,000	AccuStandard	2.5	500	50
	Ca	10,000	AccuStandard	2.5		50
	Fe	10,000	AccuStandard	2.5		50

	Mg	10,000	AccuStandard	2.5		50
	K	10,000	AccuStandard	2.5		50
	Na	10,000	AccuStandard	1.25		25
Zn – 10 ppm	Zn	1000	High Purity	0.5	50	10
Zr – 1 ppm	Zr	100	AccuStandard	0.5	50	1.0
W – 1 ppm	W	100	AccuStandard	0.5	50	1.0
Mix 7A	ICAL 1	10	High Purity	1.0	10	1.0
	ICAL 2	10	High Purity	1.0		1.0
	ICAL 3	1000	High Purity	1.0		100

9.3.3. Matrix Acid Blank (S0)

9.3.3.1. Prepare matrix acid solution by mixing 3% by volume nitric acid and 1% by volume hydrochloric acid in reagent water. Transfer into a clean HDPE bottle and identify the solution as S0.

9.3.3.2. Use this solution for standards or digestate dilutions.

9.3.4. Initial Calibration Standard

9.3.4.1. The initial calibration consists of a blank (S0) and four standards (S1, S2, S3 and S4). Prepare the standards as suggested below. Refer to Table 3 for final concentrations for each analyte. Please note: More standard points may be added at the discretion of the analyst.

Standard Name	ICAL 1 (ml)	ICAL 2 (ml)	Cation Mix (ml)	Trace Mix (ml)	Zn - 10 ppm (ml)	W / Zr – 1 ppm (ml)	P – 100 ppm (ml)	W / Zr – 100 ppm (ml)	Final volume (ml)	Final Concentration (µg/L)
S1	NA	NA	0.050	0.025	0.0025	0.025	0.0125	NA	50	0.5/25/50/1
S2	0.025	0.025	0.500	NA	0.025	0.250	0.025	NA		5/250/500/10/50
S3	0.125	0.125	2.5	NA	0.125	NA	0.125	0.0125		25/1250/2500/50/250
S4	0.250	0.250	5.0	NA	0.250	NA	0.250	0.0250		50/2500/5000/100/500

9.3.5. Continuing Calibration Verification (CCV) Standard

9.3.5.1. Prepare CCV using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

Stock Standard	Aliquot (ml)	Final volume (ml)	CCV Final Concentration (µg/ml)
ICAL 1	0.125	50	0.025
ICAL 2	0.125		0.025
Cation Mix	2.500		2.5/1.250
Zn – 10 ppm	0.125		0.050
P	0.125		0.250
Zr	0.0125		0.025
W	0.0125		0.025

9.3.5.2. Prepare intermediate solution for Low Level CCV (LLCCV) using the stock standards and S0 as suggested below. Refer to Table 3 for final concentrations of each analyte.

	Aliquot (ml)	Final volume (ml)	LLCCV Final Concentration (µg/L)
MIX 7A	0.050	50	1.0/100
B – 1 ppm	0.450		9
P – 100 ppm	0.025		50
Sr – 1 ppm	0.050		1
Zn – 10 ppm	0.045		10
Zr – 1 ppm	0.250		5
W – 1 ppm	0.250		5

9.4. **Secondary Source Standard**

9.4.1. Purchase secondary stock standard from a different source as certified standards or equivalent. Refer to list below.

SOURCE	STANDARD	ELEMENTS	CONC. (mg/L)	MATRIX
CPI	EMAX MIX 2	As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Sr, Tl, Ti, V, Zn, Ag, Sb, Mo, Li, U, Sn	10	5% HNO_3 + Tr HF
	EMAX MIX 3	Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3
Phosphorus	CPI	P	1000	0.05% HNO_3
Zirconium	CPI	Zr	100	2% HNO_3
Tungsten	Ultra Scientific	W	10	Water

9.4.2. Secondary Source Working Standard – Prepare a secondary source working standard using S0 as suggested below or equivalent.

Standard	Element	Stock Conc. (mg/L)	Source	Aliquot (ml)	Final Volume (ml)	Final Conc. (mg/L)
Cation Mix 2	Al	10,000	CPI	2.5	500	50
	Ca	10,000	CPI	2.5		50
	Fe	10,000	CPI	2.5		50
	Mg	10,000	CPI	2.5		50
	K	10,000	CPI	2.5		50
	Na	10,000	CPI	1.25		25

9.4.3. Refer to EMAX-QC02 for detailed procedure of standard preparation and labeling.

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV using the secondary stock working standards and S0 as suggested below. Refer to Table 3 for final concentrations for each analyte.

Stock Standard	Aliquot (ml)	Final Volume (ml)	ICV Final conc. (µg/ml)
ICV1	0.150	50	0.030/0.060
Cation Mix 2	3.000		3.000/1.500
P	0.015		0.300
Zr	0.015		0.030
W	0.015		0.030

9.6. **Interference Standards (ICSA/ICSAB)**

9.6.1. Purchase ICS stock standard as mix certified standards at concentration levels listed below.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
6020ICS-0A (ICSA)	Inorganic Ventures	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	
6020ICS-0A + (ICSAB) ICAL 1 + ICAL 2	6020ICS-0A	Al, Ca, Fe, Mg, Na, P, K, S	1000	1.4% HNO_3
		C	2000	
		Cl	10000	
		Mo, Ti	20	
	ICAL 1	As, B, Se, Tl, Ti, V, Zn, Sb, Mo, Sn	10	5% HNO_3 + Tr HF
	ICAL 2	Ba, Be, Cd, Cr, Co, Cu, Pb, Li, Mn, Ni, Ag, U	10	5% HNO_3 + Tr HF

9.6.2. Prepare Intermediate ICSA and ICSAB standards at concentration levels suggested below. Refer to Table 3 final concentrations.

Standard	Parent Standard	Aliquot (ml)	Final Volume (ml)	Final Concentration (mg/L)
Intermediate ICSA	6020ICS-0A	5	50	Varied
Intermediate ICSAB	6020ICS-0A	5	50	Varied
	ICAL 1	0.10		
	ICAL 2	0.10		
	Zr	0.010		
	W	0.010		

9.7. **LCS/MS Spike Standard**

9.7.1. Purchase LCS/MS standards as certified custom-mixed.

STANDARD	SOURCE	ELEMENTS	CONC. (mg/L)	MATRIX
ICV 1	CPI	B, Sr, As, Ba, Be, Ag, Cd, Cr, Co, Cu, Tl, Pb, Mn, Ni, Se, V, Zn, Ti, Sb, Mo, Li, U, Sn	10	5% HNO_3+ Tr HF
ICV 2		Al, Fe, Ca, Mg, K, Na	1000	5% HNO_3
Phosphorus	CPI	P	1000	0.05% HNO_3
Zirconium	CPI	Zr	100	2% HNO_3
Tungsten	High Purity	W	10	Water

9.8. **P/A Tuning Standard**

9.8.1. Using the calibration stock standard from 9.3.1, prepare a 50 µg/L and 100 µg/L mixed standard. These standards should also include 50 µg/L and 100 µg/L of internal standard, which can be prepared by using the internal standard stock from 9.2.1.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Water Samples

10.1.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 samples per preparative batch). Withdraw the sample(s) from the sample control room and bring them to the preparation area. Allow the samples to equilibrate at room temperature.

10.1.1.2. Shake the sample container. Pour a small amount of sample into the sample cap and trickle just enough to wet the pH indicator strip. Compare the color of the wet strip to the indicator chart displayed in the pH indicator box. Record the pH in the digestion log. If the pH value is <2, proceed to 10.1.3. If the pH value is ≥2, check if special instruction is written on the analysis folder or in the COC. Otherwise, fill out an NCR and inform the supervisor immediately. DO NOT PROCEED WITH THE DIGESTION. WAIT FOR FURTHER INSTRUCTION.

10.1.1.3. Line up the samples chronologically under the hood. Check and record the lot number of the digestion vessels if it has been verified for accuracy. Take digestion vessels and label each one corresponding to the samples withdrawn and place them in front of each sample making sure that their labels agree. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.1.4. Mix the sample thoroughly to achieve homogeneity. Fill each digestion vessel up to the 50-ml mark. (The reduction of the volume is due to waste minimization).

10.1.1.5. Record the volume in the digestion log. Use reagent water for blank and LCS.

10.1.1.6. Take another digestion vessel; fill it with tap water to 50 ml mark. Put a thermometer inside and let it sit on the digestion block. Turn the thermostat to a pre-determined mark to deliver heat at 90°C - 95°C. Record the temperature reading in the digestion log.

10.1.1.7. **Standard Addition**

10.1.1.7.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.1.1.7.2. Add 0.125 ml of each from EMAX MIX 2 and 3 (see Section 9.4.1) solutions to matrix spike samples and LCS. If Phosphorus, Zirconium and Tungsten are target analytes, add 0.0125 ml of each standard.

10.1.1.8. **Acid Digestion for Dissolved Metals**

10.1.1.8.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.1.8.2. Cap the digestion vessels with disposable watch glass.

10.1.1.8.3. Check that the temperature of the digestion block is ≈ 95°C (covered vessel) and adjust if necessary.

10.1.1.8.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.1.8.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion plate and allow the vessels to cool down.

10.1.1.8.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.1.8.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new polyethylene container.

10.1.1.9. **Acid Digestion for Total Recoverable Metals**

10.1.1.9.1. Add 0.5 ml of concentrated HNO_3 and 0.25 ml concentrated HCl to each of the digestion vessels.

10.1.1.9.2. Cap the digestion vessels with disposable watch glass.

10.1.1.9.3. Check that the temperature of the digestion block is ≈ 95°C (covered vessel) and adjust if necessary.

10.1.1.9.4. Place the digestion vessels on the digestion block and reduce volume of sample by continuous heating without boiling for two hours.

10.1.1.9.5. Reflux gently for another 15 minutes. Remove the digestion vessels from the digestion block and allow the vessels to cool down.

10.1.1.9.6. Using a reagent water wash bottle, rinse the disposable watch glass collecting the rinsate on the same digestion vessel that it covered. Add 1.0 ml concentration HNO_3 and 0.25 ml concentration HCl for matrix matching.

10.1.1.9.7. Dilute the digestate with reagent water to the 50 ml mark of the digestion vessel. Seal the vessel and shake. If the digestate appears to be turbid, pass it through Whatman #41 filter and collect it in a new

polyethylene container.

10.1.2. Soil Samples

10.1.2.1. **Sample Handling**

10.1.2.1.1. Based from the work order, determine the samples to form a preparative batch (not to exceed 20 field samples). Withdraw the sample(s) from the sample control room designated for metals analysis (passing # 10 sieve) and bring them to the weighing area. Allow the samples to equilibrate at room temperature.

Note: *Sample homogeneity is crucial in metals analysis. If sample is not solely designated for metals analysis (i.e., sample is to be used for other analysis) and it is apparent that sample particles contain > #10 sieve, inform the Supervisor for further instruction.*

10.1.2.1.2. Take digestion vessels and label each one corresponding to the samples withdrawn. Take four more vessels and label them as preparation blank, LCS, matrix spike and matrix spike duplicate.

10.1.2.1.3. Check project sub-sampling requirement. If multi-incremental sub-sampling (MIS) is required, refer to EMAX-SM01, section 5.13.2 for details. Otherwise follow the steps described in EMAX-SM01, section 5.13.1.

10.1.2.1.4. Scoop 1-2 g sub-sample and transfer into a properly labeled digestion vessel. Record the weight to the nearest 0.01 g.

10.1.2.2. **Pre-heating the Digestion Block**

10.1.2.2.1. Place a digestion vessel with reagent water and a temperature monitoring thermometer on the digestion block.

10.1.2.2.2. Turn the digestion block on and set the thermostat to ~95°C or to a predetermined temperature to obtain approximately 95°C once the digestion vessel is covered with a watch glass.

10.1.2.2.3. When the temperature reading is about 90°-95°C, the digestion block is now ready for digestion.

10.1.2.3. **Standard Addition**

10.1.2.3.1. Call for a witness for standard addition. Have the witness verify the setting of the micropipette and the expiration dates of the spike standards.

10.1.2.3.2. Add 2.5 ml of EMAX MIX 2 & 3 (Sec. 9.4.1) to LCS and matrix spike samples. If Phosphorus and Zirconium are target analytes, add 0.25 ml of each standard. If Tungsten is a target analyte, add 0.025 mL of standard.

10.1.2.4. **Acid Digestion**

10.1.2.4.1. Add 10 ml of reagent water and 5 ml of concentrated HCL[1] into each vessel, swirl the vessel to mix the acid and the sample. Add same amount of acid into a clean and empty vessel and designate it as blank. Insert the vessels in the digestion block(s). Cap the vessels with conical watch glass.

10.1.2.4.2. Check the temperature of the digestion block 90°C-95°C, adjust if necessary. If temperature happens to be ≥ 100°C, adjust the thermostat and wait until temperature falls within 90°C-95°C. Record the temperature reading in the digestion log.

10.1.2.4.3. Place the digestion vessels on the digestion block and reflux for 15 minutes without boiling.

10.1.2.4.4. Transfer the vessels into unheated digestion block and allow the vessels to cool down for at least 5 minutes. Lift the watch glass and add 10-mL of concentrated HNO_3. Place the watch glass back before working on the next vessel.

10.1.2.4.5. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.2.4.6. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes. Lift the water glass and add 10 ml 1:1 HNO_3. Place the water glass back before working on the next vessel.

10.1.2.4.7. Return the vessels to the digestion block and reflux for another 15 minutes.

10.1.2.4.8. Transfer the vessels into unheated digestion blocks and allow the vessels to cool down for at least 5 minutes.

10.1.2.4.9. Add 2 ml of reagent water. Then add 3 ml of 30% hydrogen peroxide (H_2O_2) to each vessel, swirling each one of them after every addition to initiate peroxide reaction. Continue to add H_2O_2 until the amount added reaches 10 ml.

10.1.2.4.10. Return the vessels to the heated digestion block. Care must be taken to ensure that losses do not occur due to excessive effervescence.

10.1.2.4.11. Continue to reflux the mixture at 90°C-95°C for 15 minutes. Remove the digestion vessels from the digestion block and allow the vessel to cool down for at least 5 mins.

10.1.2.4.12. Lift the watch glass, add 5 ml of concentrated HCl. Swirl the vessel until added reagents are properly mixed with the solution. Place the watch glass before working on the next vessel. Return the vessels into the heated digestion block. Reflux for additional 15 minutes. Subsequently, remove the digestion vessels from the digestion block and allow the vessels to cool down and dilute to 100 ml final volume with reagent water.

[1] Addition of 5 ml HCl is a modification from Method 3050B to enhance recovery of antimony. Refer to Appendix 3 for the comparative study done on ICP-MS.

10.1.2.4.13. Let the digestate settle and centrifuge or filter with Whatman #41 (see 10.1.5) if necessary otherwise digestates are now ready for analysis.

10.1.2.5. **Digestate Filtration**

10.1.2.5.1. Place Whatman #41 filter paper into each funnel resting on holders. Rinse the filter papers with reagent water.

10.1.2.5.2. Place a pre-labeled digestate container under each funnel making sure that the labels are visible.

10.1.2.5.3. Check the labels to make sure that they agree. Pour the digestate into the filter.

10.1.2.5.4. Filter and collect the digestates in the labeled container. The digestates are now ready for analysis.

10.2. **Instrument Parameters**

10.2.1. Set instrument parameters as suggested below.

10.2.2. Plasma Condition

- RF Power: 1500 W
- RF Matching: 1.68 V
- Sample Depth: 8.0 mm
- Torch Height: -0.4 mm
- Torch Vertical: 0 mm
- Carrier Gas: 0.9 L/min
- Make-up Gas: 0.15 L/min Note: Total Carrier and Make-up gas not to exceed 1.1 L/min.
- Peristaltic pump: 0.1 rps
- Spray Chamber (S/C) Temp: 2°C

10.2.3. Ion Lenses

- Extract 1: 0 V
- Extract 2 : -140V
- Omega Bias-ce: -22 V
- Omega Lens-ce: -1.2 V
- Cell Entrance: -26 V
- QP Focus: 2 V
- Cell Exit: -30 V

10.2.4. Octopole Parameters

- Octopole RF: 150 V
- Octopole Bias: -6 V

10.2.5. Q-Pole Parameters

- AMU Gain: 127
- AMU Offset: 125
- Axis Gain: 0.9996
- Axis Offset: 0.04
- QP Bias: -3 V

10.2.6. Detector Parameters

- Discriminator: 8 mV
- Analog HV: 1630 V
- Pulse HV: 990 V

10.2.7. Reaction Cell

- H_2 Gas: 3.0 ml/min
- He Gas: 4 ml/min

10.2.8. Adjust the instrument parameters to optimize the instrument performance in conformance to the tuning requirement.

10.2.9. Print the most current instrument parameters and place in the appropriate binder for easy reference. Replaced instrument parameter set-up should be archived chronologically for future reference and historical record.

10.3. **Calibration**

10.3.1. Instrument Set-Up

10.3.1.1. Set up the ICP-MS with proper operating parameters. Refer to Section 10.3.

10.3.1.2. Ignite the plasma and allow the instrument to become thermally stable for at least 30 minutes.

10.3.1.3. Check the peristaltic pump to deliver a steady flow.

10.3.2. Tuning the Instrument

10.3.2.1. Tune the instrument according to Normal Mode, Hydrogen Mode and Helium Mode without the internal standard. Refer to Section 10.3 for parameters. On the ICP-MS main Menu, go to Instrument and click Tune and run the tuning solution without the internal standard. After about 60 seconds (making sure the solution is in the system) click start and evaluate the counts of the isotopes according to the table below.

Mode	Range		
Normal	Li6 ≥ 6400 counts	Y89 ≥ 16000 counts	Tl205 ≥ 9600 counts
Hydrogen	Ar/Ar78 < 10	Y89 ≥ 3000 counts	
Helium	V51/Co59 < 0.6	Co59 ≥ 7000 counts	ArCl-75 < 10 counts

10.3.2.2. If non-compliant, adjust parameters (e.g. Torch height, Torch vertical, Octopole Bias and QP Bias) and repeat the tune process until the required range is met.

10.3.2.3. Click Generate report for a full scan of the tune. Save all tune values to the current method.

10.3.3. Perform a P/A Factor Evaluation

10.3.3.1. Analyze the 50 µg/L P/A Tuning Standard.

10.3.3.2. Under "Tune," access "P/A Factor."

10.3.3.3. Select "Load masses from the acquisition method". Select and delete Ca, $(Cd)^{106}$, $(Cd)^{108}$, $(Pb)^{206}$, $(Pb)^{207}$ from the list of elements.

10.3.3.4. Select "run."

10.3.3.5. When complete accept the changes.

10.3.3.6. Print out P/A Factor and store the printout with the tuning data.

10.3.3.7. Accept the new P/A Factors.

10.3.3.8. Under "file" select "copy tune parameters" and copy the P/A Factors to both the H2 and He modes.

10.3.3.9. Save file as "norm.u".

10.3.4. Perform Tune Check

10.3.4.1. Analyze the intermediate tune check solution (9.1.1) using 4 replicates.

10.3.4.2. Evaluate the tune check so that the mass calibration differs no more than 0.1 AMU of the true value and the resolution to be less than 0.9 AMU full width at 10% peak height RSD should less than or equal to 5% for the 4 replicate analysis.

10.3.5. Initial Calibration (ICAL)

10.3.5.1. Analyze a calibration blank (S0) and a multi-point calibration standard (Section 9.3.3.1).

10.3.5.2. Set the instrument rinse time to 90 seconds between each standard solution.

10.3.5.3. Refer to Appendix 1 for ICAL acceptance criteria and /or corrective action.

10.3.6. Initial Calibration Verification (ICV)/ Instrument Calibration Blank (ICB)

10.3.6.1. Analyze the ICV (Section 9.5.1) from a second source to verify the concentration of the ICAL.

10.3.6.2. Analyze a low-level ICV (LLICV) from the same source as the calibration standard to verify the lower limit of quantitation (RL).

10.3.6.3. Analyze an ICB after LLICV to demonstrate absence of instrument contamination.

10.3.6.4. Refer to Appendix 1 for ICV, LLICVand ICB acceptance criteria and /or corrective action.

10.3.7. Continuing Calibration Verification (CCV)/ Continuing Calibration Blank (CCB)

10.3.7.1. Analyze CCV to check the validity of the ICAL every 10 samples and at the end of the analytical sequence.

10.3.7.2. Analyze low-level CCV (LLCCV) to check the system stability at low end of ICAL at the end of the analytical sequence.

10.3.7.3. Analyze a CCB every after LLCCV to demonstrate the absence of instrument contamination.

10.3.7.4. Refer to Appendix 1 for CCV, LLCCV and CCB acceptance criteria and/or corrective action.

10.3.8. ICSA and ICSAB

10.3.8.1. Analyze ICSA and ICSAB at the beginning of each analytical run and every 12 hours thereafter**.**

10.3.9. Establishing Instrument Detection Limit (IDL)

10.3.9.1. Analyze a minimum of seven consecutive method blanks.

10.3.9.2. Repeat the process within three non-consecutive days.

10.3.9.3. Calculate the standard deviation of each run.

10.3.9.4. The average of the standard deviation of the three runs determines the IDL for each analyte.

10.3.9.5. Establish IDL at least every 3 months.

10.3.10. Verifying Linear Dynamic Range (LDR)

10.3.10.1. Verify the LDR by preparing a standard at the upper limit of the LDR. Analyze and quantitate against the normal calibration curve. Percent recovery must be within ± 10% of expected value. If non-complaint re-establish LDR.

10.3.10.2. At a minimum perform LDR verification every six months.

10.4. **Analysis**

10.4.1. Analytical Sequence

10.4.1.1. From the main menu of the ICPMS top window, go to Sequence and create the analytical sequence by editing the sample log table. Refer to Table 4.

10.4.1.2. Set QC limits on QC samples for easy verification while analytical samples are running.

10.4.1.3. Using the sample log table, input the standards and the digestates to be analyzed. Samples are analyzed in the order they appear in the scanner.

10.4.1.4. Transfer about 5 ml of its content into the autosampler tubes placing them on the autosampler rack in the same order as the analytical sequence. A dilution of x10 for soil samples is required due to the high acid content of the digestate.

10.4.1.5. Dilution Test sample is prepared at 5 times dilution. Seal the tube with Parafilm and invert the tube several times to ensure adequate mixing.

10.4.1.6. Prepare a Post Digestion Spike test sample. Using the un-spiked sample digestate (preferably the QC sample), add MS standard to maintain the same spike level as the MS sample digestate.

10.4.1.7. A 100 µg/L internal standard shall be spiked into each sample.

10.4.1.8. Set the prepared analytical samples into the auto-sampler and start the analytical run.

10.4.2. Sample Result Evaluation

10.4.2.1. Check QC parameters as soon as the data is available.

- Check the initial calibration verification (ICV, LLICV and ICB) against Appendix 1.
- Check MB, LCS against Appendix 1. Perform specified corrective action if necessary.
- Check the MS, duplicate sample, serial dilution and post digestion spike results. If matrix interference is indicated, dilute the sample and re-analyzed.
- Check intensity of internal standard on each sample.
- If any of the above checkpoints is non-compliant, perform the specified corrective action in Appendix 1. If results indicate digestion problem, order re-digestion for affected samples. If unresolved, consult the Supervisor for further action.

10.4.2.2. Check the sample rack to ensure that the Autosampler did not skip any sample.

10.4.2.3. Check concentration of target analytes. If the response exceeds LDR, dilute and reanalyze the sample at a concentration within the LDR.

10.4.2.4. Check other QC requirements like ICSA, ICSAB, CCV, LLCCV, CCB against Appendix 1.

10.5. **Calculations**

10.5.1. The computer software is designed to calculate the concentration in the digestate, based on the assumption that the initial calibration is linear through the origin. Thus, for aqueous samples, the computer-generated result represent the concentration of the sample.

10.5.2. For water samples

$$C_s = C_i\left(\frac{ExpAmt}{Aliquot}\right)\left(\frac{Vd}{ExpVd}\right)DF \qquad \text{Eq.-10.5.2}$$

where:

C_s – Concentration in the sample, µg/L

C_i – Concentration in the digestate, (computer-generated), µg/L

V_d – Digestion volume, ml

ExpVd – Expected digestion volume, ml

DF – Dilution factor

ExpAmt – Expected amount for digestion, ml

Aliquot – Amount digested, ml

10.5.3. For solids, use the following equation to calculate the concentration

$$Cs = C_i\left(\frac{ExpAmt}{Aliquot}\right)\left(\frac{V_d}{ExpVd}\right)\left(\frac{100}{100-\%H_2O}\right)\times DF\times 0.1 \qquad \text{Eq.-10.5.3}$$

where:

C_s – Concentration in the sample, mg/Kg

C_l – Concentration in the digestate (computer-generated), µg/L

V_d – Digestion volume, ml

ExpVd – Expected digestion volume, ml

ExpAmt – Expected amount for digestion, g

Aliquot – Amount digested, g

$\% H_2O$ – Percent moisture of the sample

DF – Dilution factor

0.1 – Conversion factor

10.5.4. Calculate the percent recovery (%R)

$$\% \ Recovery = \frac{Cf - C}{Cs} * 100 \qquad \text{Eq.-10.5.4}$$

where:

C_f – Concentration found, µg/ L

C – Concentration of sample, µg/L

C_s – Concentration of spike, µg/L

10.5.5. Relative Percent Difference (%RPD)

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.5}$$

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Make a copy of the analytical run log and sample preparation log.

10.6.2. Highlight the data to be reported.

10.6.3. Print a copy of the raw data and the QC report.

10.6.4. Keep all other data generated with the analytical folder marked with “For record only” for traceability purpose.

10.7. **Report Generation**

10.7.1. Print the summary of the analytical run, perform a data transfer into a disk, and convert the instrument electronic output file into a CSV file format.

10.7.2. Run the ICPCHK.exe program for calibration check.

10.7.3. Identify samples that need to be re-analyzed, if any, and report all samples that met the analytical requirements.

10.7.4. Generate the report using the following reporting program:

Executable Files	Required Support Files	Output
WDBX[2].exe	Login File (requires network), project.pln, seq_name.sq, seq_name.ckv, seq_name.ckb, seq_name.csv, seq_name.qck, EXCLCMP.LST	Method.txt [this file integrates the login sample information and the analytical sample information]
IF1VX.exe	method.txt, method.met, method.crf, project.pln, project code.txt, qcell.txt	Sample Results (Form1)
IQCICP.exe	method.txt, method.crf, method.qc, project.pln, project code.txt, qcell.txt	QC Summary for LCS and MS (Form 3)
QCX.exe	method.txt, method.crf, method.qc, project.pln, qcell.txt	Summary for Dilution Test (Form 3)
LABCHRNX.exe	method.txt	Lab Chronicle
CN2.exe	Login File, method.txt, Form 1, Form 3	Case Narrative

10.7. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below.

- Case Narrative
- Lab Chronicle
- Sample Results
- LCS/LCSD Summary
- MS/MSD Summary
- Sample Duplicate Summary
- Analytical Run Log
- ICAL Summary
- ICV Summary
- CCV Summary

X[2] – latest program version

- Sample Preparation Log
- Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- Review the ICPCHK.exe output file to ensure that it agrees with the instrument output. Check Project Specific Requirement (PSR) or Appendix 1 for acceptance criteria.
- Check frequency of calibration verification. Verify results to be within acceptance limits.
- Check of target analytes concentration to be within linear range.
- Verify interference check results to be within acceptance limits.

10.8.3. If any of the above checkpoints is non-compliant, re-analysis is required.

10.8.4. Review the attached logs that they are properly filled.

10.8.5. Check the generated reports against the raw data. Check that the analytical data generated indicating positive results are qualitatively and quantitatively correct.

10.8.6. Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.7. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Instruments shall receive routine preventive maintenance that is properly recorded in the instrument-specific maintenance logs. The list of maintenance is summarized in Form 6020FM. The practice ensures optimum operating condition of the equipment thus reducing the possibility of frequent instrument malfunction.

Maintenance Activity	Description	Frequency
Verification	Verify instrument parameters to ensure normal operating conditions. Change tubings as necessary. Perform system tune check. Check instrument performance (e.g., ICV/ICB)	Daily prior to analysis
Vacuum System Maintenance	Inspect vacuum hoses and exhaust tubes for possible problems. Check pump for evidence of leakage	Daily prior to analysis
Documentation	Record all instrument maintenance performed in the instrument maintenance log.	Daily prior to analysis
Ion Lens Cleaning	Remove and clean surfaces of the ion lens. Sonicate ion lens parts	As necessary
System Cleaning	Remove covers and clean dust from fans and vent covers	Every 6 months or as necessary
Pump Maintenance	Replace oil mist filter, drain and replace mechanical pump oil. Verify proper	Every 6 months

	pump operation	
Inspection	Perform general inspection of the complete system	Once a year

11.0 QUALITY CONTROL

11.1. Sample Preparation QC

11.1.1. All labwares used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.1.2. A preparative batch consists of 20 or fewer samples of the same matrix that are prepared for analysis simultaneously or sequentially, using the same lots of all reagents.

11.1.3. Every preparative batch shall have at least one method blank, one LCS and a set of MS/MSD unless otherwise specified by the project. These QC samples shall be digested together with the field samples.

11.1.4. All reagents shall be subjected to QC check prior to its use. Refer to EMAX-QC01 for details.

11.2. Sample Analysis QC

11.2.1. Perform a tune check before every analytical run, an initial calibration and initial calibration verification (ICV / LLICV). Obtain the ICV standard from a different source from that of the initial calibration and LLICV from the same source as the ICAL. Analyze an instrument calibration blank (ICB) after the LLICV. No further analysis shall be valid unless acceptance criteria are met.

11.2.2. Monitor the intensities of all internal standards for every analysis. Refer to Appendix 1 for acceptance criteria.

11.2.3. Verify inter-element and background correction factors with ICSA and ICSAB standards after ICB every 12 hours.

11.2.4. Verify calibration with continuing calibration verification (CCV) standard and continuing calibration blank (CCB) after every ten samples and at the end of the analytical run. Also verify LLCCV at the end of the analytical run.

11.2.5. Evaluate results of MS/MSD to document matrix interference.

11.2.6. Perform Post Digestion Spike whenever recoveries for MS/MSD failed.

11.2.7. Evaluate Dilution Test result if post digestion spike result failed to meet the acceptance criteria. Failure typically happens when analyte concentrations are high.

11.2.8. Refer to Appendix 1 for acceptance criteria.

11.3. Method QC

11.3.1. A valid DL and LOD must exist prior to sample analysis. Refer to EMAX-QA04 for details.

11.3.2. Perform dynamic range study at least every six months or whenever there is a significant change in instrument response unless otherwise specified by the project.

11.3.3. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05.

12.0 CORRECTIVE ACTION

12.1. Quality control procedures and corresponding corrective actions are summarized in Appendix 1.

12.2. If tune is non-compliant, consider the following suggestions to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check argon gas flow.
- Perform auto tune or visual optimization
- If the problem persists, inform the Supervisor.

12.3. If correlation coefficient (R) of ICAL is non-compliant, consider the following suggestions to help you correct the problem:

- Check the calibration points for possible presence of out-lier. If out-lier is present, prepare a fresh standard and repeat the calibration.
- Check the connections and make sure that they are air-tight. Perform maintenance as needed.
  - Presence of bubbles is indicative of poor connection between the sipper and the nebulizer.
  - Poor precision to inability to light the plasma is a symptom of a poor drain tube connection
  - Poor precision and carry-over problems are indicative of a dirty spray chamber.
  - Relative increase in the sensitivity ratio of the higher: lower atomic number elements are indicative of stretched pump tubing. The sample flow rate decreases as the tubing stretches.
- Check the argon gas flow. Loss of signal is indicative of low or no argon gas flow.
- Poor precision and a gradual loss of signal is indicative of “salting-out” in the nebulizer and/or spray chamber due to samples with high dissolved or suspended solids. This problem will necessitate nebulizer and spray chamber cleaning.
- If the problem persists, inform the Supervisor.

12.4. If ICV is non-compliant, consider the following suggestions to help you correct the problem:

- If the RSD is high it is indicative that the carry-over might be present in the spray chamber.
- If result is bias high, prepare a fresh standards and repeat calibration.
- If the problem persists, inform the Supervisor.

12.5. If ICB/CCB is non-compliant, consider the following suggestions to correct the problem:

- Prepare a fresh calibration blank solution. Perform instrument rinsing and repeat the ICB/CCB prior to re-analysis of associated sample(s).
- Carry-over problem is indicative of dirty spray chamber, nebulizer and/or torch. Perform instrument maintenance and repeat the calibration.
- If the problem persists, inform the Supervisor.

12.6. If CCV or LLICV or LLCCV is non-compliant, consider the following suggestions to correct the problem:

- Check the connections prior to re-running the ICAL. Refer to Section 12.3.
- Prepare a new standard and repeat the ICAL.

12.7. If the intensity of the Internal Standard is non-compliant, consider the following suggestions to correct the problem:

- Check for drift occurrence by observing the internal standard intensities in the calibration blank.
- If drift has occurred, terminate the analysis, recalibrate, verify the new calibration and reanalyze the affected samples.
- If drift has not occurred, dilute affected samples five fold and reanalyze with the addition of appropriate amounts of internal standards.

12.8. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

- Rule-out instrument contamination by checking the CCBs. Refer to Section 12.5.
- Rule-out reagent contamination by testing each reagent as described in EMAX-QC01.
- Rule-out digestate vessel contamination by adding verified reagents heating the vessels prior to testing.
  - Common environmental contaminants – Ca, Si, Fe, Na, Mg, K, Tl, Cu, Mn, can be minimized by maintaining the lab clean.
- Other sources of contamination:
  - Sweat contains Ca, Mg, Pb, K, NH_4^+ , SO_4^{-2}, PO_4^{-3}, and Cd (for those who smoke).
  - Cosmetics can contain high concentrations of Al, Be, Ca, Cu, Cr, K, Fe, Mn, Ti, and Zn.
  - Some hair dyes contain $Pb(OAC)_2$.
  - Dandruff shampoo can contain significant levels of Se.
  - Eye make-up may contain Hg as a preservative.
  - Calamine lotion is almost pure ZnO.
  - Watches and jewelry contain an assortment of elements and should not be worn in the laboratory.
- Re-digest MB and the associated samples with reagents free of contamination or with newly opened reagents.
- If the problem persists, inform the Supervisor.

12.9. If LCS is non-compliant, consider the following suggestions to correct the problem:

- If result is bias-high, check the LCS standard by analyzing at the spike level.

  If the LCS check is within 80-120 % of the expected value, check the calibration of the micropipette use for spiking. Re-digest and re-analyze the LCS and the associated samples.

  If the LCS check is not within 80-120%, prepare a fresh LCS standard, re-digest and re-analyze LCS and the associated samples.
- Common Problems with Ag, As, Ba, Pb, and Cr, indicating stock standard degradation, are as follows:

  Low Silver (Ag) recovery is indicative of Chloride contamination causing AgCl precipitation

  Low Arsenic (As) recovery is indicative of loss during sample preparation as volatile oxides (AsO_3) or precipitation as $AsCl_3$

  Low Barium (Ba) recovery is indicative of SO_4or CrO_4 contamination. Barium will form precipitates with HF and H_2SO_4.

High Lead (Pb) recovery is indicative of environmental contamination.

12.10. A Non-Conformance Report (NCR) is required when the following circumstances occur:

- Anomalies other than those specified in Appendix 1 are observed.
- Sample is out of technical holding time.

12.10.1. Refer to EMAX-QA08 for NCR details.

13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standards in fume hoods.

14.0 WASTE MANAGEMENT

14.1. No sample may be dumped in the laboratory sink.

14.2. Separate and properly identify all unused and expired analytical standards for proper disposal.

14.3. Place all waste generated during the analytical process in properly labeled satellite waste containers for proper collection.

14.4. Dispose all unused samples, digestates, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1 **Preparation Batch** - is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.1 **Analytical batch -** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Detection Limit (DL) – The lowest concentration or amount of the target analyte that can be identified, measured and reported with confidence that the analyte concentration is not a false positive.

15.1.3. Limit of Detection (LOD) – An estimate of the minimum amount of substance that an analytical process can reliably detect.

15.1.4. Limit of Quantitation (LOQ) – The minimum levels, concentrations or quantities of target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

15.1.5. Safety Data Sheet (SDS) – is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.6. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.7. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.8. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.9. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical procedure to monitor contamination.

15.1.10. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.11. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.12. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.13. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.14. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.15. Matrix – is a physical state of a sample. Most of environmental samples are classified as water, soil or air.

15.1.16. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.17. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.18. Re-analysis – is a repeated analysis from the same extract/digestate or sample, identified with the Lab Sample ID suffixed with "W".

15.1.19. Re-extract/digest – is a repeated sample preparation process identified with the Lab Sample ID suffixed with "R".

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing metals analysis. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Update IV, Method 6020A.

16.2. Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, Method 200.8 Rev. 5.4, 1994.

16.3. USEPA SW846, Method 3050B, Revision 2, December 1996.

16.4. Title 40 Code of Federal Regulations, Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants, latest edition.

16.5. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. **Tables**

17.1.1. Table 1 ICP-MS Elements & Isotopes

17.1.2. Table 2 Calibration Standard and Verification Preparation

17.1.3. Table 3 Calibration Standards Concentration and Reporting Limit

17.1.4. Table 4 ICP-MS Analytical Sequence

17.1.5. Table 5 DL, LOD, LOQ and Linear Range Concentration Levels

17.2. **Figures**

17.2.1. Figure 1 Typical Sample Report

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17.2.3. Figure 3 Typical MS/MSD Summary

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17.3. **Appendices**

17.3.1. Appendix 1 Summary of Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.3.3. Appendix 3 Comparative Study of Modified 3050B

17.4. **Forms**

17.4.1. 6020FS Sample Preparation Log

17.4.2. 6020FA Analytical Run Log

17.4.3. 6020FM Instrument Maintenance Log

Table 1: ICP-MS ELEMENTS & ISOTOPES

ELEMENT	SYMBOL	MASS	Tune Mode	Internal Standard
Aluminum	Al	27	3	Sc45
Antimony	Sb	121	3	In115
Arsenic	As	75	2	Ge72
Barium	Ba	137	3	In115
Beryllium	Be	9	3	Li6
Boron	B	11	3	Li6
Cadmium	Cd	111	3	In115
Calcium	Ca	43	1	Sc45
Chromium	Cr	53	2	Sc45
Cobalt	Co	59	3	Sc45
Copper	Cu	63	2	Sc45
Iron	Fe	57	1	Sc45
Lead	Pb	208	3	Tb159
Lithium	Li	7	3	Li6
Magnesium	Mg	24	3	Sc45
Manganese	Mn	55	3	Sc45
Molybdenum	Mo	95	3	In115
Nickel	Ni	60	2	Sc45
Phosphorus	P	31	3	Sc45
Potassium	K	39	3	Sc45
Selenium	Se	78	1	Ge72
Silver	Ag	107	3	In115
Sodium	Na	23	1	Sc45
Strontium	Sr	88	3	Y89
Thallium	Tl	205	3	Tb159
Tin	Sn	118	3	In115
Titanium	Ti	47	3	Sc45
Tungsten	W	182	3	Tb159
Uranium	U	238	3	Tb159
Vanadium	V	50	2	Sc45
Zinc	Zn	66	3	Ge72
Zirconium	Zr	90	3	Ge72

Tune Mode: 1=Reaction H_2 Mode; 2=Collision He Mode; 3= Normal Mode

Table 2 : CALIBRATION STANDARD AND VERIFICATION PREPARATION

Standard #	Mixed Standard Name	Conc. (µg/ml)	Source	Preparation		
				Aliquot (ml)	Final Vol. (ml)	Final Conc. (µg/ml)
S1	Trace Mix	1	High Purity	0.025	50	0.0005
	Cation Mix	50/25	AccuStandard	0.050		0.050/0.025
	Zn	10	High Purity	0.0025		0.001
	W	1	AccuStandard	0.025		0.0005
	P	100	AccuStandard	0.0125		0.025
	Zr	1	AccuStandard	0.025		0.0005
S2	ICAL 1	10	High Purity	0.025	50	0.005
	ICAL 2	10	High Purity	0.025		0.005
	Cation Mix	50/25	AccuStandard	0.500		0.500/0.250
	Zn	10	High Purity	0.025		0.010
	W	1	AccuStandard	0.250		0.005
	P	100	AccuStandard	0.025		0.050
	Zr	1	AccuStandart	0.250		0.005
S3	ICAL 1	10	High Purity	0.125	50	0.025
	ICAL 2	10	High Purity	0.125		0.025
	Cation Mix	50/25	AccuStandard	2.500		2.500/1.250
	Zn	10	High Purity	0.125		0.050
	W	100	AccuStandard	0.0125		0.025
	P	100	AccuStandard	0.125		0.250
	Zr	100	AccuStandard	0.0125		0.025
S4	ICAL 1	10	High Purity	0.250	50	0.050
	ICAL 2	10	High Purity	0.250		0.050
	Cation Mix	50/25	AccuStandard	5.000		5.000/2.500
	Zn	10	High Purity	0.250		0.100
	W	100	AccuStandard	0.025		0.050
	P	100	AccuStandard	0.250		0.500
	Zr	100	AccuStandard	0.025		0.050
ICV	ICV 1	10	CPI	0.150	50	0.030/0.060
	Cation Mix 2	50/25	CPI	3.000		3.000/1.500
	W	10	Ultra Scientific	0.150		0.030
	P	1000	CPI	0.015		0.300
	Zr	100	CPI	0.015		0.030
CCV	ICAL 1	10	High Purity	0.125	50	0.025
	ICAL 2	10	High Purity	0.125		0.025
	Cation Mix	50/25	AccuStandard	2.500		2.500/1.250
	W	100	AccuStandard	0.0125		0.025
	Zn	10	High Purity	0.125		0.050
	P	100	AccuStandard	0.125		0.250
	Zr	100	AccuStandard	0.0125		0.025
LLICV / LLCCV (water)	Mix 7	1/100	High Purity	0.05	50	0.001/0.1
	Zn	10	AccuStandard	0.045		0.01
	W	1	AccuStandard	0.100		0.002
	P	100	AccuStandard	0.025		0.050
	Zr	1	AccuStandard	0.25		0.005
LLICV / LLCCV (soil)	Mix 7	1/100	High Purity	0.025	50	0.0005/0.05
	Zn	10	AccuStandard	0.0025		0.001
	W	1	AccuStandard	0.100		0.002
	P	100	AccuStandard	0.025		0.050
	Zr	1	AccuStandard	0.250		0.005

Table 3: CALIBRATION STANDARDS CONCENTRATION AND REPORTING LIMIT

ELEMENT	ICAL (µg/L)				ICV (µg/L)	CCV (µg/L)	ICSA (µg/L)	ICSAB (µg/L)	LLICV,LLCCV, LOQ (Water) (µg/L)	LLICV,LLCCV, LOQ (Soil) (mg/Kg)
	S1	S2	S3	S4						
Aluminum	50	500	2500	5000	3000	2500	100000	100000	100	100
Antimony	0.5	5	25	50	30	25	0	20	1	0.5
Arsenic	0.5	5	25	50	30	25	0	20	1	0.5
Barium	0.5	5	25	50	30	25	0	20	1	0.5
Beryllium	0.5	5	25	50	30	25	0	20	1	0.5
Boron	0.5	5	25	50	30	25	0	200	10	10
Cadmium	0.5	5	25	50	30	25	0	20	1	0.5
Calcium	50	500	2500	5000	3000	2500	100000	100000	100	100
Chromium	0.5	5	25	50	30	25	0	20	1	0.5
Cobalt	0.5	5	25	50	30	25	0	20	1	0.5
Copper	0.5	5	25	50	30	25	0	20	1	0.5
Iron	50	500	2500	5000	3000	2500	100000	100000	100	100
Lead	0.5	5	25	50	30	25	0	20	1	0.5
Lithium	0.5	5	25	50	30	25	0	20	2	0.5
Magnesium	50	500	2500	5000	3000	2500	100000	100000	100	100
Manganese	0.5	5	25	50	30	25	0	20	1	0.5
Molybdenum	0.5	5	25	50	30	25	2000	2000	2	0.5
Nickel	0.5	5	25	50	30	25	0	20	1	0.5
Phosphorus	25	50	250	500	300	250	100000	100000	50	50
Potassium	50	500	2500	5000	3000	2500	100000	100000	100	100
Selenium	0.5	5	25	50	30	25	0	20	1	0.5
Silver	0.5	5	25	50	30	25	0	20	1	0.5
Sodium	25	500	2500	5000	3000	2500	100000	100000	100	100
Strontium	0.5	5	25	50	30	25	0	20	2	0.5
Thallium	0.5	5	25	50	30	25	0	20	1	0.5
Tin	0.5	5	25	50	30	25	0	20	1	20
Titanium	0.5	5	25	50	30	25	2000	2000	2	0.5
Uranium	0.5	5	25	50	30	25	0	20	1	0.5
Vanadium	0.5	5	25	50	30	25	0	20	1	0.5
Zinc	1	10	50	1000	60	50	0	20	20	2
Zirconium	0. 5	5	25	50	30	25	0	20	5	5
Tungsten	0.5	5	25	50	30	25	0	20	2	2

Table 4: ICP-MS ANALYTICAL SEQUENCE

RUN ID LABEL	SAMPLE DESCRIPTION	SOLUTION ID LABEL
S0	Calibration Standard 1 (blank)	S0
S3, S4, S5	ICAL Standards	S3, S4, S5
ICV	Initial Calibration Verification	ICV
LLICV	Low Level Initial Calibration Verification	LLICV
ICB	Initial Calibration Blank	ICB
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution A and B	ICSAB
CCV1	Continuing Calibration Verification #1	CCV
CCB1	Continuing Calibration Blank #1	S0
IMSSSSB[3]	Preparation Blank	
IMSSSSL/C	Lab Control Sample	
Sample 1	Sample 1	
Sample 1M	Sample 1 Matrix Spike	
Sample 1S	Sample 1 Matrix Spike Duplicate	
Sample 1J	Sample 1 Serial Dilution(5x dilution sample 1)	
Sample 1A	Sample 1 Post Digestion spike	
Samples 2 to 4	Sample 2 to Sample 5	
CCV2	Continuing Calibration Verification #2	CCV
CCB2	Continuing Calibration Blank #2	S0
Samples 5 to 14	Maximum of 10 Samples	
CCV3	Continuing Calibration Verification #3	CCV
CCB3	Continuing Calibration Blank #3	S0
Samples 15 to 20	Sample 15 to 20 or a maximum of 10 samples (sample 15 to 24)	
ICSA	Initial Interference Solution A	ICSA
ICSAB	Initial Interference Solution B	ICSAB
CCV4	Continuing Calibration Verification #4	CCV
LLCCV	Low Level Continuing Calibration Verification	LLCCV
CCB4	Continuing Calibration Blank #4	S0

[3] where IMSSSS is the digestion batch reference.

Table 5: DL, LOD, LOQ AND LINEAR RANGE CONCENTRATION LEVELS

ELEMENT	WATER (µg/L)			SOIL (mg/kg)			LINEAR RANGE µg/L
	DL	LOD	LOQ	DL	LOD	LOQ	
Aluminum	10	20	100	5	10	100	125000
Antimony	0.25	0.5	1	0.1	0.2	0.5	3000
Arsenic	0.1	0.2	1	0.05	0.1	0.5	3000
Barium	0.25	0.5	1	0.072	0.1	0.5	3000
Beryllium	0.05	0.1	1	0.05	0.1	0.5	500
Boron	2.5	5	10	2.5	5	10	250
Cadmium	0.1	0.2	1	0.057	0.1	0.5	3000
Calcium	13	25	100	17	20	100	400000
Chromium	0.1	0.2	1	0.05	0.1	0.5	3000
Cobalt	0.1	0.2	1	0.05	0.1	0.5	3000
Copper	0.25	0.5	1	0.1	0.2	0.5	3000
Iron	5	10	100	5	10	100	300000
Lead	0.05	0.1	1	0.05	0.1	0.5	3000
Lithium	0.25	0.5	2	0.139	0.2	0.5	500
Magnesium	5	10	100	10	20	100	150000
Manganese	0.1	0.2	1	0.153	0.2	0.5	3000
Molybdenum	0.25	0.5	2	0.1	0.2	0.5	3000
Nickel	0.1	0.2	1	0.063	0.1	0.5	3000
Potassium	10	20	100	10	20	100	400000
Phosphorus	12.5	25	50	12.5	25	50	400000
Selenium	0.15	0.3	1	0.05	0.1	0.5	3000
Silver	0.1	0.2	1	0.05	0.1	0.5	250
Sodium	25	50	100	10	20	100	300000
Strontium	0.5	1	2	0.05	0.1	0.5	3000
Thallium	0.1	0.2	1	0.05	0.1	0.5	3000
Tin	0.1	0.2	1	5	10	20	3000
Titanium	0.25	0.5	2	0.125	0.25	0.5	3000
Tungsten	0.5	1	2	0.5	1	2	1000
Uranium	0.05	0.1	1	0.05	0.1	0.5	3000
Vanadium	0.25	0.5	1	0.19	0.3	0.5	3000
Zinc	5	10	20	0.683	1	2	3000
Zirconium	1	2	5	1	2	5	2000

Figure 1: **TYPICAL SAMPLE REPORT**

METHOD 6020A
METALS BY ICP-MS

Client	: XYZ, INC.	Date Collected:	11/17/10
Project	: CLEAN PROJECT	Date Received:	11/19/10
SDG NO.	: 10K283	Date Extracted:	11/30/10 17:15
Sample ID:	YWB10-2578	Date Analyzed:	12/03/10 18:05
Lab Samp ID:	K283-10	Dilution Factor:	0.991
Lab File ID:	98L04043	Matrix :	SOIL
Ext Btch ID:	IMK029S	% Moisture :	11.6
Calib. Ref.:	98L04035	Instrument ID :	EMAXTI98

PARAMETERS	RESULTS (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Aluminum	18000	112	22.4
Antimony	ND	0.561	0.112
Arsenic	2.03	0.561	0.112
Barium	51.9	0.561	0.112
Beryllium	0.344J	0.561	0.112
Cadmium	ND	0.336	0.112
Calcium	618	112	22.4
Chromium	5.01	0.561	0.112
Cobalt	3.29	0.561	0.112
Copper	3.12	0.561	0.224
Iron	13300	112	22.4
Lead	4.34	0.561	0.112
Magnesium	2750	112	22.4
Manganese	227	0.561	0.112
Molybdenum	1.24	0.561	0.112
Nickel	3.33	0.561	0.112
Potassium	2050	112	22.4
Selenium	0.188J	0.561	0.112
Silver	ND	0.561	0.112
Sodium	ND	112	22.4
Thallium	0.236J	0.561	0.112
Vanadium	30.0	0.561	0.112
Zinc	28.9	1.12	0.561

Figure 2: **TYPICAL LCS/LCD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	NA
DILTN FACTR:	1	1	1		
SAMPLE ID:	MBLK1S				
CONTROL NO.:	IMK029SB	IMK029SL	IMK029SC		
LAB FILE ID:	98L04037	98L04038	98L04039		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	NA
DATIME ANALYZD:	12/03/1017:41	12/03/1017:45	12/03/1017:49	DATE RECEIVED:	11/30/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	BLNK RSLT mg/kg	SPIKE AMT mg/kg	BS RSLT mg/kg	BS % REC	SPIKE AMT mg/kg	BSD RSLT mg/kg	BSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	ND	2500	2370	95	2500	2400	96	1	80-120	20
Antimony	ND	25.0	23.7	95	25.0	23.8	95	1	80-120	20
Arsenic	ND	25.0	23.8	95	25.0	23.5	94	1	80-120	20
Barium	ND	25.0	24.2	97	25.0	24.6	98	2	80-120	20
Beryllium	ND	25.0	23.8	95	25.0	23.9	96	1	80-120	20
Cadmium	ND	25.0	23.5	94	25.0	23.8	95	1	80-120	20
Calcium	ND	2500	2490	99	2500	2490	99	0	80-120	20
Chromium	ND	25.0	24.4	98	25.0	24.7	99	1	80-120	20
Cobalt	ND	25.0	23.8	95	25.0	24.1	96	1	80-120	20
Copper	ND	25.0	24.2	97	25.0	24.4	98	1	80-120	20
Iron	ND	2500	2440	98	2500	2450	98	0	80-120	20
Lead	ND	25.0	24.5	98	25.0	24.4	97	0	80-120	20
Magnesium	ND	2500	2370	95	2500	2390	95	1	80-120	20
Manganese	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Molybdenum	ND	25.0	24.2	97	25.0	24.2	97	0	80-120	20
Nickel	ND	25.0	24.3	97	25.0	24.6	98	1	80-120	20
Potassium	ND	2500	2440	98	2500	2450	98	0	80-120	20
Selenium	ND	25.0	23.8	95	25.0	23.9	95	0	80-120	20
Silver	ND	25.0	23.6	94	25.0	23.9	96	1	80-120	20
Sodium	ND	2500	2460	98	2500	2440	98	1	80-120	20
Thallium	ND	25.0	23.8	95	25.0	24.0	96	1	80-120	20
Vanadium	ND	25.0	24.3	97	25.0	24.5	98	1	80-120	20
Zinc	ND	25.0	25.0	100	25.0	24.7	99	1	80-120	20

Figure 3: TYPICAL MS/MSD SUMMARY

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
SDG NO.: 10K283
METHOD: METHOD 6020A

MATRIX:	SOIL			% MOISTURE:	11.6
DILTN FACTR:	0.991	0.992	0.992		
SAMPLE ID:	YWB10-2578				
CONTROL NO.:	K283-10	K283-10M	K283-10S		
LAB FILE ID:	98L04043	98L04040	98L04041		
DATIME EXTRCTD:	11/30/1017:15	11/30/1017:15	11/30/1017:15	DATE COLLECTED:	11/17/10
DATIME ANALYZD:	12/03/1018:05	12/03/1017:53	12/03/1017:57	DATE RECEIVED:	11/19/10
PREP. BATCH:	IMK029S	IMK029S	IMK029S		
CALIB. REF:	98L04035	98L04035	98L04035		

ACCESSION:

PARAMETER	SMPL RSLT mg/kg	SPIKE AMT mg/kg	MS RSLT mg/kg	MS % REC	SPIKE AMT mg/kg	MSD RSLT mg/kg	MSD % REC	RPD %	QC LIMIT %	MAX RPD %
Aluminum	18000	2810	21900	139*	2810	23200	187*	6	80-120	20
Antimony	ND	28.1	23.5	84	28.1	24.5	87	4	80-120	20
Arsenic	2.03	28.1	26.7	88	28.1	27.9	92	5	80-120	20
Barium	51.9	28.1	84.3	116	28.1	90.1	136*	7	80-120	20
Beryllium	0.344J	28.1	26.5	93	28.1	27.0	95	2	80-120	20
Cadmium	ND	28.1	25.8	92	28.1	26.8	95	3	80-120	20
Calcium	618	2810	3330	97	2810	3360	98	1	80-120	20
Chromium	5.01	28.1	31.4	94	28.1	33.1	100	5	80-120	20
Cobalt	3.29	28.1	28.5	90	28.1	29.5	93	3	80-120	20
Copper	3.12	28.1	28.6	91	28.1	29.7	95	4	80-120	20
Iron	13300	2810	17000	131*	2810	18300	176*	7	80-120	20
Lead	4.34	28.1	30.8	94	28.1	32.6	101	6	80-120	20
Magnesium	2750	2810	5550	100	2810	5770	108	4	80-120	20
Manganese	227	28.1	274	170*	28.1	285	207*	4	80-120	20
Molybdenum	1.24	28.1	27.2	93	28.1	28.5	97	5	80-120	20
Nickel	3.33	28.1	29.3	92	28.1	30.7	98	5	80-120	20
Potassium	2050	2810	5000	105	2810	5170	111	3	80-120	20
Selenium	0.188J	28.1	24.4	86	28.1	25.1	89	3	80-120	20
Silver	ND	28.1	26.1	93	28.1	27.0	96	3	80-120	20
Sodium	ND	2810	2620	93	2810	2680	96	2	80-120	20
Thallium	0.236J	28.1	25.9	92	28.1	27.3	96	5	80-120	20
Vanadium	30.0	28.1	58.0	100	28.1	63.4	119	9	80-120	20
Zinc	28.9	28.1	57.7	103	28.1	60.5	113	5	80-120	20

Figure 4: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 10K283

METHOD 6020A
METALS BY ICP-MS

A total of twelve (12) soil samples were received on 11/19/10 for Total Metals by ICP-MS analysis, Method 6020A in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Initial Calibration was established as prescribed by the method and was verified using a secondary source. Interference checks were performed and results were within required limits. Continuing calibration verifications and continuing calibration blanks were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for IMK029SL/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries were within project QC limits except for results qualified with [*] in K283-10M/S summary form, most likely due to matrix interference.
Check QC summaries form for details.
In addition Analytical spike and serial dilution were analyzed for matrix interference evaluation. Results were within method acceptance criteria.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURES	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Tune Check (Mass calibration and resolution check)	Daily before ICAL.	±0.10 AMU (Mass of Isotope) <0.9 AMU full width resolution RSD of 4 replicates : ≤5%	Correct problem and repeat tune check.		
Initial Calibration (multi-point)	Daily initial calibration prior to sample analysis.	r ≥ 0.998	Correct the problem and repeat the initial calibration.		
Initial Calibration Verifications (ICV) Second Source	Daily after the initial calibration.	All analytes within ±10% of expected value RSD of Replicate integrations: < 5%	Correct the problem and repeat the initial calibration.		
Low Level Calibration Verification (LLICV / LLCCV)	LLICV: Daily after initial calibration. LLCCV: At the end of the analysis sequence	All analytes with ± 30% of expected value.	Correct the problem and repeat the initial calibration.		
Calibration Verifications (CCV)	Daily before sample analysis, after every 10 samples and at the end of the analysis sequence.	All analytes within ±10% of expected value. RSD of replicate integrations < 5%.	Repeat calibration and reanalyze all samples since last successful calibration.		
Calibration Blanks (ICB/CCB)	After every calibration verification	All target analytes < LOQ.	Correct problem then reanalyze calibration blank and previous samples.		
Interference Check Sample (ICSA/ICSAB)	Analyze at the beginning of each analytical run or once every 12 hours , whichever is more frequent.	Within ±20% of expected value	Terminate analysis, correct the problem, reanalyze ICS, and reanalyze all affected samples		
Internal Standard (IS)	ICV, LLICV, CCV, LLCCV, CCBs, MB, LCS, every sample	IS Intensities > 70% from Initial Calibration Blank IS Intensity	Correct problem then re-analyze		
Method Blank	One per preparation batch	All target analytes < ½ LOQ.	Re-digest and reanalyze method blank and all samples processed with the contaminated blank.		
Laboratory Control Sample (LCS)	One per preparation batch	% Recovery: 80% - 120%	Re-digest and reanalyze LCS and all associated samples		
Matrix Spikes (MS/MSD)	One MS/MSD every 20 project samples per matrix	% Recovery: 75% - 125% RPD ≤20%	Evaluate post spike and dilution test: • If parent sample result is "ND", evaluate post spike. • If parent sample result is high (i.e., 4x of spike concentration) and post spike failed, evaluate dilution test.		
Post Digestion Spike Addition	When MS fails.	Recovery within 80-120% of expected value	Correct the problem then reanalyze post digestion spike addition		
Dilution Test (5X)	When MS fails.	1:5 dilution must agree within ±10% of the original determination	Evaluate. Discuss in case narrative.		
Instrument Detection Limit (IDL)	Every three months		Correct the problem and repeat the IDL determination.		
Comments: Refer to PSR for flagging criteria.			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: µg/L
Sample Amt(ml): 50

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : WATER

PARAMETER	98A04019	98A04020	98A04021	98A04022	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA006WL	IMA006WC	IMA006WX	IMA006WY							
Aluminum	2513	2514	2516	2513	2500	2514	101	1.41	0.06	80 - 120	PASSED
Antimony	25.1	25.1	25.2	25.0	25	25	100	0.09	0.36	80 - 120	PASSED
Arsenic	24.6	25.0	24.8	24.8	25	25	99	0.17	0.67	80 - 120	PASSED
Barium	25.7	25.6	25.7	25.4	25	26	102	0.15	0.58	80 - 120	PASSED
Beryllium	26.2	26.4	26.0	26.4	25	26	105	0.18	0.67	80 - 120	PASSED
Boron	27.3	27.8	27.2	27.7	25	28	110	0.31	1.13	80 - 120	PASSED
Cadmium	25.4	25.3	25.5	25.2	25	25	101	0.13	0.50	80 - 120	PASSED
Calcium	2578	2555	2563	2585	2500	2570	103	13.70	0.53	80 - 120	PASSED
Chromium	25.4	25.4	25.3	25.0	25	25	101	0.18	0.72	80 - 120	PASSED
Cobalt	25.4	26.0	25.6	25.6	25	26	103	0.22	0.87	80 - 120	PASSED
Copper	25.6	25.8	25.7	25.3	25	26	102	0.22	0.86	80 - 120	PASSED
Iron	2600	2583	2596	2594	2500	2593	104	7.27	0.28	80 - 120	PASSED
Lead	25.7	25.8	25.5	25.6	25	26	103	0.10	0.40	80 - 120	PASSED
Lithium	24.6	24.9	24.7	25.1	25	25	99	0.22	0.88	80 - 120	PASSED
Magnesium	2510	2516	2492	2506	2500	2506	100	10.20	0.41	80 - 120	PASSED
Manganese	25.6	25.7	25.7	25.4	25	26	102	0.15	0.59	80 - 120	PASSED
Molybdenum	25.1	25.1	25.1	24.7	25	25	100	0.19	0.74	80 - 120	PASSED
Nickel	25.3	25.6	25.4	25.0	25	25	101	0.23	0.91	80 - 120	PASSED
Potassium	2602	2593	2602	2558	2500	2589	104	20.93	0.81	80 - 120	PASSED
Selenium	25.4	25.1	25.3	25.0	25	25	101	0.16	0.62	80 - 120	PASSED
Silver	25.4	25.6	25.5	25.0	25	25	101	0.27	1.05	80 - 120	PASSED
Sodium	2507	2502	2507	2544	2500	2515	101	19.48	0.77	80 - 120	PASSED
Strontium	25.3	25.4	25.3	25.2	25	25	101	0.09	0.35	80 - 120	PASSED
Thallium	25.5	25.9	25.7	25.7	25	26	103	0.16	0.63	80 - 120	PASSED
Tin	25.1	25.2	25.5	25.3	25	25	101	0.15	0.59	80 - 120	PASSED
Titanium	25.2	25.0	25.2	24.8	25	25	100	0.17	0.66	80 - 120	PASSED
Uranium	26.1	26.1	25.9	25.9	25	26	104	0.13	0.50	80 - 120	PASSED
Vanadium	25.3	25.4	25.2	24.8	25	25	101	0.26	1.03	80 - 120	PASSED
Zinc	25.3	25.4	25.6	25.2	25	25	101	0.15	0.59	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

Analytical SOP: EMAX-6020
Conc Unit: µg/L
Sample Amt(ml): 50

Analysis date: 5/9/2011
Extracted by: C. Capulong
Analyzed by: C. Capulong

PARAMETER	98E05041	98E05042	98E05043	98E05044	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IME016WL	IME016WC	IME016WX	IME016WY							
Phosphorus	236.9	244.8	236.5	237.6	250	239	96	3.93	1.64	80 - 120	PASSED
Zirconium	25.0	27.2	25.8	26.3	25	26.1	104	0.93	3.55	80 - 120	PASSED

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: µg/L
Sample Amount(mL): 50

Instrument ID: 98
Analysis date: 6/25/2013
Analyzed by: C. Capulong

PARAMETER	98F06024	98F06025	98F06026	98F06027	TV	Ave. Conc.	Ave. %Rec	SD	RSD	QC Criteria	COMMENTS
	IMF012WL	IMF012WC	IMF012WX	IMF012WY							
Tungsten	26.8	26.7	26.4	26.6	25	26.3	105	0.15	0.6	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amt(gm): 1

Instrument ID: I98
Analysis date: 1/7/2011
Analyzed by: C. Capulong

MATRIX : SOIL

PARAMETER	98A04027	98A04028	98A04029	98A04030	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IMA007SL	IMA007SC	IMA007SX	IMA007SY							
Aluminum	2439	2397	2422	2435	2500	2423	97	18.95	0.78	80 - 120	PASSED
Antimony	21.1	20.9	20.8	20.8	25	21	84	0.13	0.61	80 - 120	PASSED
Arsenic	20.7	20.5	20.9	20.9	25	21	83	0.22	1.04	80 - 120	PASSED
Barium	21.6	21.5	21.4	21.7	25	22	86	0.12	0.54	80 - 120	PASSED
Beryllium	21.7	21.7	21.7	21.6	25	22	87	0.05	0.23	80 - 120	PASSED
Boron	23.0	23.2	23.4	23.5	25	23	93	0.23	1.00	80 - 120	PASSED
Cadmium	21.1	20.8	20.7	21.0	25	21	83	0.19	0.92	80 - 120	PASSED
Calcium	2535	2511	2502	2524	2500	2518	101	14.49	0.58	80 - 120	PASSED
Chromium	21.3	21.3	21.5	21.2	25	21	85	0.11	0.51	80 - 120	PASSED
Cobalt	21.5	21.2	21.6	21.5	25	21	86	0.20	0.95	80 - 120	PASSED
Copper	21.1	21.2	21.2	20.8	25	21	84	0.17	0.82	80 - 120	PASSED
Iron	2509	2501	2470	2525	2500	2501	100	23.10	0.92	80 - 120	PASSED
Lead	21.8	21.6	21.5	21.6	25	22	87	0.13	0.59	80 - 120	PASSED
Lithium	20.9	21.1	21.1	21.1	25	21	84	0.07	0.31	80 - 120	PASSED
Magnesium	2424	2401	2413	2427	2500	2416	97	11.81	0.49	80 - 120	PASSED
Manganese	21.5	21.5	21.6	21.5	25	22	86	0.06	0.29	80 - 120	PASSED
Molybdenum	21.4	21.2	21.3	21.4	25	21	85	0.11	0.53	80 - 120	PASSED
Nickel	20.9	20.8	21.0	20.8	25	21	83	0.08	0.36	80 - 120	PASSED
Potassium	2493	2499	2495	2483	2500	2493	100	6.81	0.27	80 - 120	PASSED
Selenium	21.1	20.8	21.3	21.1	25	21	84	0.19	0.92	80 - 120	PASSED
Silver	21.6	21.4	21.5	21.8	25	22	86	0.17	0.80	80 - 120	PASSED
Sodium	2440	2435	2390	2464	2500	2432	97	30.88	1.27	80 - 120	PASSED
Strontium	21.5	21.3	21.5	21.7	25	21	86	0.17	0.80	80 - 120	PASSED
Thallium	21.6	21.4	21.4	21.5	25	21	86	0.08	0.39	80 - 120	PASSED
Tin	24.6	24.2	24.1	24.3	25	24	97	0.24	1.00	80 - 120	PASSED
Titanium	21.6	21.4	21.5	21.5	25	22	86	0.08	0.38	80 - 120	PASSED
Uranium	22.4	22.0	22.4	22.4	25	22	89	0.21	0.96	80 - 120	PASSED
Vanadium	21.4	21.2	21.3	21.1	25	21	85	0.12	0.57	80 - 120	PASSED
Zinc	22.6	21.8	21.9	22.7	25	22	89	0.47	2.11	80 - 120	PASSED

Appendix 2 (Cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

Analytical SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amt(ml): 1

Analysis date: 5/9/2011
Extracted by: C. Capulong
Analyzed by: C. Capulong

PARAMETER	98E05021	98E05022	98E05023	98E05024	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	IME012SL	IME012SC	IME012SX	IME012SY							
Phosphorus	257	255	255	252	250	255	102	2.25	0.88	80 - 120	PASSED
Zirconium	27.3	29.3	29.7	29.5	25	28.9	116	1.12	3.87	80 - 120	PASSED

DEMONSTRATION OF CAPABILITY
METHOD: SW 6020A

SOP: EMAX-6020
Conc Unit: mg/Kg
Sample Amount(g): 1

Instrument ID: 98
Analysis date: 6/25/2013
Analyzed by: C. Capulong

PARAMETER	98F06019	98F06020	98F06021	98F06022	TV	Ave. Conc.	Ave. %Rec	SD	RSD	QC Criteria	COMMENTS
	IMF014SL	IMF014SC	IMF014SX	IMF014SY							
Tungsten	25.8	25.9	26.1	26.1	25	25.8	103	0.15	0.6	80 - 120	PASSED

Appendix 3: COMPARATIVE STUDY OF MODIFIED 3050B

ANALYTICAL METHOD: SW 6020A
PREPARATION BATCH: IMG031S - Modified Method 3050B
IMG032S - Reference Method 3050B
ANALYTICAL BATCH: I98H01
QC STANDARD: 09G281-02

Preparation Date: 7/27/2010
Extracted by: M. Mendoza
Analytical Run Date: 8/3/2010
Analyzed by: C. Capulong

COMPOUND	TRUE VALUES (mg/Kg)	ACCEPTANCE LIMITS (mg/Kg)	RECOVERY LIMITS (%)	REFERENCE METHOD 3050B				MODIFIED METHOD 3050B			
				Concentration (mg/Kg)		Recovery		Concentration (mg/Kg)		Recovery	
				98H01041 G281-02	98H01043 G281-02D	98H01041 G281-02	98H01043 G281-02D	98H01030 G281-02	98H01032 G281-02D	98H01030 G281-02	98H01032 G281-02D
Aluminum	7320	4940 - 16400	67 - 224	10900	10700	149%	146%	10700	10700	146%	146%
Antimony	110	11.0 - 121	10 - 110	20.0	19	18%	17%	61.4	66.6	56%	61%
Arsenic	84.2	42.8 - 92.7	51 - 110	61.2	61.7	73%	73%	63.6	65.3	76%	78%
Barium	247	186 - 318	75 - 129	255	260	103%	105%	275	273	111%	111%
Beryllium	49.0	29.0 - 53.9	59 - 110	39.7	39.6	81%	81%	42	41.7	86%	85%
Boron	130	61.8 - 149	48 - 115	104	104	80%	80%	126	126	97%	97%
Cadmium	76.5	48.7 - 84.4	64 - 110	65.3	66.7	85%	87%	69.9	69.8	91%	91%
Calcium	10200	7860 - 12900	77 - 126	9360	10700	92%	105%	10200	10300	100%	101%
Chromium	116	74.8 - 140	64 - 121	99.5	98.4	86%	85%	107	110	92%	95%
Cobalt	64.6	47.2 - 79.7	73 - 123	62.1	61.3	96%	95%	63.8	64	99%	99%
Copper	143	99.7 - 166	70 - 116	116	115	81%	80%	127	126	89%	88%
Iron	23300	11500 - 36200	49 - 155	23900	23700	103%	102%	24800	24800	106%	106%
Lead	82.0	41.9 - 90.2	51 - 110	63.3	64.9	77%	79%	67.5	67.6	82%	82%
Magnesium	7400	5300 - 9060	72 - 122	6770	6760	91%	91%	6930	7100	94%	96%
Manganese	475	428 - 724	90 - 152	546	562	115%	118%	584	571	123%	120%
Molybdenum	66.1	36.0 - 72.7	54 - 110	54.9	53.5	83%	81%	60.1	59.4	91%	90%
Nickel	144	88.8 - 158	62 - 110	112	113	78%	78%	122	122	85%	85%
Potassium	3740	2360 - 4990	63 - 133	3620	3600	97%	96%	3690	3560	99%	95%
Selenium	189	97.2 - 208	51 - 110	142	148	75%	78%	154	157	81%	83%
Silver	40.6	21.2 - 44.6	52 - 110	30.9	32.7	76%	81%	34.2	34.9	84%	86%
Sodium	200	31.4 - 324	16 - 162	292	197	146%	99%	192	200	96%	100%
Strontium	135	88.1 - 162	65 - 120	123	121	91%	90%	129	128	96%	95%
Thallium	127	73.2 - 144	58 - 113	110	114	87%	90%	117	112	92%	88%
Tin	250	39.5 - 275	16 - 110	71.2	73.2	28%	29%	84.7	85.2	34%	34%
Titanium	609	426 - 792	70 - 130	737	744	121%	122%	772	760	127%	125%
Uranium	1.12	0.784 - 1.46	70 - 130	0.93	1.1	83%	98%	1.03	1.01	92%	90%
Vanadium	61.8	55.6 - 123	90 - 199	90.2	89.7	146%	145%	92.8	93.1	150%	151%
Zinc	208	145 - 270	70 - 130	208	207	100%	100%	225	214	108%	103%

** Note: Modified 3050B procedure is specified in EMAX-3050 Rev. 4*

6020FS: SAMPLE PREPARATION LOG

EMAX LABORATORIES, INC.

DIGESTION LOG
for
ICP-MS

Page 1

Note: For samples, relevant QCs/Standards digested, refer to attached digestion sequence.

Comments:

Book #: EIM-033
Batch:
Matrix:
Digestor ID:

SOP #	Rev. #
☐ EMAX-200.8	
☐ EMAX-6020	
☐ EMAX-	

Start	Temp	End	Temp
	°C		°C

Standards	ID	Amount Added (ml)
LCS-1		
LCS-2		
MS		
Reagent	**Lot# / ID**	**Amount Added (ml)**
HNO_3		
HCl		
H_2O_2		
HNO3(1:1)		

Digestate Location	
Extract Location	

☐ Soil Samples: -diluted 1 ml of digestate to 10 ml reagent water (DF=100)

☐ Reagent Water ID:

☐ Thermometer ID:

☐ Pipette ID:

☐ Pipette ID:

☐ Pipette ID:

☐ HNO_3 dispenser checked @ 5.0 ml with Class A volumetric flask

☐ HCl dispenser checked @ 5.0 ml with Class A volumetric flask

Prepared By:

Standard Added By: Witnessed By:

Extract Rcvd By: Checked By:

6020FA: ANALYSIS RUN LOG

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
ICP-MS

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Start Date:

End Date:

Comments:

Book #: A98-030

Instrument No.: 98

Analytical Batch:

Analytical Sequence:

Method File:

SOP #	Rev. #
☐ EMAX-6020	
☐ EMAX-200.8	
☐ EMAX-	

STANDARDS ID	
S0	
S1	
S2	
S3	
S4	
S5	
S6	
S7	
ICV	
CCV	
ICSA	
ICSAB	
6020 TUNE SOLN.	
200.8 TUNE SOLN.	
MRL1	
MRL2	
MRL3	

Analyzed By:

Date:

6020FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

ICP-MS MAINTENANCE LOG

Instrument No: 98 Month: Year: 201_ Book # M98-007

Date							
Argon, Hydrogen, Helium							
Instrument Discharge							
Pump Tubings							
Rinse Bottle							
Printer Paper							
Autosampler							
Cooling Water							
Peri Pump Rate (0.08-0.12 RPS)							
Nebulizer Gas (0.8-1.30 L/min)							
Makeup Gas (0.1-0.3 L/min)							
ICP-MS TUNE							
Li - 7 (≥ 6400 Counts)							
Y - 89 (≥ 16000 Counts)							
Tl - 205 (≥ 9600 Counts)							
Oxides (MO^+) ≤ 2%							
Double Charge (M^{++}) ≤ 2%							
Analyst Initials							
ICP-MS TUNE							
Problem(s) Encountered							
Corrective Action							
Return To Specs (Analyst Initials)							

Code	Problems Encountered	Code	Corrective Action

SOP REVIEW FORM

EMAX-7471	Rev. 7	MERCURY IN SOLID OR SEMISOLID WASTE
SOP No.	Revision Number	Title

Document the review process and comment. Check the "NA" box if it is not applicable to the SOP, check the "Yes" box if you have fully understood the section, check "No" if you have any questions or if there are discrepancies with the current practice. Discuss the issue with the mentor/supervisor. If you need more space use the allocated space below or attach additional page.

SECTION	Yes	No	NA	COMMENTS
Scope & Application	✓			
Summary of Method	✓			
Detection Limits	✓			
Dynamic Range	✓			
Sample Holding Time & Preservation	✓			
Associated SOPs	✓			
Safety	✓			I have read the following MSDS:
Instruments, Chemicals & Reagents	✓			
Standards	✓			
Procedures	✓			
- Sample Preparation	✓			
- Instrument Parameters	✓			
- Calibration	✓			
- Analysis	✓			
- Calculations	✓			
- Data Reduction	✓			
- Report Generation	✓			
- Data Review	✓			
- Preventive Maintenance	✓			
Quality Control	✓			
Corrective Action	✓			
Pollution Prevention	✓			
Waste Management	✓			
Supplementary Notes	✓			
References	✓			
Appendices	✓			

This is to acknowledge that I have read, understood and agree to perform the procedures set forth in this SOP. Print your name & affix your signature.

Reviewed By Mary Jane Mendoza [signature] Date: 7/8/14

STANDARD OPERATING PROCEDURE

MERCURY IN SOLID OR SEMISOLID WASTE

SOP No.:	EMAX-7471	Revision No.	7	Effective Date:	12-Dec-12
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Control Number: 7471-07-

1.0 SCOPE AND APPLICATION

1.1. This procedure applies to the measurement of Mercury in domestic and industrial wastes, soils, sediments, extracts and sludge samples by Cold Vapor Absorption Technique.

1.2. This SOP is an adaptation of Method 7471B.

2.0 SUMMARY OF METHOD

2.1. A representative amount of sample is digested in nitric and hydrochloric acids, followed by oxidation with potassium permanganate.

2.2. Organic mercurial are broken down and converted into mercuric ions in order to respond to the cold vapor atomic absorption technique. Addition of permanganate ensures that organo-mercury compounds are oxidized.

2.3. Absorption of radiation by mercury vapor at 253.7 nm is then measured in the digested samples.

2.4. **Interferences**

2.4.1. Sulfides (as sodium sulfide), copper and chloride at high concentrations are known to interfere with the recovery of mercury. Samples containing such interference may require additional permanganate (about 12.5 ml).

2.4.2. Care must be taken to ensure that free chlorine is absent before the mercury is swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent. In addition, the dead air space in the digestion vessel must be purged before adding stannous sulfate.

2.4.3. Certain volatile organic materials that absorb at this wavelength may also cause interference. A preliminary run without reagents should determine if this type of interference is present.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for validation, verification and generation of DL, LOD and LOQ.

3.1.2. Established DL, LOD and LOQ are:

MATRIX	DL	LOD	LOQ
Soil (mg/Kg)	0.01	0.02	0.1

4.0 DYNAMIC RANGE

4.1. The highest quantifiable range requiring no dilution is equal to the concentration of the highest calibration point (See Section 9.6). All samples analyzed above this range are considered "over-range" and requires dilution to properly quantitate.

4.2. The lowest quantifiable range of diluted samples is equal to the concentration of the lowest calibration point. All diluted samples analyzed below this range are considered "under-range" and requires lower dilution factor to properly quantitate.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Sample Collection**

5.1.1. Samples are expected to be contained in a jar or Shelby tube and cooled to ≤ 6°C without freezing.

5.2. **Holding Time**

5.2.1. Digest all samples within 28 days from date of collection.

5.3. **Preservation**

5.3.1. Store the samples at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

6.1.	EMAX-DM01	Data Flow Review
6.2.	EMAX-QA04	Detection Limit (DL)
6.3.	EMAX-QA05	Training
6.4.	EMAX-QA08	Corrective Action
6.5.	EMAX-QC01	Quality Control of Chemicals
6.6.	EMAX-QC02	Analytical Standard Preparation
6.7.	EMAX-QC06	Calibration of Micropipettes
6.8.	EMAX-QC07	Glassware Cleaning
6.9.	EMAX-SM03	Waste Disposal
6.10.	EMAX-SM04	Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves, at all times when performing this procedure. Perform preparation and analysis of mercury in a fume hood equipped with an exhaust fan or blower.

7.3. If for any reason, sample and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with copious amounts of water. If irritation persists inform your supervisor immediately so that proper action can be taken.

7.4. Do not look directly at the Mercury Lamp while lit. The radiation may cause damage to your eyes.

7.5. Perform all reagent additions under a fume hood.

7.6. Mercury analyzers are to be used by trained personnel only.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. Mercury Analyzers

8.1.1.1. Leeman PS-200 Automated Mercury Analyzer with Autosampler, Computer, Printer and PS 200 Software.

8.1.1.2. Leeman Hydra AA Automated Analyzer with Autosampler, Computer, Printer and PS200 Software.

8.1.2. 100 ml Digestion vessel

8.1.3. Digestate containers

8.1.4. Digestion block or equivalent.

8.1.5. Magnetic stirrer

8.1.6. Micropipettes and tips

8.1.7. Thermometer

8.2. **Chemicals and Reagents**

8.2.1. Hydrochloric acid, concentrated. Reagent grade.

8.2.2. Nitric acid, concentrated. Reagent grade.

8.2.3. Stannous Chloride: Dissolve 200 g. of $SnCl_2$ in reagent water, add 200 ml concentrated HCl and dilute to 2 L.

8.2.4. Hydroxylamine hydrochloride, 12% solution: Dissolve 120 g of hydroxylamine hydrochloride in 1 L reagent water.

8.2.5. Potassium permanganate, 5% solution. Dissolve 50 g of potassium permanganate in 1 L reagent water.

8.2.6. Aqua Regia – 1 part HNO_3 : 3 parts HCl solution

8.2.7. Reagent water – mercury-free water

8.2.8. Silica Sand for blank soil matrix

9.0 STANDARDS

9.1. Refer to EMAX-QC02 for proper analytical standard preparation.

9.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.3. **Stock Standard**

9.3.1. Purchase stock standards as certified solutions from two different vendors. Use one as primary standard and the other as secondary standard.

9.3.2. Transfer standards on a properly labeled inert vial with minimal headspace and store at -10°C to -20°C.

9.3.3. Prepare calibration standards from the primary standard.

9.3.4. Prepare initial calibration verification standards and spiking standards from the secondary standard.

Stock Std	**Name**	**Source**	**CAT #**	**Conc.**	**Notes**
Primary / CCV	Mercury	Leeman	602-00064	100 mg/L	Or equivalent
ICV/LCS/MS	Mercury	ERA	027	1000 mg/L	Or equivalent

9.4. **Intermediate Standard Solution**

9.4.1. From 100 mg/L stock solution take a 2 ml aliquot and dilute to 200 ml using reagent water. The solution shall have a final concentration of 1.0 mg/L.

9.4.2. Prepare secondary dilution from 1000 mg/L stock solution, take a 1 ml aliquot and dilute to 100 ml using reagent water. This solution shall have a final concentration of 10 mg/L.

9.5. **Working Standard**

9.5.1. From the secondary dilution of intermediate standard, prepare the working standard solution to have a final concentration of 100 µg/L.

9.6. **Initial Calibration Standards**

9.6.1. From the working solution, prepare the following *Leeman* standards.

Level	Aliquot (ml)	Final Digestion Volume (ml)	Concentration (µg/L)
S1	0	100	0
S2	0.2	100	0.2
S3	1.0	100	1.0
S4	2.0	100	2.0
S5	5.0	100	5.0
S6	10.0	100	10.0
CCV	5.0	100	5.0

9.7. **ICV/ LCS/MS**

9.7.1. From the working standard, prepare ICV/CCV/LCS/MS solutions using *ERA* Standards.

Name	Aliquot (ml)	Final Digestion Volume (ml)	Concentration (µg/L)

ICV	2.0	100	2.0
LCS/MS	5.0	100	5.0

10.0 PROCEDURES

10.1. Sample Preparation

10.1.1. Weigh a representative 0.6 g portion of wet sample into digestion vessels.

10.1.2. Add spike standards to the LCS/MS. Add appropriate standards for Initial Calibration, ICV and CCVs in clean digestion vessels. (Refer to Section 9.6.1 and 9.7.1 for spike amounts).

10.1.3. Add 5 ml of reagent water and 5 ml aqua regia with mixing after each addition.

10.1.4. Heat for 2 minutes at 95°C ± 3°C in the digestion block, cool and add 50 ml of reagent water.

10.1.5. Add 15 ml of 5% $KMnO_4$ solution to each bottle.

10.1.6. Swirl each vessel to mix and let it stand for 15 mins. Check each vessel if purple color persists. If not, add permanganate solution at 2.5 ml increments swirling the digestion vessel at every addition until purple color persists.

Add the maximum amount of permanganate solution added to a solution, to the method blank, LCS, calibration standards and calibration verification standards.

10.1.7. Place samples on the digestion block for 30 minutes at 95°C ± 3°C.

10.1.8. Allow the samples to cool.

10.1.9. Add 6 ml hydroxylamine hydrochloride solution and dilute to 100 ml using reagent water.

10.1.10. Properly fill up the Sample Preparation Log.

10.2. Instrument Parameters

10.2.1. PROTOCOL

10.2.1.1. Set values as follows.

Instrument ID:	PS200	HYDRA AA
Number of Integration	1	
Uptake time	20 sec.	18 sec.
Weight	N	N
Dilution	N	N
On/Off, times, gains		
On	Y	Y
Time	10	10
Gas	0.35 LPM	0.15 LPM

Pump Rate	5 ml/min	7 ml/min
AUTOSAMPLER – Setup		
Station 1 (rack1)	From cup 1 to cup 44	From cup 1 to cup 44
Station 2 (rack 2)	From cup 1 to cup 44	From cup 1 to cup 44
Rinse time	60 sec.	60 sec.
CALIBRATION S1, S2, S3, S4, S5, S6	Concentration, µg/L 0 0,.20, 1.0, 2.0, 5.0, 10.0	Concentration, µg/L 0 0,.20, 1.0, 2.0, 5.0, 10.0

10.2.2. DATA OUTPUT – Specify Report

Data Output	Real Time	Post Run
Samples	Y	Y
Standards	Y	Y
Updates	Y	Y
Peaks	N	N
IEC Stds.	N	N
Check Stds.	Y	Y
Dups and % Diff.	Y	Y
Wavelength	N	N
Rel. Absorbances	N	N
% RSD	Y	Y
Scans to PRN		N
Detail		Y
Summary		N
Post Run Copies		1
Post Run Report Order [1-sorted; 2- sequential]	2	

10.3. **Calibration**

10.3.1. Instrument Set-up

10.3.1.1. Set up PS200 or Hydra AA to proper operating parameters. Refer to Section 10.2.1.

New pump tubing, must ran with rinse for 45 minutes to break in the tubing.

10.3.1.2. Turn on lamp and allow to warm up for at least 5 minutes.

10.3.1.3. Check the peristaltic pump to deliver a steady flow.

10.3.1.4. Check that the reductant solution, 10% $SnCl_2$, is sufficient. If not, prepare solution as described in Section 8.2.3.

10.3.2. Initial Calibration (ICAL)

10.3.2.1. Prepare initial calibration solution as described in Section 9.6.1.

10.3.2.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.2.3. Analyze as described in Section 10.4.

10.3.2.4. Refer to Section 10.5 for calculations.

10.3.2.5. Initiate initial calibration as described in the instrument operations manual and acquire the calibration data for review after calibration is completed.

10.3.2.6. Refer to Appendix 1 for Quality Control acceptance criteria.

10.3.2.7. Verify the initial calibration by a secondary source standard.

10.3.3. Initial Calibration Verification (ICV)

10.3.3.1. Prepare ICV as described in Section 9.7.

10.3.3.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.3.3. Analyze the ICV sample to verify the concentration of the ICAL.

10.3.3.4. Refer to Appendix 1 for Quality Control acceptance criteria.

10.3.4. Continuing Calibration Verification (CCV)

10.3.4.1. Prepare CCV as described in Section 9.6.

10.3.4.2. Perform the same procedure used for analytical samples as described in Section 10.1.

10.3.4.3. Analyze the CCV sample to verify the concentration of the ICAL.

10.3.4.4. Refer to Appendix 1 for Quality Control acceptance criteria.

10.4. **Analysis**

10.4.1. Calibration

10.4.1.1. Refer to the instrument operations manual for proper calibration and analytical sequence setup (autosampler setup).

10.4.1.2. Analytical batch ID naming convention: MIIMSSS

where:

M – is for Mercury and is always the first character

II – is the instrument number

M – is the month code (A for January, B for February, and so on)

SSS – is a sequential number (resets to 001 for the first folder created each month)

10.4.1.3. **Typical Calibration Sequence**

S1	0.00000

S2	0.20000
S3	1.00000
S4	2.00000
S5	5.00000
S6	10.0000

10.4.2. Analytical Sequence

10.4.2.1. ICV

10.4.2.2. ICB

10.4.2.3. CCV1

10.4.2.4. CCB1

10.4.2.5. Method Blank (MB)

10.4.2.6. Lab Control Sample (LCS)

10.4.2.7. Lab Control Sample Duplicate (LCSD)

10.4.2.8. Post Analytical Spike

10.4.2.9. Parent Sample

10.4.2.10. Serial Dilution

10.4.2.11. Matrix Spike (MS)

10.4.2.12. Matrix Spike Duplicate (MSD)

10.4.2.13. Maximum of 2 samples

10.4.2.14. CCV2

10.4.2.15. CCB2

10.4.2.16. Maximum of 10 samples

10.4.2.17. CCV3

10.4.2.18. CCB3

10.4.3. Prepare a Dilution Test sample at 5x dilution. Pipette 2 ml of sample, add 10 ml of S_0 into a sample tube. Seal the tube with parafilm and invert the tube several times to ensure adequate mixing.

10.4.4. Prepare a Post Digestion Spike test sample. Using the un-spiked sample digestate (preferably the QC sample), add MS standard to maintain the same spike level as the MS sample digestate.

10.4.5. Check QC criteria as soon as the data is available.

10.4.5.1. Check the LCS recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 for QC limits.

10.4.5.2. Check the matrix spike recovery against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 for QC limits.

10.4.5.3. Check that sample result concentrations are within the calibration range.

10.4.6. Dealing with Carryover

10.4.6.1. Check the sample analyzed preceded by another sample found to have target analyte concentrations exceeding the calibration range.

10.4.6.2. If no target analyte is detected as found in preceding high concentration sample, proceed with data reduction.

10.4.6.3. If there is any target analyte detected as found in preceding high concentration sample, re-analyze the sample to rule-out carryover. If carryover is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.7. Method of Standard Addition (MSA)

10.4.7.1. Perform MSA for all EP extracts, samples for de-listing petition, whenever a new matrix is encountered and/or as indicated above.

10.4.7.2. Prepare three sample solutions (Ms1, Ms2, Ms3) to objectively produce equal increments of concentration in the final solution without diluting the sample more than 50% of its original volume and expected concentrations falls within the linear range.

Example: Sample concentration is tentatively determined at 2 µg/L.

Ms1 – take 10 ml of digestate and add 0.2 ml of 100 µg/L spike standard (≈ 6 µg/L)

Ms2 – take 10 ml of digestate and add 0.4 ml of 100 µg/L spike standard (≈ 7 µg/L)

Ms3 – take 10 ml of digestate and add 0.6 ml of 100 µg/L spike standard (≈ 8 µg/L)

10.4.7.3. Analyze Ms1, Ms2 and Ms3 and calculate the results using Eq.-10.5.7.

10.4.7.4. Upload the electronic data to the network.

10.4.8. Sample Result Evaluation

10.4.8.1. Check that the analytical data generated which indicates positive results are quantitatively correct.

10.4.8.2. Check that analytical results are generated by the prescribed calibration schedule of method.

10.4.8.3. Check for possible carry-over. Re-analyze samples having trace level concentration preceded by a sample having a concentration over the calibration range.

10.4.8.4. Check the MS/MSD, serial dilution and the post digestion spike[1] results. If a matrix interference is indicated, check the PSR if MSA is waived. Otherwise, refer to Section 10.4.7.

10.4.8.5. Properly fill up the Analytical Run Log.

10.5. **Calculations**

10.5.1. Calibration Factor (CF)

[1] This SOP defaults to Post-Digestion Spike recovery of 85-115% based on Method 7000A. However, if project specific requirements reference to Method 7000B, recovery requirement is 80-120%.

$$CF = \frac{R_a}{C_a}$$ Eq.-10.5.1

where:

R_a – Response for analyte measured in absorbance

C_a – Known concentration of analyte measured in µg/L

10.5.2. Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF}{n}$$ Eq.-10.5.2

where:

ΣCF – Sum of calibration factors

N – Number of calibration factors

10.5.3. Correlation Coefficient

$$r(x,y) = \frac{\frac{1}{N}\sum_{i-1}^{N}(x_1 - \bar{x})(y_1 - \bar{y})}{(SD_x)(SD_y)}$$ Eq.-10.5.3

where:

$r(x,y)$ – Correlation coefficient

N – Number of measurements

X_1 – Found value of the ith measurement

$\bar{x}$ – Mean of found values

Y_1 – True value of the ith measurement

$\bar{y}$ – Mean of true values

SD_x – Standard deviation of the found values

SD_y – Standard deviation of the true values

10.5.4. Sample Result

$$C = (R_s)(CF)(DF)\frac{V_e}{S_a}$$ Eq.-10.5.4

where:

C – Sample concentration in µg/L or µg/Kg

CF – Calibration factor

DF – Dilution factor

R_s – Sample absorbance

V_e – Extract volume in L

S_a – Sample amount in ml or g

10.5.5. Calculate for Percent Recovery

$$\%\,\mathrm{Recovery} = \frac{(C_f - C)}{C_s} \times 100 \qquad \text{Eq.-10.5.5}$$

where:

C_f – Concentration found

C – Concentration of the sample (use 0 for LCS)

C_s – Concentration of spike

10.5.6. Calculate for Percent Recovery

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.6}$$

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.5.7. Calculation for MSA

$$C_x = \frac{(S_2)(V_s)(C_s)}{(S_2 - S_1)V_x} \qquad \text{Eq.-10.5.7}$$

where:

C_x – Concentration of the sample

C_s – Concentration of spike

S_1 – Analytical signal of MS1

S_2 – Analytical signal of MS2

V_x – Volume of sample aliquot

V_s – Volume of spike or reagent water

10.6. **Data Reduction**

10.6.1. Make a copy of the analytical run log and sample preparation log.

10.6.2. Print a copy of the raw data, the QC report and the digestion log.

10.6.3. Highlight the data to be reported.

10.7. **Report Generation**

10.7.1. Generate the report using the following in-house reporting program:

Executable Files	Required Support Files	Output
WDBX[2].exe	Login File (requires network) Seq_name.sq; Gcints.txt	Method.txt [this file integrates the login sample information and the analytical sample information]
MSRBX.exe	Method.txt; Method.met; Method.crf; Project.pln; Qcell.txt	Sample Results (Form1)
IQCVXC.exe	Method.txt; Method.crf; Method.qc; Project.pln;Qcell.txt	QC Summary for LCS, MS, Post Digestion Spike
CQX.exe	Method.txt; Method.crf; Method.qc; Project.pln;Qcell.txt	Summary for Dilution Test, Sample Duplicate
LABCHRNX.exe	Method.txt	Lab Chronicle
CN2.exe		Case Narrative

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below:

10.8.1.1. Case Narrative

10.8.1.2. Lab Chronicle

10.8.1.3. Sample Results

10.8.1.4. LCS/LCSD Summary

10.8.1.5. MS/MSD Summary

10.8.1.6. Dilution Test Report Summary

10.8.1.7. Post Digestion Spike Summary

10.8.1.8. Analytical Run Log

10.8.1.9. Raw Data

10.8.1.10. Sample Preparation Log

10.8.1.11. Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- ✓ Check the Method Blank is compliant to Project Specific Requirement (PSR) critreria.
- ✓ Check LCS/LCSD, MS/MSD and dilution test against the PSR. In the absence of the PSR, default to in-house QC limits.
- ✓ Evaluate the analytical spike test if dilution test failed.
- ✓ Check for possible carry-over and if so, check if confirmation is performed.
- ✓ Review the attached sample preparation log and analytical run log are properly filled.

[2] X – latest program version

- ✓ Check the generated reports against the raw data, analytical run log and digestion log. Check the analytical data generated indicating positive results are qualitatively and quantitatively correct.
- ✓ Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Daily routine maintenance shall be observed religiously. Observe manufacturer's notes regarding Dos and DONTs:

- System preparation is a ***MUST*** before instrument startup.
- Make certain that drying tube has been packed loosely. If drying tube is blocked, liquid may backflow into the optical cell. This will require disassembly and cleaning.
- Do not shutdown the instrument when operational. Abort the run first if interruption is needed.

10.9.2. Record daily routine maintenance, troubleshooting and major repairs in the maintenance log.

10.9.3. Maintain the instrument clean at all times.

10.9.4. For troubleshooting, consult the Operations Manual, Section 4.

11.0 QUALITY CONTROL

11.1. **Sample Preparation QC**

11.1.1. A preparative batch consists of 20 or fewer samples of the same matrix, that are prepared for analysis simultaneously or sequentially, using the same lot of reagents.

11.1.2. Every preparative batch must have at least one method blank, one LCS and a set of MS/MSD unless otherwise specified by the project. These QC samples is digested together with the field samples.

11.1.3. All reagents are subjected to QC check prior to use. Refer to EMAX-QC01.

11.2. **Sample Analysis QC**

11.2.1. Every analytical run are preceded by an initial calibration and an initial calibration verification. The ICV standard should be obtained from a different source from that of the initial calibration. Analyze an instrument calibration blank (ICB) after the ICV. No further analysis are valid unless acceptance criteria are met.

11.2.2. Verify calibration with continuing calibration verification (CCV) standard and continuing calibration blank (CCB) after every ten samples and at the end of the analytical run.

11.2.2.1. Dilution Test shall be performed whenever a new or unusual sample matrix is encountered.

11.2.2.2. Evaluate Post Digestion Spike result if the dilution test failed to meet the acceptance criteria.

11.2.3. Use Method of Standard Addition (MSA) technique for analysis of all EP extracts and whenever a new sample matrix is being analyzed.

11.2.4. Refer to Appendix 1 for acceptance criteria.

11.3. **Method QC**

11.3.1. Detection Limit must be established before the analytical procedure can be used and a quarterly verification must be performed.

11.3.2. Method proficiency must be established before the analytical procedure can be used.

11.3.3. All analysts conducting this analysis must have established demonstration of capability

11.3.4. Perform Instrument Detection Limit quarterly unless otherwise specified by the project.

12.0 CORRECTIVE ACTION

12.1. **Calibration**

12.1.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

- Replace the sample tubing, prepare fresh rinsate and re-prepare fresh $SnCl_2$. Rinse the system for at least 15 minutes prior to calibration.
- If problem persists, run the latest passing calibration standard to check for possible instrumentation problem. If it passes, this is an indication that no instrumentation problem exists. Re-digest the calibration standards. If it fails, clean the lamp prior to re-calibration.
- If problem persists, inform the supervisor for further action.

12.1.2. If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Run the latest passing ICV standard to check for possible standards preparation error. If it passes, this is an indication of standards preparation error. Re-digest the ICV and re-analyze. If it fails, refer to 12.1.1 prior to re-calibration.

12.1.3. If the CCV is non-compliant, consider the following suggestions to correct the problem:

- Run the latest passing CCV standard to check for possible standards preparation error. If it passes, this is an indication of standards preparation error. Re-digest the CCV and re-analyze. If it fails, refer to 12.1.1 prior to re-calibration.

12.2. **Sample Prep QCs**

12.2.1. It method blank is non-compliant, consider the following suggestions to correct the problem:

- Check the sample results. If sample results are non-detected, you may report the result upon concurring with the PM. Otherwise, perform the corrective action as specified in the PSR.

12.2.2. If LCS is non-compliant, consider the following suggestions to correct the problem:

- Check for errors in calculation and concentration of the analyte solution.
- Check instrument performance to determine if it is within acceptable guidelines.
- Re-calculate the data and/or reanalyze the extract if any of the above checks reveals a problem.

- If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate digestion problem, fill-up an NCR and order re-digestion to include the associated sample(s).

12.2.3. If MS is non-compliant, consider the following suggestions to correct the problem:

- If recovery failed to meet the acceptance criteria, and sample result is > 5X the LOQ, and the spike amount is > 4X of the parent sample concentration, evaluate the serial dilution sample result. Refer to Appendix 1 for acceptance criteria. If it fails to meet the acceptance criteria, perform MSA.
- If recovery failed to meet the acceptance criteria, and sample result is ≤ 5X the LOQ, and the spike amount is >4X the parent sample concentration, evaluate the post digestion spike sample result. Refer to Appendix 1 for acceptance criteria. If it fails to meet the acceptance criteria, perform MSA.

13.0 POLLUTION PREVENTION

13.1. Mercury is a very volatile element, dangerous levels are readily attained in air. Mercury vapor should not exceed 0.1 mg/m^{-3} in air. Air saturated with the vapor at 20°C contains mercury in a concentration far greater than that limit. The danger increases at higher temperatures. It is, therefore, important that mercury be handled with care. Containers of mercury should be securely covered and spillage should be avoided. Mercury should only be handled under the hood in a well-ventilated area. Prepare all standards in the fume hoods.

13.2. Because of the toxic nature of mercury vapor, precaution must be taken to avoid its inhalation. A by-pass must be included on the system to vent the mercury vapor into an exhaust hood.

13.3. Small amounts of mercury spillage can be cleaned up by addition of sulfur powder. The resulting mixture should be properly labeled and turned over to the waste disposal unit for proper disposal.

14.0 WASTE MANAGEMENT

14.1. No samples may be dumped on the laboratory sink.

14.2. Separate and properly identify all unused and expired analytical standards for proper disposal.

14.3. Place all waste generated during analytical process in properly labeled satellite waste containers for proper collection.

14.4. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. Since there is no technical difference between SW846 7471A and 7471B, this SOP may also be applicable for projects requiring method SW846 7471A.

15.2. **Definition of Terms**

15.2.1. Mercury – Also known as quicksilver, is a chemical (element) that occurs naturally in the environment in several forms. One form of mercury is used in thermometers. This form is called

"metallic mercury". Mercury is also used in barometers and other common consumer products. Mercury can also be combined with other chemicals, such as chlorine, carbon or oxygen to form either "inorganic" or "organic" mercury compounds.

15.2.2. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.2.3. Batch – Is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.2.3.1. **Preparation batch** – is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.2.3.2. **Analytical batch** – is composed of prepared samples (extracts, digestates or concentrates) which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.2.4. Detection Limit (DL) - is defined as the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type I error) is 1%.

15.2.5. Limit of Detection (LOD) - is defined as the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%.

15.2.6. Limit of Quantitation (LOQ) - is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.2.7. Material Safety Data Sheet (MSDS) – is a written information concerning a chemical physical properties, toxicity, health hazards, fire hazard and reactivity data including storage, spill and handling precautions.

15.2.8. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.2.9. Calibration Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.2.10. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.2.11. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.2.12. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.2.13. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.2.14. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID

are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.2.15. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.2.16. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.2.17. Matrix – is a component or form of a sample.

15.2.18. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.2.19. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.2.20. Corrective Action – Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

15.2.21. Non-conformance – An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

15.2.22. Raw Data – Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheet, record, memoranda, notes or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

15.3. **Application of EMAX QC Procedures**

15.3.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing analysis for mercury. In instances where there is a project or program QAPP, the requirements given in the project takes precedence over this SOP.

15.4. **Department of Defense (DoD) Projects**

15.4.1. Samples from DoD sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update is applied.

15.5. **Department of Energy (DoE) Projects**

15.5.1. Samples from DoE sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update is applied.

16.0 REFERENCES

16.1. Method 7471B, Rev. 2, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846, Feb. 2007.

16.2. EMAX Quality Systems Manual, as updated.

17.0 APPENDICES

17.1. Figures

17.1.1. Figure 1 Autosampler Layout

17.1.2. Figure 2 Typical Calibration Curve

17.1.3. Figure 3 Typical Sample Result Summary

17.1.4. Figure 4 Typical LCS/LCSD Summary

17.1.5. Figure 5 Typical MS/MSD Summary

17.1.6. Figure 6 Typical Dilution Test Report Summary

17.1.7. Figure 7 Typical Post Digestion Spike Summary

17.1.8. Figure 8 Typical Case Narrative

17.2. Appendices

17.2.1. Appendix 1 Summary of Quality Control Procedures

17.2.2. Appendix 2 Demonstration of Capability

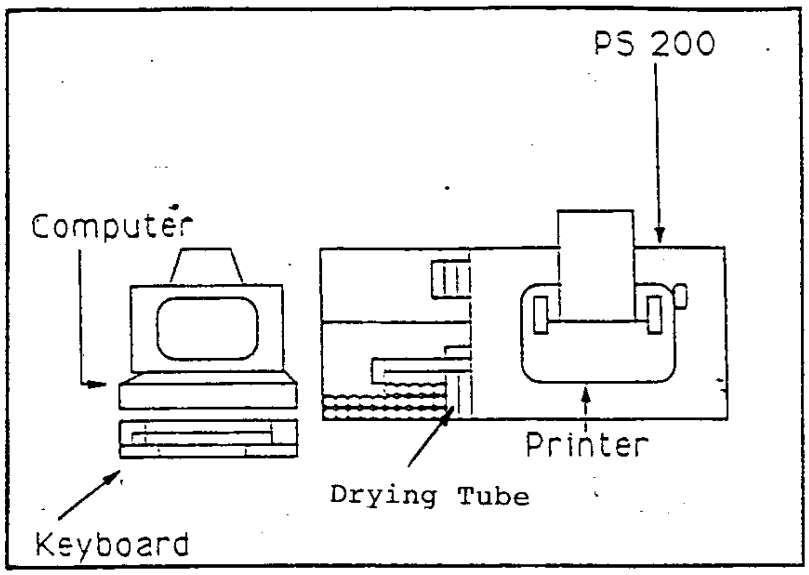
17.3. Forms

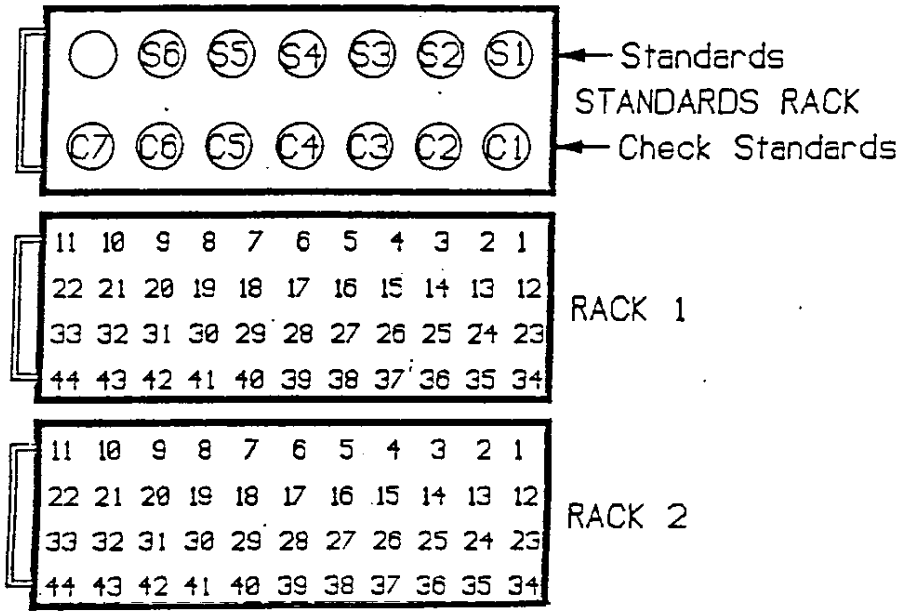
17.3.1. 7471FS Sample Preparation Log

17.3.2. 7471FA Analytical Run Log

17.3.3. 7471FM Instrument Maintenance Log

Figure 1: **AUTOSAMPLER LAYOUT**





Autosampler layout

Figure 2: **TYPICAL CALIBRATION CURVE**

```
RunProt: HGCOM
RunFold: M47C011  Seq: 6    Batch:
                  Prnt: R/T On                        Pump: On
                  Rev: 4.2    15:23:19 12 Mar 2010 Xmit: Off Gas:     0.35 LPM
State: Idle                                           User: NT/JC       A/S: On
CALIBRATION: Line  proto: HGCOM
     Hg                          Accepted
    Conc.   Calc.    Dev. ->linear
S1  .000   -.032   -.032   Quadratic
S2  .200    .148   -.052   Wtdlinear
S3  1.00    .970   -.030           C
S4  2.00    2.03    .026   Accept   o
S5  5.00    5.19    .191            n
S6  10.0    9.90   -.102            c
A   .0000000      r    .999652
B   8.45241e-6    C   -6.68307e-2
      Mean                                  Relative Absorbance
S1      4115        0 SD      4115
S2     25365      0 %RSD     25365
S3    122632      0 %RSD    122632
S4    247569      0 %RSD    247569
S5    622010      0 %RSD    622010
S6   1178982      0 %RSD   1178982

New cal coefficients stored
```

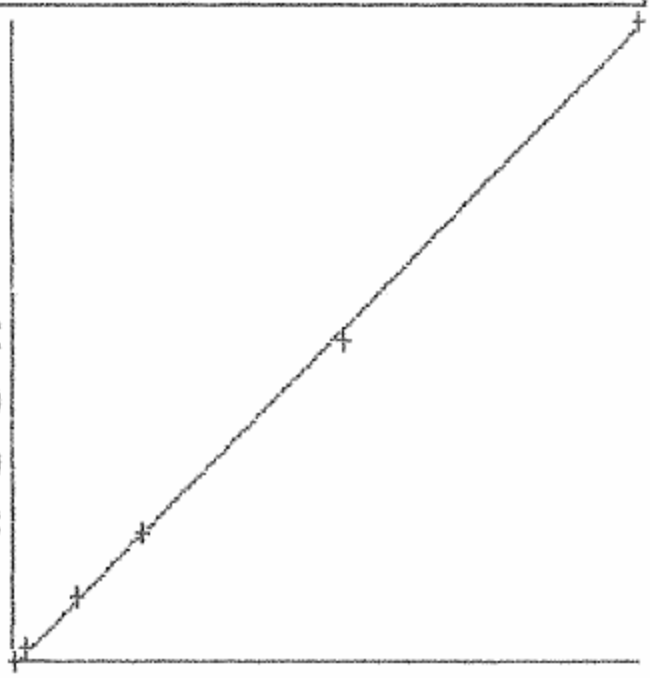


Figure 3: **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 7471B
MERCURY BY COLD VAPOR

Client : XYZ, INC.
Project : CLEAN LAND PROJECT
Batch No. : 10C029
Matrix : SOIL
Instrument ID : TI047

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/kg)	DLF	MOIST	LOQ (mg/kg)	LOD (mg/kg)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1S	HGC016SB	ND	1	NA	0.100	0.0330	03/12/1015:33	03/12/1011:00	M47C011010	M47C011008	HGC016S	NA	03/12/10
LCS1S	HGC016SL	0.845	1	NA	0.100	0.0330	03/12/1015:35	03/12/1011:00	M47C011011	M47C011008	HGC016S	NA	03/12/10
LCD1S	HGC016SC	0.848	1	NA	0.100	0.0330	03/12/1015:37	03/12/1011:00	M47C011012	M47C011008	HGC016S	NA	03/12/10
B340-002SAS	C029-06A	14.3	1	14.3	0.117	0.0385	03/12/1015:40	03/12/1011:00	M47C011013	M47C011008	HGC016S	03/02/10	03/02/10
B340-002S	C029-06	ND	1	14.3	0.117	0.0385	03/12/1015:42	03/12/1011:00	M47C011014	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SDL	C029-06J	ND	5	14.3	0.583	0.193	03/12/1015:44	03/12/1011:00	M47C011015	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SMS	C029-06M	1.00	1	14.3	0.117	0.0385	03/12/1015:46	03/12/1011:00	M47C011016	M47C011008	HGC016S	03/02/10	03/02/10
B340-002SMSD	C029-06S	0.996	1	14.3	0.117	0.0385	03/12/1015:49	03/12/1011:00	M47C011017	M47C011008	HGC016S	03/02/10	03/02/10
B340-003S	C029-07	ND	1	16.6	0.120	0.0396	03/12/1015:51	03/12/1011:00	M47C011018	M47C011008	HGC016S	03/02/10	03/02/10
B340-004S	C029-08	ND	1	16.1	0.119	0.0393	03/12/1015:53	03/12/1011:00	M47C011019	M47C011008	HGC016S	03/02/10	03/02/10

Figure 4: **TYPICAL LCS/LCSD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
SDG NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL			% MOISTURE:	NA
DILTN FACTR:	1	1	1		
SAMPLE ID:	MBLK1S				
CONTROL NO.:	HGC016SB	HGC016SL	HGC016SC		
LAB FILE ID:	M47C011010	M47C011011	M47C011012		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	NA
DATIME ANALYZD:	03/12/1015:33	03/12/1015:35	03/12/1015:37	DATE RECEIVED:	03/12/10
PREP. BATCH:	HGC016S	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008	M47C011008		

ACCESSION:

PARAMETER	BLNK RSLT mg/kg	SPIKE AMT mg/kg	BS RSLT mg/kg	BS % REC	SPIKE AMT mg/kg	BSD RSLT mg/kg	BSD % REC	RPD %	QC LIMIT %	MAX RPD %
Mercury	ND	0.833	0.845	101	0.833	0.848	102	0	80-120	20

Figure 5: **TYPICAL MS/MSD SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
SDG NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL			% MOISTURE:	14.3
DILTN FACTR:	1	1	1		
SAMPLE ID:	B340-002S				
CONTROL NO.:	C029-06	C029-06M	C029-06S		
LAB FILE ID:	M47C011014	M47C011016	M47C011017		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATIME ANALYZD:	03/12/1015:42	03/12/1015:46	03/12/1015:49	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT mg/kg	SPIKE AMT mg/kg	MS RSLT mg/kg	MS % REC	SPIKE AMT mg/kg	MSD RSLT mg/kg	MSD % REC	RPD %	QC LIMIT %	MAX RPD %
Mercury	ND	0.972	1.00	103	0.972	0.996	102	1	80-120	20

Figure 6: TYPICAL DILUTION TEST REPORT SUMMARY

EMAX QUALITY CONTROL DATA
SERIAL DILUTION ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
BATCH NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL		% MOISTURE:	14.3
DILUTION FACTOR:	1	5		
SAMPLE ID:	B340-002S	B340-002SDL		
EMAX SAMP ID:	C029-06	C029-06J		
LAB FILE ID:	M47C011014	M47C011015		
DATE EXTRACTED:	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATE ANALYZED:	03/12/1015:42	03/12/1015:44	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SERIAL DIL RSLT (mg/kg)	DIF RSLT %	QC LIMIT (%)
Mercury	ND	ND	0	10

Figure 7: TYPICAL POST DIGESTION SPIKE REPORT SUMMARY

EMAX QUALITY CONTROL DATA
ANALYTICAL SPIKE ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND PROJECT
SDG NO.: 10C029
METHOD: METHOD 7471B

MATRIX:	SOIL		% MOISTURE:	14.3
DILTN FACTR:	1	1		
SAMPLE ID:	B340-002S			
CONTROL NO.:	C029-06	C029-06A		
LAB FILE ID:	M47C011014	M47C011013		
DATIME EXTRCTD:	03/12/1011:00	03/12/1011:00	DATE COLLECTED:	03/02/10
DATIME ANALYZD:	03/12/1015:42	03/12/1015:40	DATE RECEIVED:	03/02/10
PREP. BATCH:	HGC016S	HGC016S		
CALIB. REF:	M47C011008	M47C011008		

ACCESSION:

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	AS RSLT (mg/kg)	AS % REC	QC LIMIT (%)
Mercury	ND	0.972	1.02	105	85-115

Figure 8: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN LAND PROJECT

SDG : 10C029

METHOD 7471B
MERCURY BY COLD VAPOR

A total of three (3) soil samples were received on 03/02/10 for Mercury analysis, Method 7471B in accordance with Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, USEPA SW-846.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source. Continuing calibration verifications were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for HGC016SL/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries for C029-06M/S were within project QC limits.
Analytical spike and serial dilution were analyzed for matrix interference evaluation. Results were within method acceptance criteria.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURE

PARAMETER	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Initial multipoint calibration	Daily initial calibration prior to sample analysis	Correlation coefficient r ≥ 0.995 for linear regression	Correct the problem then repeat initial calibration		
Initial calibration verification (second source)	Daily after initial calibration	Analyte within ± 10% of expected value	Correct the problem then repeat initial calibration		
Calibration verification (CCV)	Daily, before sample analysis, every 10 samples and at the end of analysis sequence	Analyte within ± 20% of expected value	Repeat calibration and re-analyze all samples since last successful calibration		
Calibration blank (CCB)	After every calibration verification	No analyte detected > LOD	Correct the problem then re-analyze calibration blank and previous samples		
Method blank (MB)	One per preparation batch	No analyte detected > ½ LOQ	Re-prep and re-analyze method blank and all samples processed with the contaminated blank		
Lab Control Sample (LCS)	One LCS per preparation batch	%Rec.: 80-120%	Re-prep and re-analyze the LCS and all associated samples		
MS/MSD or MS/Dup	One set MS/MSD or MS/Dup in every preparatory batch	%Rec. 80-120%, RPD≤ 20%	Perform Post-Digestion Spike.		
Post-Digestion Spike	When MS/MSD or MS/Dup fails	%Rec. 85-115%	Perform dilution test if analyte concentration is sufficiently high (~5x the LOQ after dilution), otherwise perform MSA.		
Dilution Test	When Post-Digestion Spike fails and analyte concentration is sufficiently high (~5x the LOQ after dilution)	Within ± 10% of the parent sample result	Perform MSA.		
Comments: Refer to PSR for flagging criteria LOQ = lowest calibration point			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
MERCURY

SOP: EMAX-7471
Conc Unit: mg/Kg
Sample Amount(gm): 1

Extraction dates: 12/22/11 & 12/29/11
Analysis dates: 12/22/11 & 12/29/11
Extracted and Analyzed by: N. Tan

PARAMETER	HGL016SL	HGL016SC	HGL018SL	HGL018SC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	M47L015-11	M47L015-12	M47L017-11	M47L017-12							
Mercury	0.887	0.875	0.900	0.910	0.833	0.893	107	0.015	1.7	80 - 120	PASSED

7471FS: SAMPLE PREPARATION LOG

EMAX LABORATORIES, INC.

DIGESTION LOG *for* MERCURY

Page 1

Note: For samples, relevant QCs/Standards digested, refer to attached digestion sequence.

Comments:

Book #: E47-089

Batch No.:

Matrix:

SOP #	Rev. #
☐ EMAX-7470	
☐ EMAX-7471	
☐ EMAX-245.1	
☐ EMAX-	

Standards	ID	Conc. (µg/L)	Amount Added (ml)
ICAL			
CCV			
ICV			
LCS/MS			

Reagent	ID
HNO_3	
HCl	
H_2SO_4	
$KMnO_4$	
$K_2S_2O_8$	
$NH_2OH{\cdot}HCl$	
$SnCl_2$	
Silica Sand	

Digestor ID/ Temp (°C)

Thermometer ID:

Pipette ID:

☐ H_2SO_4 dispenser checked @ 2.5 ml with Class A graduated cylinder

☐ HCl dispenser checked @ ___ ml with Class A graduated cylinder

☐ HNO_3 dispenser checked @ ___ ml with Class A graduated cylinder

Prepared By:

Standard Added By: Witnessed By:

7471FA: ANALYTICAL RUN LOG

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
MERCURY

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Start Date: Start Time:

End Date: End Time:

Comments:

Book #: A47-085

Instrument No.: 47

Analytical Sequence/Batch:

Method File:

Micropipette ID: ☐ ICP DOE-1

Micropipette ID: ☐ HG-03

Micropipette ID: ☐ HG-04

Micropipette ID: ☐

SOP #	Rev. #
☐ EMAX-7470	
☐ EMAX-7471	
☐ EMAX-245.1	
☐ EMAX-	

STANDARDS ID
S1
S2
S3
S4
S5
S6
CCV
ICV
LCS
Analytical Spike

Analyzed By:

Date:

7471FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrumetnt No: 47 Month: Year: 201_ Book # M47-010

DAQ TEST							
Sample: 700,000 - 1,720,000							
Hg Lamp Volt: 8.0-9.5							
GAS CONTROL TEST							
Argon Input Pressure: 75-90 psi							
Power Supply Voltage: 5V+/-0.25, +12V+/-0.5, -12V+/-0.5							
Gas : 0 - 1.0 LPM							
Pump Rate: 2 - 15 mL/min							
Instrument Warm-up Minimum 5 min							
Peristaltic Pump							
Tubings Pump/Capillary							
Fume Hood							
Reductant Bottle							
Rinse Solution							
Computer Date/Time							
Printer Paper							
Analyst Initial							
Trouble Shooting							
Problem(s) Encountered							
Return To Specs (Analyst Initial)							

Code		Code	Corrective Action

STANDARD OPERATING PROCEDURES

ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY

SOP No.:	EMAX-8081	Revision No.	8	Effective Date:	16-Jun-14
Prepared By:	Tu Nisamaneepong			Date:	06-16-14
Approved By:	Kenette Pimentel QA Manager			Date:	06.16.14
Approved By:	Caspar Pang Laboratory Director			Date:	06-16-14

Control Number: 8081-08-

1.0 SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentration of various Organochlorine Pesticides in soil, sediment, sludge, and wastewater samples by gas chromatography method. This SOP is an adaptation of EPA 8081B. Since EPA 8081B is an update and enhancement of EPA 8081A, this SOP is also applicable to EPA 8081A.

2.0 SUMMARY OF METHOD

2.1. This method provides gas chromatographic conditions for the identification and quantitation of Organochlorine Pesticides with dual Electron Capture Detectors (ECD). The samples are extracted in methylene chloride and exchanged to hexane before GC analysis.

2.2. **Interferences**

2.2.1. Interferences by phthalate esters introduced during sample preparation can pose a major problem in pesticide determinations. Avoiding contact with any plastic materials and checking all solvents for phthalate contamination can minimize interferences. Glassware must be scrupulously cleaned.

2.2.2. The presence of elemental sulfur will result in broad peaks that interfere with the detection of early-eluting organochlorine pesticides. Sulfur contamination is most likely present in sediment samples. The TBA procedure, GPC or other cleanup technique can be used for sulfur removal.

2.2.3. Other interferences such as aliphatic compounds, aromatics and nitrogen-containing compounds may be eliminated by using Florisil cleanup.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Table 10 lists the DL, LOD and LOQ values of the target analytes of this method.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The linear dynamic range for this method as determined in this SOP is listed on the table below.

Analytes	Water (µg/L)	Soil (µg/Kg)
alpha-BHC, Endosulfan I, gamma-BHC, Heptachlor, Aldrin, alpha-Chlordane, beta-BHC, delta-BHC, gamma-Chlordane, Heptachlor Epoxide	0.1 – 0.8	2 – 26
4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Dieldrin, Endrin, Endosulfan II, Endosulfan Sulfate, Endrin Aldehyde, Endrin Ketone	0.1 – 1.6	2 – 52
Methoxychlor	1 – 8	10– 260
Toxaphene	2 – 20	50 – 660
Technical Chlordane	1 – 15	50 – 500
2,4'-DDD, 2.4'-DDE, 2,4'-DDT, Oxychlordane, cis-Nonachlor, trans-Nonachlor, Mirex	0.1 – 0.8	2 – 26

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. Extract water and soil samples within 7 and 14 days from date of collection, respectively.

5.1.2. Analyze extracts within 40 days after extraction completion date.

5.2. **Preservation**

5.2.1. Store samples and extract at ≤6°C.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA04 Detection Limit Study

6.3. EMAX-QA08 Corrective Action

6.4. EMAX-QC01 Quality Control for Chemicals

6.5. EMAX-QC02 Analytical Standard Preparation

6.6. EMAX-QC07 Glassware Cleaning

6.7. EMAX-SM03 Waste Disposal

6.8. EMAX-SM04 Analytical and QC Sample Labeling

6.9. EMAX-3520 Extraction, Continuous Liquid/Liquid

6.10. EMAX-3550 Extraction, Pulse Sonication

6.11. EMAX-3540 Extraction, Soxhlet

6.12. EMAX-3620 Cleanup, Florisil

6.13. EMAX-3660 Cleanup, Sulfur

7.0 SAFETY

7.1. Read all SDS of chemicals listed in this SOP.

7.2. ECD contains minute quantity of Radioactive Ni (63). Conduct a wipe test (experienced personnel or manufacturer only) semi-annually or sooner if potential problem is suspected.

7.3. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves at all times when performing this procedure.

7.4. If, for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with copious amounts of tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS, AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatograph	PE Clarus 680
Detector	Dual Electron Capture Detectors
Column	RTX CLPEST I (30 m x 0.32 mm x 0.32 μm) RTX CLPEST II (30 m x 0.32 mm x 0.25 μm) (Alternate columns may be used after verification of performance)
Data System	EZ Chrom Elite
Auto Sampler	PE Clarus 680 or equivalent
Gas	ultra-high purity nitrogen Peak Scientific Hydrogen Generator PH-600 PE Hydrogen Generator PGX Series 3
Microsyringes	10, 25, 100and 500 ul with a 0.006 mm ID needle (Hamilton 702N or equivalent) for dilution purposes
Transfer Pipette	Pasteur

8.2. **Chemicals and Reagents**

Solvent [GC-grade]	Methylene Chloride, Hexane, Acetone

9.0 STANDARDS

9.1. **Standard Preparation**

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.2. **Stock Standard**

9.2.1. Purchase Primary Calibration stock standards as certified solutions in one mixture. After opening, transfer the stock standard to an inert amber vial and store with a minimum of headspace.

9.2.2. Purchase a Secondary set of stock standards from a different source to verify the concentration of the first set of standard. Treat the secondary standard similarly as the primary standard.

9.2.3. Purchase LCS/MS, surrogate and performance evaluation standards as certified solutions from various suppliers.

9.2.4. All standards shall be stored at ≤ 6°C.

9.3. **Intermediate Standard**

9.3.1. Prepare intermediate standards as suggested in Table 3 (primary source) and Table 4 (secondary source).

9.3.2. Store all prepared standards in an inert vial with minimum headspace at ≤ 6°C.

9.4. **Initial Calibration Standard (ICAL)**

9.4.1. Prepare five or more calibration standards as suggested in Table 2 from primary intermediate standard (refer to Table 3).

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV at concentration levels suggested in Table 5 using intermediate standard from second source stock standard (refer to Table 4).

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Prepare DCC from the same source as the ICAL standard as suggested in Table 5.

9.7. **Surrogate Standard**

9.7.1. Prepare surrogate standard as suggested in Table 6.

9.8. **LCS/MS Spike Standard**

9.8.1. Prepare LCS solution as suggested in Table 4.

9.8.2. Prepare MS spike standard as suggested in Table 7.

9.9. **Performance Evaluation Mixture (PEM)**

9.9.1. Prepare PEM as suggested in Table 8.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Prepare aqueous samples as described in EMAX-3520 or EMAX-3510.

10.1.2. Prepare solid samples as described in EMAX-3550, EMAX-3540 or EMAX-3545.

10.1.3. Perform extract clean up (if necessary) as described in EMAX-3620, EMAX-3640 or EMAX-3660, whichever is appropriate.

10.2. **Instrument Parameters**

10.2.1. Method 8081A requires an analytical system complete with a temperature programmable gas chromatograph equipped with an autosampler suitable for on column injection of 1 to 5 µl.

10.2.2. Gas Pressure

N_2 gas line : 60 – 90 psi

H_2 gas line : 60 – 90 psi

10.2.3. Detector Temperature : 305°C (Inst. E8 and F9)

10.2.4. Injector Temperature : 220°C (Inst. E8 & F9)

10.2.5. Make-up Gas Flow : N_2 at 40 mL/min

10.2.6. Carrier Gas Flow

For Temperature Program (Inst. F9) : 3.8 mL/min

For Temperature Program (Inst. E8) : See flow program below

Carrier Gas Ramp	Rate (mL/min)	Setpoint (mL/min)	Hold (min)
Initial	0	2.7	5.5
1	2.0	4.0	20.0

10.2.7. Oven Temperature Program (Instrument E8)

Oven Ramp	Rate (°C/min)	Temp (°C)	Hold (min)
Initial	0	140	0.50
1	25	230	2.00
2	5	260	0.20
3	25	290	2.50

10.2.8. Oven Temperature Program (Instrument F9)

Oven Ramp	Rate (°C/min)	Temp (°C)	Hold (min)
Initial	0	130	0.50
1	25	230	2.00
2	5	260	0.20
3	25	290	3.00

10.3. **Calibration**

10.3.1. **Performance Evaluation Check**

10.3.1.1. Analyze instrument blank and a PEM containing DDT and Endrin to monitor the system performance at 12-hour interval prior to performing any calibration.

10.3.1.2. Calculate the breakdown by using Equations 10.6.6 ($\%B_T$) for DDT and 10.6.7 ($\%B_E$) for Endrin.

10.3.1.3. Check Appendix 1 for acceptance criteria before proceeding with sample analysis.

10.3.1.4. If system failed to meet the acceptance criteria, refer to Section 12 for corrective action.

10.3.2. **Initial Calibration (ICAL)**

10.3.2.1. Perform ICAL if instrument is new, ICV or DCC failed to meet acceptance criteria or after a major instrument repair.

10.3.2.2. A minimum of five calibration standards, or as suggested in Table 1, over the concentration range of interest are sequentially injected into the GC. Refer to Table 1 for ICAL concentrations. Peak areas are obtained from each analyte.

10.3.2.3. Application of ICAL Curve for Quantitation

10.3.2.3.1. Generate a summary of calibration factors for each analyte at each concentration using Eq-10.6.1. Calculate the Average Calibration Factor (ACF), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to, Eq. 10.6.2, Eq. 10.6.3 and Eq. 10.6.4, respectively.

- If RSD is ≤ 20% ACF may be applied.
- Apply Inverse Weighting Factor (1/y or 1/y2; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.995.
- Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.995.
- It may be appropriate to force the regression through zero for specific analytes[1]. When exercising this option [as included in the data acquisition software], make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.2.4. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.2.5. Refer to Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.3.3. **Initial Calibration Verification (ICV)**

10.3.3.1. Analyze ICV prepared from another source as described in Section 9.5 to verify the concentrations of the ICAL.

[1] SW846 Method 8000B, Section 7.5.3; SW846 Method 8000C, Section 11.5.2.1

10.3.3.2. Calculate the CF and the percent difference (%D) according to Eq-10.6.1 and 10.6.5 respectively. Refer to Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.3.4. **Multicomponent Target Analyses**

10.3.4.1. For multicomponent target analytes (Toxaphene), a five-point calibration standard shall be included in initial calibration for pattern recognition and quantitation.

10.3.4.2. Integrate the total response of the chromatogram to obtain the total area. Calculate the calibration factor (CF) by using Equation 10.6.1.

10.3.5. **Daily Calibration Check (DCC)**

10.3.5.1. Analyze DCC at the start of the 12-hour shift prior to sample analysis and close the analytical run with an ending DCC.

10.3.5.2. Calculate the %D by using Equation 10.6.5. Check Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Analytical Sequence**

10.4.1.1. Following the instrument data acquisition software, prepare the analytical sequence file as suggested below:

- Pesticide Prime – 20/200 ppb pesticide injected at the beginning of analytical sequence if the GC has not been used for a day or more
- IB – instrument blank
- PEM – performance evaluation mixture
- ICAL – initial calibration standards
- ICV or DCC1 – initial calibration verification or continuing calibration standard
- MB – method blank
- LCS – lab control sample
- Samples – up to 12 hours
- DCC2 – continuing calibration standard or ending DCC

10.4.2. **Sample Analysis**

10.4.2.1. Transfer a minimum of 0.5 ml of extract to a 2-ml auto sampler vial (or equivalent) using a Pasteur pipette. Seal the vial with a polypropylene screw cap with PTFE/red silicone rubber septa. Similarly, prepare the analytical standards and QC samples.

10.4.2.2. Introduce sample extract into the GC using direct injection technique (1 to 5 µl) after all system quality control criteria have been met.

10.4.2.3. If the response exceeds the linear range of the system, dilute the sample and re-analyze.

10.4.3. **Sample Result Evaluation**

10.4.3.1. Check QC parameters as soon as the data is available.

- ✓ Check LCS recoveries against Appendix 1.
- ✓ Check MB that it is project compliant.
- ✓ Check retention time.
- ✓ Check surrogate recoveries against Appendix 1.
- ✓ Check concentration of target analytes. If the response exceeds the calibration range, dilute and re-analyze the sample until the response falls within the calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate extraction problem, fill-up an NCR and order re-extraction for the affected sample(s).

10.4.3.2. Positive identification is made when a peak falls within the retention time window of a target analyte on both columns established by the standard reference compound.

10.4.3.3. If one column meets the retention time criteria and a retention time shift is suspected on the other column, use the following guideline in reporting the data:

- ✓ Check that the expanded window does not exceed the RTW of the column in control or the established RTW or the CLP RTW (refer to table 7) whichever is greater.
- ✓ If the above condition is met, report the data and include a description of the observation in the case narrative.

10.4.4. **Retention Time Windows**

10.4.4.1. Establishing RTW

10.4.4.1.1. Collect at least three Daily Calibration Standards analyzed over a period of 72 hours.

10.4.4.1.2. Calculate the Standard Deviation (SD) of absolute retention time obtained for each analyte.

10.4.4.1.3. The width of RTW is defined by $\pm$3X SD obtained from 10.4.4.1.2.

10.4.4.2. Evaluating RTW

10.4.4.2.1. If the SD is equal to 0.00, default to the previous study until historical data is obtained or use the CLP[1] retention time window (refer to Table 9) which ever is narrower.

10.4.4.2.2. For new instruments, in the interim use the CLP retention time window (refer to Table 9) until RTW is obtained for the new instrument parameters condition.

[1] CLP-OLM4.2 Table 1 D-79/PEST

10.4.4.3. Application of RTW

10.4.4.3.1. Establish the center of absolute retention time for each analyte to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.4.3.2. Whenever the observed retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing the analyses.

10.4.4.4. Updating RTW

10.4.4.4.1. Re-establish the RTW as described in Section 10.4.4.1 when any of the following conditions occur:

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of RTW)
- Major instrument maintenance (e.g. replacement of detector or column; temperature program change, etc.)

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01 for details of manual integration.

10.4.6. **Dealing with Carryover**

- ✓ Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- ✓ If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.
- ✓ If there was a target analyte detected as found in the sample following the sample that exceeded the calibration range (for pesticides concentration ≥ 500/1000/5000 ppb; for Toxaphene concentration ≥ 25 ppm; for chlordane concentration ≥ 10 ppm and for PCBs concentration ≥ 100 ppm) re-analyze the sample to rule-out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.5. **Data Reduction**

10.5.1. Check the chromatogram of positively identified peaks.

- ✓ Peaks fall within the established retention time window on both columns.
- ✓ Peaks are sharp and not saturated.
- ✓ Peaks are properly integrated (refer to Figure 1 for Peak Evaluation Techniques).
- ✓ Target analyte peak is present in both columns to confirm positive identification.

10.5.2. Positive identification is confirmed when the identified analyte is present in both columns. The agreement between the quantitative results should be evaluated after the identification is made. Calculate the relative percent difference (RPD) between the two results according to Equation 10.6.10.2.

10.5.2.1. If the RPD is less than 40% and the peaks do not indicate any anomalies, report the higher result.

10.5.2.2. If the RPD is less than 40% and one of the peaks indicate an anomaly, report the result from the better peak.

10.5.2.3. If the RPD is greater than 40%, use professional judgment to select the most appropriate result. If no evidence of any chromatographic interference, report the higher result.

10.6. **Calculations**

10.6.1. Calculate for Calibration Factor (CF)

$$CF = \frac{R_a}{C_k}$$ Eq.-10.6.1

where:

CF - is the calibration factor

R_a - is the analyte response measured in peak area

C_k - is the known concentration of the analyte in μg/L

10.6.2. *Calculate for Standard Deviation*

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}}$$ Eq.-10.6.2

where:

SD - is the standard deviation

x_i - is the result at the ith measurement

$\bar{x}$ - is the mean

N - is the number of measurements

10.6.3. Calculate for Percent Relative Standard Deviation (%RSD)

$$\%RSD = \left[\frac{SD}{ACF}\right] 100$$ Eq.-10.6.3

where:

%RSD - is the percent relative standard deviation

SD - is the standard deviation

ACF - is the average calibration factor

10.6.4. Calculate for Average Calibration Factor (ACF)

$$ACF = \frac{\sum CF}{N}$$ Eq.-10.6.4

where:

ACF - is the average calibration factor

$\sum CF$ - is the summation of the calibration factors

N - is the number of calibration points

10.6.5. **Calculate for Least Square Linear Regression**

$$y = ax + b$$ Eq.-10.5.1.3

where:

y = Response factor

x = Concentration

a = x1 = slope of the line

$$a = \frac{\sum (x - \bar{x})(y - \bar{y})}{(x - \bar{x})^2}$$

where:

$\bar{x}$ = Average of amount ratios

$\bar{y}$ = Average of response ratios

b=x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.6.6. **Calculate for Inverse Weighting Factor**

$$y = ax + b$$ Eq.-10.5.1.4

where:

y = Response Factor

x = Concentration

a = x1 = slope of the line

$$a = \frac{\sum [(x - x_a)(y - y_a)]}{\sum (x - x_a)^2}$$

where:

$$x_a = \sum [x(1/x) / \sum (1/x)]$$

$$y_a = \sum [y(1/x) / \sum (1/x)]$$ or

$$x_a = \sum [x(1/x^2) / \sum (1/x^2)]$$

$$y_a = \sum\left[y\left(1/x^2\right)/\sum\left(1/x^2\right)\right]$$

b = x0 = intercept of the line

$$b = y_a - a * x_a$$

10.6.7. Calculate for Percent Difference for DCC from ACF

$$\%D = \left[\frac{CF - A\,CF}{ACF}\right] 100 \qquad \text{Eq.-10.6.5}$$

where:

%D - is the % Difference

ACF - is the Average Calibration Factor

CF - is the Calibration Factor of the DCC

10.6.8. Calculate for % Breakdown for DDT ($\%B_T$).

$$\%B_T = \frac{A_D + A_E}{A_T + A_D + A_E} \qquad \text{Eq.-10.6.6}$$

where:

$\%B_T$ - % DDT Breakdown

A_D - Total area of DDD

A_E - Total area of DDE

A_T - Total area of DDT

10.6.9. Calculate for % Breakdown for Endrin ($\%B_E$)

$$\%B_E = \frac{A_A + A_K}{A_E + A_A + A_K} \qquad \text{Eq.-10.6.7}$$

where:

$\%B_E$ - % Endrin Breakdown

A_A - Total area of Endrin Aldehyde

A_K - Total area of Endrin Ketone

A_E - Total area of Endrin

10.6.10. Sample Results

10.6.10.1. **Water Samples**

$$C = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a}\right)DF \qquad \text{Eq.-10.6.8.1}$$

where:

C - Concentration of sample measured in µg/L

Ra - Total response of analyte in peak area

ACF - Average response factor measure in ICAL

V_e - Volume of extract in ml

S_a - Sample amount in ml

DF - Dilution factor of sample extract

10.6.10.2. **Soil Samples**

$$C = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a\left(\%Solid\right)}\right)DF \qquad \text{Eq.-10.6.8.2}$$

where

C - Concentration of analyte to be measured (µg/kg)

R_a - Total response of analyte in peak area

ACF - Average response factor

V_e - Volume of extract in ml

S_a - Sample Amount in g

% Solid- $\frac{100 - \%\,moisture}{100}$

DF - Dilution factor of the sample extract

10.6.11. Multi-peak Compound in Sample (Toxaphene)

10.6.11.1. Total area is integrated and concentration is determined by equation 10.6.8.1 or 10.6.8.2.

10.6.12. Accuracy and Precision

10.6.12.1. **Percent Recovery**

$$\%R = \frac{C_f - C}{C_s} * 100 \qquad \text{Eq.-10.6.10.1}$$

where:

%R - percent recovery

C_f - concentration found in spiked sample

C - concentration of unspiked sample (For LCS, C=0)

Cs - theoretical concentration of surrogate spike

10.6.12.2. **Relative Percent Difference (RPD)**

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.6.10.2}$$

where:

%RPD - Relative Percent Difference

C1 - Measured concentration of the first sample aliquot

C2 - Measured concentration of the second sample aliquot

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe.

10.7.2. Generate Lab Chronicle using LABCHRN1.exe.

10.7.3. Generate sample results using F1NV3C.exe.

10.7.4. Generate the QC Summary file using QCV3CN.exe.

10.7.5. Generate the case narrative using CN1.exe.

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- DCC Summary
- ICAL Summary
- ICV Summary
- Copy of Analysis Log
- Copy of Preparation Log

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01 and the Project Specific Requirements (PSR).

✓ Check that all samples required for analysis are performed.

✓ Check that samples are extracted and analyzed within Holding Time.

✓ Check that all calibration requirements are fulfilled.

✓ Check the chromatogram of all positively identified peak(s).

✓ Check surrogate recoveries against required limits.

✓ Check that concentration of target analytes are within calibration range.

If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.2. Review the case narrative and edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to Form 8081FM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back in control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler Check	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check liner as necessary. Check instrument performance (e.g., daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Documentation	Record maintenance in instrument service logs.	Daily prior to analysis
Leak Test	Perform inlet pressure decay test.	Every 6 months or as necessary
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector where applicable.	Every 6 months or as necessary
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, sample probe, and loop.	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD (when required by the project) and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, prepare LCS/LCD to check for precision.

11.1.3. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

11.1.4. Perform QC check prior to utilizing the surrogate and LCS/MS spike standards by analyzing the prepared standard at the spiking level. Results should be within ± 20% of the expected value.

11.2. **Analytical Batch QC**

11.2.1. Instrument Performance Evaluation Check must be analyzed daily. Acceptance criteria and corrective action are discussed in Section 10.3.1.4 and Appendix 1.

11.2.2. A continuing calibration shall be performed before any other analysis is done. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.5 and Appendix 1.

11.3. **Method QC**

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid LOD and LOQ must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis. Check Appendix 1 for acceptance criteria.

11.3.5. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of In-House Quality Control Procedures in Appendix 1. Document out-of-control event/s and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If PEM failed to meet the DDT and Endrin breakdown acceptance criteria, consider the following suggestions to correct the problem:

12.2.1. Deactivate or replace the injection liner.

12.2.2. Check that the injector nut is leak-free.

12.2.3. If problem persists, inform the Supervisor.

12.3. If Initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.3.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.3.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.3.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.3.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.

12.3.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.3.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.3.5.2. Check the gas flow.

12.3.5.3. Prepare a fresh standard and repeat calibration.

12.3.6. If the problem persists, inform the supervisor.

12.4. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.4.1. Re-analyze ICV (to rule out poor injection).

12.4.2. If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error

12.4.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.

12.4.4. If the problem persists, inform the supervisor.

12.5. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.5.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new auto sampler syringe.

12.5.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.5.3. Rule out preparation contamination by preparing a new instrument blank.

12.5.4. If the problem persists, inform the supervisor.

12.6. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.6.1. Change the liner.

12.6.2. Clean injection port.

12.6.3. Prepare new standard.

12.6.4. Cut or replace column.

12.6.5. Clean the detector.

12.6.6. Rule out leaks by checking all connections.

12.6.7. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL.

12.7. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.7.1. Rule out instrument contamination by checking instrument blank.

12.7.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01.

12.7.3. Rule out glassware contamination used for extraction as described in EMAX-QC07.

12.7.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents.

12.7.5. If the problem persists, inform the supervisor.

12.8. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.8.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level.

12.8.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.8.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.9. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.9.1. If corrective action needs the function of other department; e.g., if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.9.2. If corrective action needs the assistance of the project manager; e.g. If the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.10. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. All unused expired analytical standards shall be separated and properly identified prior to endorsing them to WDU for proper disposal.

14.0 WASTE MANAGEMENT

14.1. All unused samples, expired analytical standards and other waste generated during the analytical process, endorsed to WDU shall be disposed in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation Batch** – is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical Batch** – is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include

samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – is defined as the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type I error) is 1%.

15.1.4. Limit of Detection (LOD) – is defined as the smallest amount or concentration of substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative result rate (Type II error) is 1%.

15.1.5. Limit of Quantitation (LOQ) – is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.1.6. Safety Data Sheet (SDS) – is written information concerning a chemical physical properties, toxicity, health hazards, fire hazard and reactivity data including storage, spill and handling precautions.

15.1.7. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.8. Calibration Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.9. Carry-over – are contaminants retained in the instrument/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.10. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.11. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical process to monitor contamination.

15.1.12. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.13. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.14. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.15. Sample Duplicate – is a replicate of a sub-sample taken one sample, prepared and analyzed within the same preparation batch.

15.1.16. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.17. Matrix – A component or form of a sample.

15.1.18. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.19. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.20. Surrogate – are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard; used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be detected in environmental media.

15.1.21. Reagent Water – is purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.22. Reagent Soil – organic-free Ottawa sand or equivalent.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing organochlorine pesticides analysis by GC. In instances where there is a project or program QAPP, the requirements given in the project takes precedence over this SOP.

15.3. **Department of Defense (DoD) Projects and Department of Energy (DoE) Projects**

15.3.1. Samples from DoD and DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical / Chemical Methods", EPA Publication SW-846 Methods 8000B and 8081B, as updated

16.2. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. **Figures**

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17.1.2.	Figure 2	Typical Chromatogram
17.1.3.	Figure 3	Typical Initial Calibration Summary
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17.2. **Tables**

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17.4.1. 8081FS Sample Preparation Log
17.4.2. 8081FA Analytical Run Log
17.4.3. 8081FM Instrument Maintenance Log

Figure 1: PEAK EVALUATION TECHNIQUE

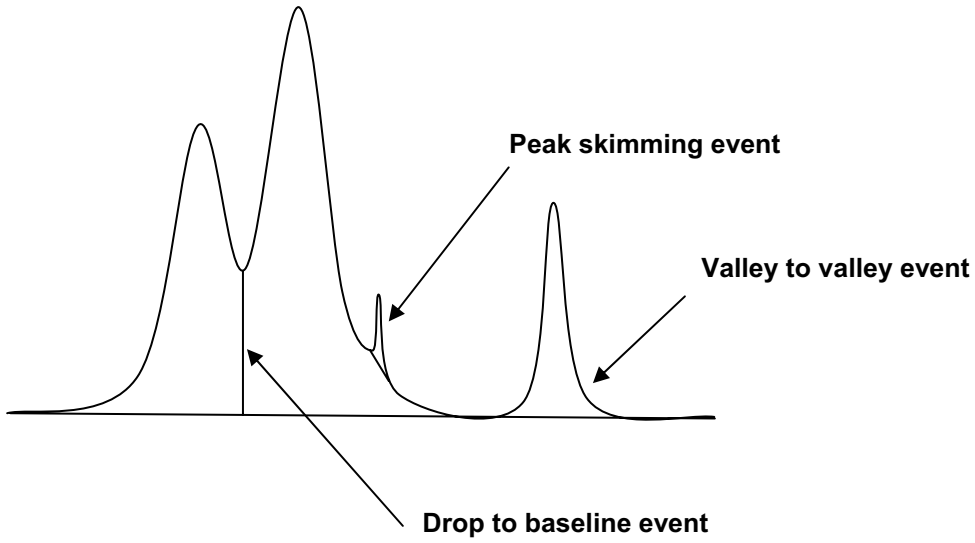
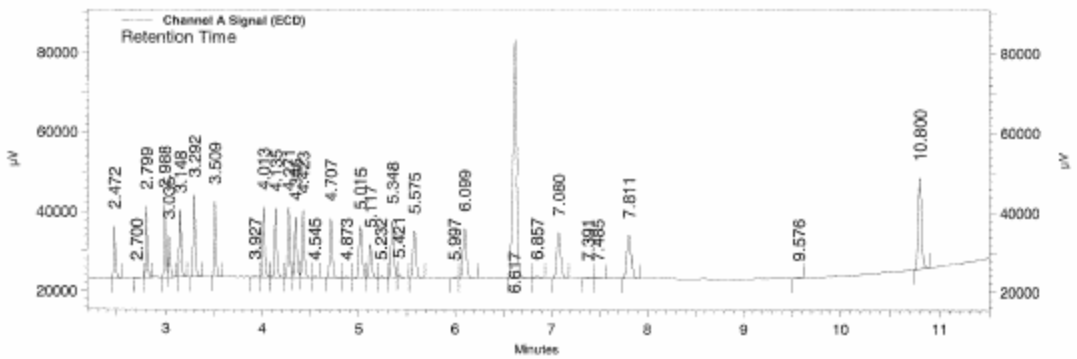


Figure 2: **TYPICAL CHROMATOGRAM**

Organochlorine Pesticides by GC/ECD
EMAX Laboratories, Inc.

Page 1 of 2

Sample ID: ICPE8A2601 (20/200ppb PEST ICV)
Instrument ID: E8
Method Name: C:\EZChrom Elite\Methods\CPE8A26.met
Data: C:\EZChrom Elite\Data\MA26\MA26034.dat
User: Enrico
Acquired: 01/27/14 06:35:24
Printed: 01/27/14 11:45:07



Channel A Signal (ECD) Results

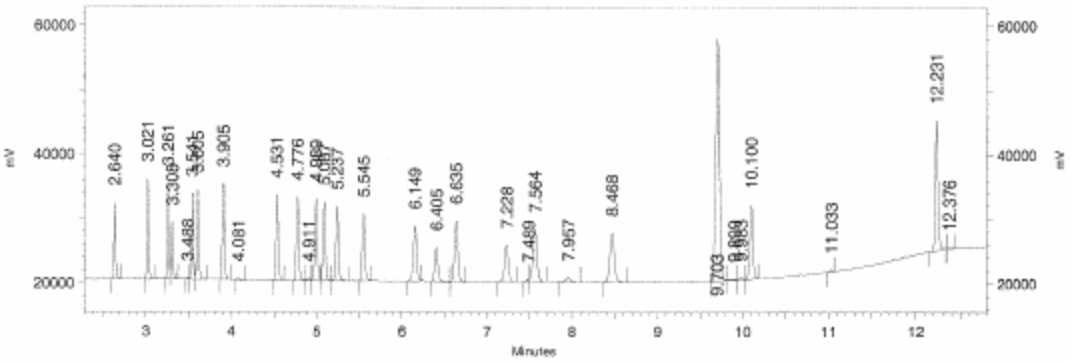
Name	Expected RT (mins)	Retention Time (mins)	Area	Average RF	ESTD concentration (ppb)	Integration Codes
TCX	2.476	2.472	955775	47593.1	20.082	BB
alpha-BHC	2.804	2.799	1157551	58657.7	19.734	BB
gamma-BHC	2.993	2.988	1194590	60273.4	19.820	BV
beta-BHC	3.040	3.035	755069	37664.5	20.047	VI
delta-BHC	3.153	3.148	1136840	57926.2	19.626	BB
Heptachlor	3.297	3.292	1538033	76393.2	20.133	BB
Aldrin	3.515	3.509	1420481	70593.4	20.122	BB
Heptachlor Epoxide	4.020	4.013	1522180	75468.6	20.170	VV
gamma-Chlordane	4.141	4.135	1539037	76628.8	20.084	VV
alpha-Chlordane	4.277	4.271	1556812	76507.4	20.349	VV
DDE	4.352	4.345	1385456	71405.8	19.403	VV
Endosulfan I	4.429	4.423	1586424	81710.0	19.415	VV
Dieldrin	4.713	4.707	1462708	72989.9	20.040	BV
Endrin	5.021	5.015	1372902	69755.1	19.682	BV
DDD	5.124	5.117	888487	47187.6	18.829	VV
Endosulfan II	5.356	5.348	1607919	77469.6	20.755	BV
DDT	5.581	5.575	1409455	61818.5	22.800	BB
Endrin aldehyde	6.107	6.099	1682493	81300.8	20.695	VB
Methoxychlor	6.625	6.617	8917026	42300.6	210.801	BV
Endosulfan Sulfate	7.087	7.080	1781217	86351.4	20.628	BB
Endrin Ketone	7.820	7.811	1892134	97359.1	19.435	BB
DCB	10.807	10.800	2835411	137403.8	20.636	BB

Figure 2: **TYPICAL CHROMATOGRAM**

Organochlorine Pesticides by GC/ECD
EMAX Laboratories, Inc.

Page 2 of 2

Sample ID: ICPE8A2601 (20/200ppb PEST ICV)
Instrument ID: E8
Method Name: C:\EZChrom Elite\Methods\CPE8A26.met
Data: C:\EZChrom Elite\Data\MA26\MA26034.dat
User: Enrico
Acquired: 01/27/14 06:35:24
Printed: 01/27/14 11:45:07



Channel B Signal
(ECD) Results

Name	Expected RT (mins)	Retention Time (mins)	Area	Average RF	ESTD concentration (ppb)	Integration Codes
TCX	2.644	2.640	883518	43071.9	20.513	BB
alpha-BHC	3.027	3.021	1073354	54398.4	19.731	BB
gamma-BHC	3.267	3.261	1035320	52652.3	19.663	BV
beta-BHC	3.313	3.308	674615	33191.9	20.325	VB
delta-BHC	3.547	3.541	977515	51049.0	19.149	VV
Heptachlor	3.612	3.605	1160948	59362.2	19.557	VB
Aldrin	3.911	3.905	1240610	62034.4	19.999	BB
Heptachlor Epoxide	4.537	4.531	1305228	65794.6	19.838	BB
gamma-Chlordane	4.783	4.776	1339776	67877.6	19.738	BV
alpha-Chlordane	4.995	4.989	1366492	68399.9	19.978	VV
Endosulfan I	5.092	5.087	1332936	67777.1	19.666	VV
DDE	5.245	5.237	1314457	67645.1	19.432	VB
Dieldrin	5.552	5.545	1244362	63414.0	19.623	BB
Endrin	6.156	6.149	1182887	59723.1	19.806	BB
DDD	6.412	6.405	734238	38299.0	19.171	BB
Endosulfan II	6.641	6.635	1371009	66625.0	20.578	BB
DDT	7.235	7.228	959460	44911.8	21.363	BB
Endrin Aldehyde	7.571	7.564	1433036	69406.3	20.647	VB
Endosulfan Sulfate	8.476	8.468	1515182	72700.4	20.841	BB
Methoxychlor	9.708	9.703	5835344	26720.6	218.384	BV
Endrin Ketone	10.107	10.100	1577755	79509.5	19.844	BB
DCB	12.236	12.231	2256977	108283.0	20.843	BV

Figure 2: **TYPICAL CHROMATOGRAM**

EPA 8081 by GC/ECD
EMAX Analytical Laboratories, Inc.

Page 1 of 1

Sample ID: ITOE8A2601 (500/25ppb TOXA ICV)
Instrument ID: E8
Method Name: C:\EZChrom Elite\Methods\TOE8A26.met
Data: C:\EZChrom Elite\Data\MA26\MA26044.dat
User: Enrico
Acquired: 01/27/14 09:57:27
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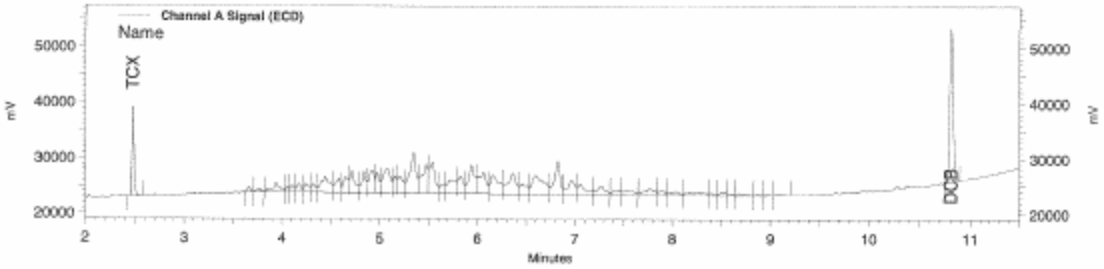
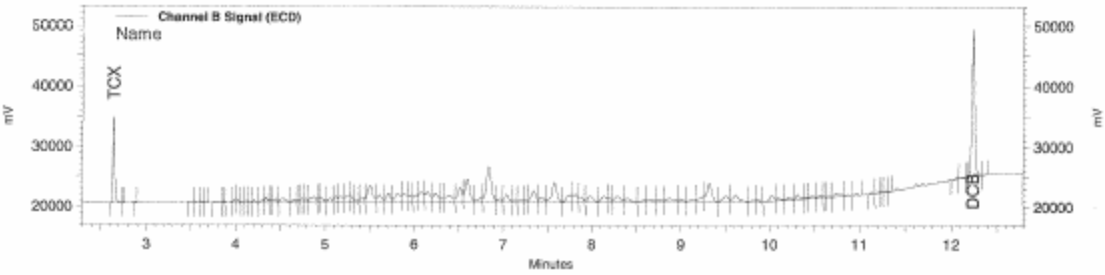


Channel A Signal (ECD) Results

Name	Expected RT (mins)	Retention Time (mins)	Area	Average RF	ESTD concentration	Integration Codes
TCX	2.480	2.473	1169230	47804.9	24.46	BB
DCB	10.813	10.804	3396622	139579.7	24.33	IB
Toxaphene			26342693	57718.4	456.40	



Channel B Signal (ECD) Results

Name	Expected RT (mins)	Retention Time (mins)	Area	Average RF	ESTD concentration	Integration Codes
TCX	2.648	2.641	1055995	42950.1	24.59	BV
DCB	12.243	12.235	2709359	112370.7	24.11	VV
Toxaphene			16053757	37656.5	426.32	

Figure 2: **TYPICAL CHROMATOGRAM**

EPA 8081 by GC/ECD
EMAX Analytical Laboratories, Inc.

Page 1 of 1

Sample ID: ICRE8A2601 (500/25ppb CHLO ICAL)
Instrument ID: E8
Method Name: C:\EZChrom Elite\Methods\CRE8A26.met
Data: C:\EZChrom Elite\Data\MA26\MA26017.dat
User: Enrico
Acquired: 01/27/14 00:47:35
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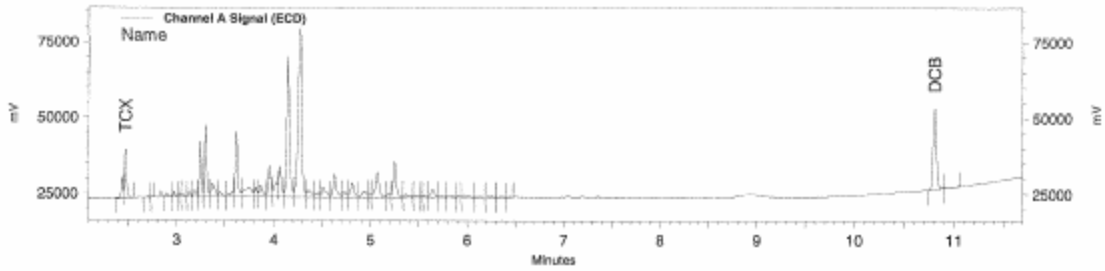
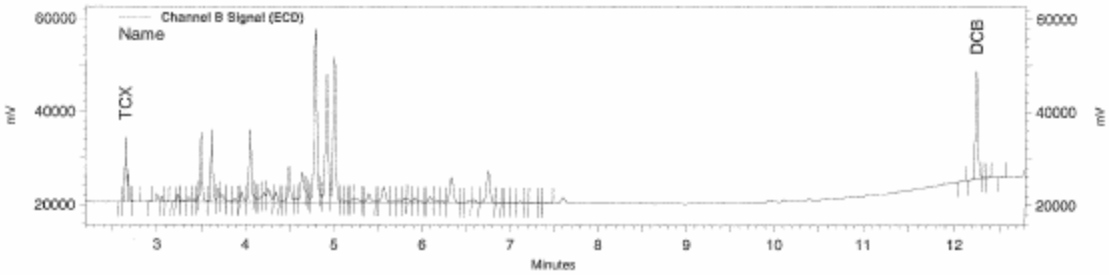


Channel A Signal (ECD) Results

Name	Expected RT (mins)	Retention Time (mins)	Area	Average RF	ESTD concentration	Integration Codes
TCX	2.475	2.475	1186519	56032.1	25.24	VB
DCB	10.805	10.808	3266020	136656.8	23.90	BV
Chlordane			31698308	70804.8	447.69	



Channel B Signal (ECD) Results

Name	Expected RT (mins)	Retention Time (mins)	Area	Average RF	ESTD concentration	Integration Codes
TCX	2.643	2.643	955172	47673.5	24.89	SV
DCB	12.233	12.236	2585430	111115.9	23.27	SS
Chlordane			25015410	55675.2	449.31	

Figure 3: TYPICAL INITIAL CALIBRATION SUMMARY

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES
Column size ID : 30MX0.32MMIDX0.32UM
LFID & Datetime: MA26018A 01/27/14 01:07 MA26026A 01/27/14 03:51
LFID & Datetime: MA26019A 01/27/14 01:28 MA26027A 01/27/14 04:11
LFID & Datetime: MA26020A 01/27/14 01:48 MA26028A 01/27/14 04:32
LFID & Datetime: MA26021A 01/27/14 02:08 MA26029A 01/27/14 04:52
LFID & Datetime: MA26022A 01/27/14 02:29 MA26030A 01/27/14 05:13
LFID & Datetime: MA26023A 01/27/14 02:49 MA26031A 01/27/14 05:33
LFID & Datetime: MA26024A 01/27/14 03:10 MA26032A 01/27/14 05:54
LFID & Datetime: MA26025A 01/27/14 03:30 MA26033A 01/27/14 06:14
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	4.00X	8.00X	16.00X	32.00X	48.00X	64.00X	MEAN	%RSD
alpha-BHC	1.25	50461	49985	49796	51003	58714	65922	69878	73502	58657.7	16.8
Hexachlorobenzene	1.25	151680	148744	145587	138470	133198	123809	116985	114133	134075.9	10.8
gamma-BHC	1.25	55418	53472	53056	53869	60438	65819	68546	71570	60273.4	12.4
beta-BHC	1.25	39043	38406	38222	36583	37752	37503	36734	37073	37664.5	2.3
delta-BHC	1.25	51082	49967	49089	50261	57320	64522	68615	72553	57926.2	16.2
Heptachlor	1.25	75430	75028	75331	73383	76309	78158	78010	79497	76393.2	2.6
Aldrin	1.25	67579	66786	65338	65515	70864	74279	76074	78312	70593.4	7.2
Heptachlor Epoxide	1.25	78332	76078	74193	72576	75070	75350	75340	76810	75468.6	2.3
gamma-Chlordane	1.25	81370	76728	75232	72774	75604	76192	76714	78415	76628.8	3.3
alpha-Chlordane	1.25	76556	75072	74055	72745	76650	78084	78783	80113	76507.4	3.2
DDE	2.50	71592	67348	66695	65767	71126	74599	76133	77986	71405.8	6.4
Endosulfan I	1.25	84110	81668	80093	78406	81687	82227	82191	83299	81710.0	2.2
Dieldrin	2.50	69740	68141	67673	67755	74240	77494	78779	80097	72989.9	7.2
Endrin	2.50	71365	68714	66974	65349	69459	71328	71420	73432	69755.1	3.8
DDD	2.50	41701	41991	41886	42268	47206	51556	54297	56596	47187.6	13.1
Endosulfan II	2.50	78419	77252	75515	74694	78285	78634	78291	78667	77469.6	2.0
DDT	2.50	60030	58843	58134	57951	61977	64277	65890	67446	61818.5	6.0
Endrin Aldehyde	2.50	90040	86147	83229	80437	80903	78039	76352	75260	81300.8	6.2
Methoxychlor	12.50	46278	44926	43915	42720	43071	40728	38661	38106	42300.6	6.9
Endosulfan Sulfate	2.50	91863	88645	86689	85372	86467	84607	83791	83376	86351.4	3.3
Endrin Ketone	2.50	97937	95853	94346	93656	98673	99419	99172	99816	97359.1	2.5
Oxychlordane	1.25	80110	76552	74949	70885	69034	65794	63498	63506	70540.9	8.8
2,4'-DDE	1.25	61390	61447	61948	59722	59374	58300	57066	58216	59682.8	3.0
trans-Nonachlor	1.25	99849	98909	97932	94988	94271	92067	89873	91036	94865.7	4.0
2,4'-DDD	1.25	45894	46222	47460	46120	46089	45603	45404	46864	46207.1	1.4
2,4'-DDT	1.25	63857	63837	63385	61709	61841	60822	59872	61548	62108.8	2.3
cis-Nonachlor	1.25	103410	104959	101085	96481	95137	93261	91561	93833	97465.8	5.2
Mirex	1.25	124772	123651	121188	114831	109357	101324	95348	94069	110567.4	11.3
SURROGATE	X	1.00X	2.00X	4.00X	8.00X	16.00X	32.00X	48.00X	64.00X	MEAN	%RSD
TCX	1.25	50050	49210	47871	46818	47525	46713	46347	46212	47593.1	2.9
DCB	1.25	150585	148308	144355	140284	139179	130342	123677	122500	137403.8	7.8

Figure 3: TYPICAL INITIAL CALIBRATION SUMMARY

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES2
Column size ID : 30MX0.32MMIDX0.25UM
LFID & Datetime: MA26018B 01/27/14 01:07 MA26026B 01/27/14 03:51
LFID & Datetime: MA26019B 01/27/14 01:28 MA26027B 01/27/14 04:11
LFID & Datetime: MA26020B 01/27/14 01:48 MA26028B 01/27/14 04:32
LFID & Datetime: MA26021B 01/27/14 02:08 MA26029B 01/27/14 04:52
LFID & Datetime: MA26022B 01/27/14 02:29 MA26030B 01/27/14 05:13
LFID & Datetime: MA26023B 01/27/14 02:49 MA26031B 01/27/14 05:33
LFID & Datetime: MA26024B 01/27/14 03:10 MA26032B 01/27/14 05:54
LFID & Datetime: MA26025B 01/27/14 03:30 MA26033B 01/27/14 06:14
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA)/UNIT 1.00X	2.00X	4.00X	8.00X	16.00X	32.00X	48.00X	64.00X	MEAN	%RSD
alpha-BHC	1.25	50646	48650	45661	45897	51758	60345	64329	67899	54398.4	15.8
Hexachlorobenzene	1.25	142667	129534	130501	124881	119255	112893	107022	104412	121395.5	10.7
gamma-BHC	1.25	45669	45113	44964	46196	52559	59047	62269	65403	52652.3	16.1
beta-BHC	1.25	31707	31626	31893	32056	34007	34380	34498	35369	33191.9	4.6
delta-BHC	1.25	46881	43645	42802	42935	48916	56753	61137	65324	51049.0	17.3
Heptachlor	1.25	64469	60382	56873	54863	57269	59256	60104	61682	59362.2	5.1
Aldrin	1.25	57630	56940	55957	56535	61716	66453	68960	72085	62034.4	10.2
Heptachlor Epoxide	1.25	67663	65619	63343	62127	65151	66233	67036	69183	65794.5	3.5
gamma-Chlordane	1.25	76197	66656	64093	63110	65815	67298	68580	71272	67877.6	6.2
alpha-Chlordane	1.25	70136	67140	65002	63977	67396	69438	70904	73206	68399.9	4.5
DDE	2.50	68214	64858	62697	62248	66686	70036	72249	74172	67645.1	6.4
Endosulfan I	1.25	66117	65987	64767	64418	67911	69585	70883	72549	67777.1	4.4
Dieldrin	2.50	58155	57964	57460	58302	63671	68435	70661	72665	63414.0	10.0
Endrin	2.50	60556	59309	57503	56433	59308	60591	60787	63298	59723.1	3.5
DDD	2.50	34514	33973	34920	34687	37768	40811	43220	46498	38299.0	12.3
Endosulfan II	2.50	65007	64584	63685	63806	67073	68650	69168	71027	66625.0	4.2
DDT	2.50	42030	43174	42810	42513	44950	46480	47650	49689	44911.9	6.2
Endrin Aldehyde	2.50	72006	71214	69592	68371	70244	68647	67376	67801	69406.3	2.4
Methoxychlor	12.50	27839	26742	26456	26189	27140	26720	26095	26583	26720.6	2.1
Endosulfan Sulfate	2.50	73417	74342	72545	71104	72952	72408	71798	73038	72700.4	1.4
Endrin Ketone	2.50	79128	76695	75503	76098	80835	82285	82088	83444	79509.5	3.9
Oxychlordane	1.25	64121	62089	64713	61264	56762	55132	54054	54658	59099.1	7.5
2,4'-DDE	1.25	70189	62449	62560	58101	56371	54969	53988	55432	59257.5	9.3
trans-Nonachlor	1.25	99838	95641	90381	84884	83673	82103	81026	82847	87549.1	8.0
2,4'-DDD	1.25	37678	36580	38190	39037	38970	39056	38826	40355	38586.6	2.9
2,4'-DDT	1.25	47592	47648	48035	46663	46259	45738	45245	46948	46766.0	2.1
cis-Nonachlor	1.25	81732	82641	83614	82015	81911	81936	81389	84595	82479.3	1.3
Mirex	1.25	103786	105295	105696	98553	93488	86478	81497	80940	94466.8	11.1
SURROGATE	X	1.00X	2.00X	4.00X	8.00X	16.00X	32.00X	48.00X	64.00X	MEAN	%RSD
TCX	1.25	43237	44796	44334	42283	43035	42766	42017	42107	43071.9	2.4
DCB	1.25	119147	116443	112721	109164	108641	103690	99108	97351	108283.0	7.2

Figure 3: TYPICAL INITIAL CALIBRATION SUMMARY

INITIAL CALIBRATION
METHOD 8081/608

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES
Column size ID : 30MX0.32MMIDX0.32UM
LFID & Datetime: MA26036A 01/27/14 07:16
LFID & Datetime: MA26037A 01/27/14 07:36
LFID & Datetime: MA26038A 01/27/14 07:56
LFID & Datetime: MA26039A 01/27/14 08:16
LFID & Datetime: MA26040A 01/27/14 08:36
LFID & Datetime: MA26041A 01/27/14 08:57
LFID & Datetime: MA26042A 01/27/14 09:17
LFID & Datetime: MA26043A 01/27/14 09:37
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	5.00X	10.00X	15.00X	20.00X	30.00X	40.00X	MEAN	%RSD
Toxaphene	50.00	58631	53413	56818	57730	58674	58520	58234	59727	57718.4	3.3

INITIAL CALIBRATION
METHOD 8081/608

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES2
Column size ID : 30MX0.32MMIDX0.25UM
LFID & Datetime: MA26036B 01/27/14 07:16
LFID & Datetime: MA26037B 01/27/14 07:36
LFID & Datetime: MA26038B 01/27/14 07:56
LFID & Datetime: MA26039B 01/27/14 08:16
LFID & Datetime: MA26040B 01/27/14 08:36
LFID & Datetime: MA26041B 01/27/14 08:57
LFID & Datetime: MA26042B 01/27/14 09:17
LFID & Datetime: MA26043B 01/27/14 09:37
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	5.00X	10.00X	15.00X	20.00X	30.00X	40.00X	MEAN	%RSD
Toxaphene	50.00	38754	36281	36249	36766	37480	37838	38209	39675	37656.5	3.2

Figure 3: TYPICAL INITIAL CALIBRATION SUMMARY

INITIAL CALIBRATION
METHOD EPA 8081

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES
Column size ID : 30MX0.32MMIDX0.32UM
LFID & Datetime: MA26009A 01/26/14 22:07
LFID & Datetime: MA26010A 01/26/14 22:27
LFID & Datetime: MA26011A 01/26/14 22:47
LFID & Datetime: MA26012A 01/26/14 23:07
LFID & Datetime: MA26013A 01/26/14 23:27
LFID & Datetime: MA26014A 01/26/14 23:47
LFID & Datetime: MA26015A 01/27/14 00:07
LFID & Datetime: MA26016A 01/27/14 00:27
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	4.00X	10.00X	20.00X	30.00X	40.00X	60.00X	MEAN	%RSD
CHLORDANE	25.00	89545	68121	80192	70426	67071	64747	63980	62357	70804.9	13.2

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES2
Column size ID : 30MX0.32MMIDX0.25UM
LFID & Datetime: MA26009B 01/26/14 22:07
LFID & Datetime: MA26010B 01/26/14 22:27
LFID & Datetime: MA26011B 01/26/14 22:47
LFID & Datetime: MA26012B 01/26/14 23:07
LFID & Datetime: MA26013B 01/26/14 23:27
LFID & Datetime: MA26014B 01/26/14 23:47
LFID & Datetime: MA26015B 01/27/14 00:07
LFID & Datetime: MA26016B 01/27/14 00:27
CONC UNIT: ppb

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	4.00X	10.00X	20.00X	30.00X	40.00X	60.00X	MEAN	%RSD
CHLORDANE	25.00	74070	56360	52924	51998	52846	52524	52477	52202	55675.2	13.6

Figure 4: TYPICAL ICAL RETENTION TIME WINDOW SUMMARY

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES
Column size ID : 30MX0.32MMIDX0.32UM
LFID & Datetime: MA26018A 01/27/14 01:07 MA26026A 01/27/14 03:51
LFID & Datetime: MA26019A 01/27/14 01:28 MA26027A 01/27/14 04:11
LFID & Datetime: MA26020A 01/27/14 01:48 MA26028A 01/27/14 04:32
LFID & Datetime: MA26021A 01/27/14 02:08 MA26029A 01/27/14 04:52
LFID & Datetime: MA26022A 01/27/14 02:29 MA26030A 01/27/14 05:13
LFID & Datetime: MA26023A 01/27/14 02:49 MA26031A 01/27/14 05:33
LFID & Datetime: MA26024A 01/27/14 03:10 MA26032A 01/27/14 05:54
LFID & Datetime: MA26025A 01/27/14 03:30 MA26033A 01/27/14 06:14

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	4.0X	8.0X	16.0X	32.0X	48.0X	64.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
alpha-BHC	2.800	2.801	2.800	2.805	2.804	2.804	2.803	2.801	2.802	2.782	2.822	0.020
Hexachlorobenzene	2.704	2.707	2.708	2.699	2.701	2.705	2.705	2.701	2.704	2.684	2.724	0.020
gamma-BHC	2.988	2.991	2.988	2.995	2.993	2.993	2.992	2.989	2.991	2.969	3.013	0.022
beta-BHC	3.036	3.039	3.036	3.043	3.040	3.041	3.039	3.037	3.039	3.017	3.061	0.022
delta-BHC	3.149	3.151	3.148	3.155	3.153	3.155	3.152	3.151	3.152	3.131	3.173	0.021
Heptachlor	3.293	3.295	3.293	3.299	3.297	3.297	3.296	3.293	3.295	3.271	3.319	0.024
Aldrin	3.511	3.512	3.511	3.516	3.515	3.515	3.513	3.511	3.513	3.487	3.539	0.026
Heptachlor Epoxide	4.016	4.019	4.016	4.023	4.020	4.021	4.019	4.016	4.019	3.989	4.049	0.030
gamma-Chlordane	4.137	4.139	4.136	4.143	4.141	4.141	4.140	4.137	4.139	4.107	4.171	0.032
alpha-Chlordane	4.273	4.275	4.272	4.279	4.277	4.277	4.276	4.273	4.275	4.243	4.307	0.032
DDE	4.348	4.349	4.348	4.353	4.352	4.353	4.351	4.348	4.350	4.318	4.382	0.032
Endosulfan I	4.425	4.427	4.425	4.431	4.429	4.429	4.428	4.425	4.427	4.392	4.462	0.035
Dieldrin	4.711	4.712	4.709	4.716	4.713	4.715	4.713	4.709	4.712	4.680	4.744	0.032
Endrin	5.021	5.020	5.019	5.025	5.021	5.024	5.021	5.019	5.021	4.991	5.051	0.030
DDD	5.121	5.121	5.120	5.127	5.124	5.127	5.124	5.121	5.123	5.093	5.153	0.030
Endosulfan II	5.353	5.353	5.352	5.359	5.356	5.357	5.355	5.352	5.355	5.326	5.384	0.029
DDT	5.580	5.580	5.579	5.584	5.581	5.583	5.581	5.579	5.581	5.551	5.611	0.030
Endrin Aldehyde	6.104	6.104	6.103	6.108	6.107	6.107	6.104	6.101	6.105	6.073	6.137	0.032
Methoxychlor	6.624	6.623	6.624	6.629	6.625	6.628	6.624	6.620	6.625	6.587	6.663	0.038
Endosulfan Sulfate	7.085	7.085	7.085	7.091	7.087	7.089	7.085	7.083	7.086	7.050	7.122	0.036
Endrin Ketone	7.817	7.819	7.817	7.821	7.820	7.820	7.817	7.815	7.818	7.782	7.854	0.036
Oxychlordane	3.925	3.927	3.927	3.919	3.921	3.925	3.925	3.921	3.924	3.905	3.943	0.019
2,4'-DDE	3.999	4.000	4.000	3.992	3.995	4.000	4.000	3.995	3.998	3.976	4.020	0.022
trans-Nonachlor	4.257	4.259	4.259	4.251	4.253	4.259	4.259	4.253	4.256	4.233	4.279	0.023
2,4'-DDD	4.551	4.552	4.552	4.544	4.547	4.551	4.552	4.545	4.549	4.524	4.574	0.025
2,4'-DDT	4.880	4.880	4.880	4.872	4.875	4.879	4.880	4.875	4.878	4.855	4.901	0.023
cis-Nonachlor	5.072	5.072	5.072	5.064	5.067	5.071	5.072	5.067	5.070	5.048	5.092	0.022
Mirex	6.788	6.788	6.788	6.781	6.783	6.785	6.788	6.781	6.785	6.757	6.813	0.028

SURROGATE	1.0X	2.0X	4.0X	8.0X	16.0X	32.0X	48.0X	64.0X	RT	FROM	TO	WIDTH
TCX	2.472	2.475	2.472	2.477	2.476	2.476	2.475	2.473	2.474	2.454	2.494	0.020
DCB	10.804	10.804	10.803	10.807	10.807	10.805	10.801	10.801	10.804	10.754	10.854	0.050

Figure 4: TYPICAL ICAL RETENTION TIME WINDOW SUMMARY

INITIAL CALIBRATION
METHOD 8081

Lab Name : EMAX Inc
Instrument ID : E8 (PE CLARUS680 GC)
GC Column : STX-CLPESTICIDES2
Column size ID : 30MX0.32MMIDX0.25UM
LFID & Datetime: MA26018B 01/27/14 01:07 MA26026B 01/27/14 03:51
LFID & Datetime: MA26019B 01/27/14 01:28 MA26027B 01/27/14 04:11
LFID & Datetime: MA26020B 01/27/14 01:48 MA26028B 01/27/14 04:32
LFID & Datetime: MA26021B 01/27/14 02:08 MA26029B 01/27/14 04:52
LFID & Datetime: MA26022B 01/27/14 02:29 MA26030B 01/27/14 05:13
LFID & Datetime: MA26023B 01/27/14 02:49 MA26031B 01/27/14 05:33
LFID & Datetime: MA26024B 01/27/14 03:10 MA26032B 01/27/14 05:54
LFID & Datetime: MA26025B 01/27/14 03:30 MA26033B 01/27/14 06:14

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	4.0X	8.0X	16.0X	32.0X	48.0X	64.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
alpha-BHC	3.021	3.024	3.023	3.029	3.027	3.027	3.025	3.024	3.025	3.007	3.043	0.018
Hexachlorobenzene	2.941	2.944	2.945	2.936	2.939	2.944	2.943	2.939	2.941	2.923	2.959	0.018
gamma-BHC	3.261	3.264	3.261	3.268	3.267	3.267	3.264	3.263	3.264	3.247	3.281	0.017
beta-BHC	3.308	3.311	3.309	3.316	3.313	3.313	3.312	3.309	3.311	3.294	3.328	0.017
delta-BHC	3.541	3.545	3.543	3.549	3.547	3.548	3.545	3.544	3.545	3.528	3.562	0.017
Heptachlor	3.607	3.611	3.608	3.615	3.612	3.612	3.609	3.608	3.610	3.592	3.628	0.018
Aldrin	3.907	3.909	3.908	3.913	3.911	3.912	3.909	3.908	3.910	3.891	3.929	0.019
Heptachlor Epoxide	4.533	4.536	4.533	4.540	4.537	4.539	4.536	4.533	4.536	4.513	4.559	0.023
gamma-Chlordane	4.780	4.783	4.780	4.785	4.783	4.785	4.781	4.779	4.782	4.761	4.803	0.021
alpha-Chlordane	4.992	4.993	4.992	4.999	4.995	4.997	4.995	4.991	4.994	4.976	5.012	0.018
DDE	5.241	5.244	5.241	5.248	5.245	5.247	5.244	5.241	5.244	5.228	5.260	0.016
Endosulfan I	5.089	5.092	5.089	5.096	5.092	5.095	5.093	5.089	5.092	5.073	5.111	0.019
Dieldrin	5.548	5.551	5.549	5.556	5.552	5.555	5.551	5.548	5.551	5.534	5.568	0.017
Endrin	6.155	6.156	6.155	6.161	6.156	6.159	6.156	6.153	6.156	6.136	6.176	0.020
DDD	6.409	6.412	6.411	6.416	6.412	6.415	6.412	6.408	6.412	6.393	6.431	0.019
Endosulfan II	6.640	6.641	6.639	6.645	6.641	6.644	6.641	6.636	6.641	6.619	6.663	0.022
DDT	7.232	7.235	7.233	7.240	7.235	7.237	7.235	7.231	7.235	7.211	7.259	0.024
Endrin Aldehyde	7.568	7.571	7.569	7.575	7.571	7.573	7.569	7.567	7.570	7.548	7.592	0.022
Methoxychlor	9.704	9.707	9.705	9.711	9.708	9.709	9.705	9.703	9.707	9.679	9.734	0.028
Endosulfan Sulfate	8.473	8.476	8.475	8.479	8.476	8.479	8.475	8.471	8.476	8.451	8.500	0.024
Endrin Ketone	10.103	10.105	10.104	10.108	10.107	10.108	10.104	10.101	10.105	10.075	10.135	0.030
Oxychlordane	4.419	4.420	4.421	4.413	4.415	4.420	4.420	4.415	4.418	4.398	4.438	0.020
2,4'-DDE	4.769	4.771	4.772	4.764	4.767	4.771	4.771	4.767	4.769	4.748	4.790	0.021
trans-Nonachlor	4.908	4.908	4.909	4.901	4.904	4.908	4.909	4.904	4.906	4.888	4.924	0.018
2,4'-DDD	5.611	5.612	5.612	5.604	5.607	5.611	5.612	5.607	5.609	5.591	5.627	0.018
2,4'-DDT	6.243	6.243	6.244	6.236	6.239	6.244	6.244	6.240	6.242	6.223	6.261	0.019
cis-Nonachlor	6.328	6.328	6.329	6.321	6.324	6.329	6.329	6.325	6.327	6.309	6.345	0.018
Mirex	9.928	9.929	9.927	9.921	9.923	9.928	9.927	9.924	9.926	9.902	9.950	0.024

SURROGATE	1.0X	2.0X	4.0X	8.0X	16.0X	32.0X	48.0X	64.0X	RT	FROM	TO	WIDTH
TCX	2.640	2.643	2.640	2.647	2.644	2.644	2.643	2.641	2.643	2.620	2.666	0.023
DCB	12.231	12.233	12.232	12.236	12.236	12.235	12.231	12.229	12.233	12.198	12.268	0.035

Figure 5: TYPICAL PEM PEST BREAKDOWN CALCULATION SUMMARY

PEM PEST BREAKDOWN CALCULATION
METHOD 8081

Lab Name : EMAX
Instrument ID : GCT016 HP-5890
GC Column : RTX-CLPEST RTX-CLPESTII
Column size ID : .32MMX30M .32MMX30M
PEM LFID & Datetime : WF17026A WF17026B 06/18/10 00:50

Base on AREA

	AREA				% Breakdown				
LFID	DDD	DDE	DDT	TOTAL	DDD	DDE	TOTAL	QL	QCLIMIT
WF17026A	0.0	11917.0	826713.0	838630.0	0.00	1.42	1.42		15
WF17026B	21368.0	17092.0	933363.0	971823.0	2.20	1.76	3.96		15
LFID	ENDRIN	ENDRIN ALDEHYDE	ENDRIN KETONE	TOTAL	ENDRIN ALDEHYDE	ENDRIN KETONE	TOTAL	QL	QCLIMIT
WF17026A	893765.0	48233.0	35430.0	977428.0	4.93	3.62	8.56		15
WF17026B	945951.0	60214.0	48710.0	1054875.0	5.71	4.62	10.33		15

Figure 6: TYPICAL SAMPLE RESULT SUMMARY

METHOD SW3520C/8081A
PESTICIDES

Client	: XYZ, INC.	Date Collected:	01/15/14
Project	: CLEAN PROJECT	Date Received:	01/16/14
Batch No.	: 14A051	Date Extracted:	01/21/14 14:00
Sample ID:	EMW02012014	Date Analyzed:	01/28/14 18:09
Lab Samp ID:	A051-03	Dilution Factor:	1
Lab File ID:	MA28020A	Matrix	: WATER
Ext Btch ID:	CPA024W	% Moisture	: NA
Calib. Ref.:	MA28011A	Instrument ID	: GCE8

PARAMETERS	RESULTS (ug/L)	LOQ (ug/L)	DL (ug/L)	LOD (ug/L)
ALPHA-BHC	(ND)|ND	0.10	0.0050	0.010
GAMMA-BHC	(ND)|ND	0.10	0.0050	0.010
BETA-BHC	(ND)|ND	0.10	0.0070	0.010
HEPTACHLOR	(ND)|ND	0.10	0.0050	0.010
DELTA-BHC	(ND)|ND	0.10	0.0070	0.010
ALDRIN	(ND)|ND	0.10	0.0050	0.010
HEPTACHLOR EPOXIDE	(ND)|ND	0.10	0.0050	0.010
GAMMA-CHLORDANE	(ND)|ND	0.10	0.0050	0.010
ALPHA-CHLORDANE	(ND)|ND	0.10	0.0050	0.010
ENDOSULFAN I	(ND)|ND	0.10	0.0080	0.010
4,4'-DDE	(ND)|ND	0.10	0.0050	0.010
DIELDRIN	(ND)|ND	0.10	0.0050	0.010
ENDRIN	(ND)|ND	0.10	0.0080	0.010
4,4'-DDD	(ND)|ND	0.10	0.0050	0.010
ENDOSULFAN II	(ND)|ND	0.10	0.0050	0.010
4,4'-DDT	(ND)|ND	0.10	0.0050	0.010
ENDRIN ALDEHYDE	(ND)|ND	0.10	0.0050	0.010
ENDOSULFAN SULFATE	(ND)|ND	0.10	0.0050	0.010
ENDRIN KETONE	(ND)|ND	0.10	0.0050	0.010
METHOXYCHLOR	(ND)|ND	1.0	0.050	0.10
TOXAPHENE	(ND)|ND	2.0	0.25	0.50
CHLORDANE	(ND)|ND	1.0	0.12	0.25

SURROGATE PARAMETERS	RESULTS	SPK_AMT	% RECOVERY	QC LIMIT
TETRACHLORO-M-XYLENE	(0.3346)|0.3344	0.4000	(83.7)|83.6	25-140
DECACHLOROBIPHENYL	(0.4240)|0.4139	0.4000	(106)|103	30-135

RL : Reporting limit
Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )

Figure 7: TYPICAL LCS/LCSD REPORT SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 14A051
METHOD: SW3520C/8081A

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1W				
LAB SAMP ID:	CPA024WB	CPA024WL	CPA024WC		
LAB FILE ID:	MA28015A	MA28016A	MA28017A		
DATE EXTRACTED:	01/21/1414:00	01/21/1414:00	01/21/1414:00	DATE COLLECTED:	NA
DATE ANALYZED:	01/28/1416:27	01/28/1416:47	01/28/1417:08	DATE RECEIVED:	01/21/14
PREP. BATCH:	CPA024W	CPA024W	CPA024W		
CALIB. REF:	MA28011A	MA28011A	MA28011A		

ACCESSION:

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
alpha-BHC	(ND)|ND	0.200	(0.203)|0.189	(101)|94	0.200	(0.204)|0.190	(102)|95	(0)|1	60-130	30
gamma-BHC	(ND)|ND	0.200	(0.202)|0.198	(101)|99	0.200	(0.202)|0.199	(101)|100	(0)|1	25-135	30
beta-BHC	(ND)|ND	0.200	0.206|(0.213)	103|(106)	0.200	0.204|(0.214)	102|(107)	1|(0)	65-125	30
Heptachlor	(ND)|ND	0.200	0.204|(0.208)	102|(104)	0.200	0.203|(0.206)	101|(103)	0|(1)	40-130	30
delta-BHC	(ND)|ND	0.200	(0.212)|0.204	(106)|102	0.200	(0.210)|0.203	(105)|101	(1)|0	45-135	30
Aldrin	(ND)|ND	0.200	(0.210)|0.205	(105)|102	0.200	(0.208)|0.204	(104)|102	(1)|0	25-140	30
Heptachlor Epoxide	(ND)|ND	0.200	(0.221)|0.216	(110)|108	0.200	0.212|(0.215)	106|(108)	4|(0)	60-130	30
gamma-Chlordane	(ND)|ND	0.200	0.215|(0.218)	108|(109)	0.200	0.213|(0.218)	106|(109)	1|(0)	60-125	30
alpha-Chlordane	(ND)|ND	0.200	(0.219)|0.212	(110)|106	0.200	(0.217)|0.210	(108)|105	(1)|1	65-125	30
Endosulfan I	(ND)|ND	0.200	(0.208)|0.204	(104)|102	0.200	(0.208)|0.202	(104)|101	(0)|1	50-110	30
4,4'-DDE	(ND)|ND	0.200	(0.224)|0.212	(112)|106	0.200	(0.221)|0.207	(110)|104	(1)|2	35-140	30
Dieldrin	(ND)|ND	0.200	(0.213)|0.212	(106)|106	0.200	(0.212)|0.209	(106)|104	(0)|1	60-130	30
Endrin	(ND)|ND	0.200	(0.228)|0.224	(114)|112	0.200	(0.229)|0.221	(114)|110	(0)|1	55-135	30
4,4'-DDD	(ND)|ND	0.200	0.217|(0.227)	108|(114)	0.200	0.213|(0.223)	106|(112)	2|(2)	25-150	30
Endosulfan II	(ND)|ND	0.200	(0.215)|0.209	(108)|104	0.200	(0.213)|0.207	(106)|104	(1)|1	30-130	30
4,4'-DDT	(ND)|ND	0.200	(0.255)|0.244	(127)|122	0.200	(0.253)|0.242	(126)|121	(1)|1	45-140	30
Endrin aldehyde	(ND)|ND	0.200	(0.213)|0.202	(106)|101	0.200	(0.211)|0.208	(105)|104	(1)|3	55-135	30
Endosulfan Sulfate	(ND)|ND	0.200	(0.226)|0.219	(113)|110	0.200	(0.225)|0.217	(112)|108	(0)|1	55-135	30
Endrin Ketone	(ND)|ND	0.200	0.208|(0.211)	104|(105)	0.200	0.207|(0.209)	104|(104)	0|(1)	75-125	30
Methoxychlor	(ND)|ND	2.00	2.30|(2.88)	115|(144)	2.00	2.28|(2.68)	114|(134)	1|(7)	55-150	30

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.4000	(0.3778)|0.3682	(94.4)|92.0	0.4000	(0.3608)|0.3530	(90.2)|88.3	25-140
Decachlorobiphenyl	0.4000	(0.4321)|0.4309	(108)|108	0.4000	(0.4262)|0.4226	(107)|106	30-135

Figure 8: TYPICAL MS/MSD REPORT SUMMARY

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 14A051
METHOD: SW3520C/8081A

MATRIX:	WATER			% MOISTURE:	NA
DILUTION FACTOR:	1	1.1	1.02		
SAMPLE ID:	EMW02012014				
LAB SAMP ID:	A051-03	A051-03M	A051-03S		
LAB FILE ID:	MA28020A	MA28021A	MA28022A		
DATE EXTRACTED:	01/21/1414:00	01/21/1414:00	01/21/1414:00	DATE COLLECTED:	01/15/14
DATE ANALYZED:	01/28/1418:09	01/28/1418:29	01/28/1418:50	DATE RECEIVED:	01/16/14
PREP. BATCH:	CPA024W	CPA024W	CPA024W		
CALIB. REF:	MA28011A	MA28011A	MA28011A		

ACCESSION:

PARAMETER	SMPL RSLT (ug/L)	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
alpha-BHC	(ND)|ND	0.220	(0.232)|0.217	(105)|99	0.204	(0.215)|0.201	(105)|99	(8)|8	60-130	30
gamma-BHC	(ND)|ND	0.220	0.227|(0.230)	103|(105)	0.204	(0.211)|0.211	(103)|103	(7)|9	25-135	30
beta-BHC	(ND)|ND	0.220	0.228|(0.253)	104|(115)	0.204	0.210|(0.231)	103|(113)	8|(9)	65-125	30
Heptachlor	(ND)|ND	0.220	0.230|(0.236)	105|(107)	0.204	0.211|(0.217)	103|(106)	9|(8)	40-130	30
delta-BHC	(ND)|ND	0.220	(0.235)|0.234	(107)|106	0.204	(0.217)|0.215	(106)|105	(8)|8	45-135	30
Aldrin	(ND)|ND	0.220	(0.236)|0.236	(107)|107	0.204	(0.218)|0.218	(107)|107	(8)|8	25-140	30
Heptachlor Epoxide	(ND)|ND	0.220	0.241|(0.243)	110|(110)	0.204	(0.233)|0.223	(114)|109	(3)|9	60-130	30
gamma-Chlordane	(ND)|ND	0.220	(0.243)|0.243	(110)|110	0.204	(0.225)|0.225	(110)|110	(8)|8	60-125	30
alpha-Chlordane	(ND)|ND	0.220	(0.249)|0.237	(113)|108	0.204	(0.229)|0.221	(112)|108	(8)|7	65-125	30
Endosulfan I	(ND)|ND	0.220	(0.235)|0.227	(107)|103	0.204	(0.217)|0.211	(106)|103	(8)|7	50-110	30
4,4'-DDE	(ND)|ND	0.220	(0.252)|0.234	(115)|106	0.204	(0.232)|0.219	(114)|107	(8)|7	35-140	30
Dieldrin	(ND)|ND	0.220	(0.245)|0.239	(111)|109	0.204	(0.227)|0.221	(111)|108	(8)|8	60-130	30
Endrin	(ND)|ND	0.220	(0.261)|0.253	(119)|115	0.204	(0.240)|0.235	(118)|115	(8)|7	55-135	30
4,4'-DDD	(ND)|ND	0.220	0.246|(0.256)	112|(116)	0.204	0.227|(0.238)	111|(117)	8|(7)	25-150	30
Endosulfan II	(ND)|ND	0.220	(0.242)|0.235	(110)|107	0.204	(0.225)|0.218	(110)|107	(7)|8	30-130	30
4,4'-DDT	(ND)|ND	0.220	(0.292)|0.278	(133)|126	0.204	(0.271)|0.257	(133)|126	(7)|8	45-140	30
Endrin aldehyde	(ND)|ND	0.220	(0.240)|0.236	(109)|107	0.204	(0.222)|0.214	(109)|105	(8)|10	55-135	30
Endosulfan Sulfate	(ND)|ND	0.220	(0.257)|0.249	(117)|113	0.204	(0.238)|0.230	(117)|113	(8)|8	55-135	30
Endrin Ketone	(ND)|ND	0.220	0.235|(0.240)	107|(109)	0.204	0.220|(0.223)	108|(109)	7|(7)	75-125	30
Methoxychlor	(ND)|ND	2.20	2.62|(3.05)	119|(139)	2.04	2.43|(2.82)	119|(138)	8|(8)	55-150	30

SURROGATE PARAMETER	SPIKE AMT (ug/L)	MS RSLT (ug/L)	MS % REC	SPIKE AMT (ug/L)	MSD RSLT (ug/L)	MSD % REC	QC LIMIT (%)
Tetrachloro-m-xylene	0.4400	(0.4345)|0.4180	(98.7)|95.0	0.4080	(0.3784)|0.3710	(92.7)|90.9	25-140
Decachlorobiphenyl	0.4400	(0.4836)|0.4728	(110)|107	0.4080	(0.4427)|0.4327	(109)|106	30-135

* : Out side of QC Limit.

Figure 9: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 14A051

METHOD SW3520C/8081A
PESTICIDES

A total of three (3) water samples were received on 01/16/14 for Pesticides Organochlorine analysis, Method SW3520C/8081A in accordance with Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2 and Project QAPP 5/2012.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument performance was checked prior to calibration. DDT and Endrin breakdown were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms of ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for CPA024WL/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for A051-03M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits. Refer to sample result forms for details.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met; otherwise, anomalies were discussed within the associated QC parameter. Positive sample results were confirmed by a second column. Relative percentage difference (RPD) between the two results was evaluated. If RPD is less than 40% and peaks are well defined the higher result is reported. Where RPD is greater than 40% the chromatogram is checked for anomalies and results are selected based on processed knowledge. If there is no evidence of any chromatographic ambiguity, the higher result is reported.

Table 1: ICAL CONCENTRATION OF INDIVIDUAL ANALYTES

PARAMETERS	ICAL STANDARD CONCENTRATION (µg/L)							
PESTICIDES	1	2	3	4	5	6	7	8
Aldrin	1.25	2.5	5	10	20	40	60	80
alpha-BHC	1.25	2.5	5	10	20	40	60	80
beta-BHC	1.25	2.5	5	10	20	40	60	80
delta-BHC	1.25	2.5	5	10	20	40	60	80
gamma-BHC	1.25	2.5	5	10	20	40	60	80
alpha-Chlordane	1.25	2.5	5	10	20	40	60	80
gamma-Chlordane	1.25	2.5	5	10	20	40	60	80
Heptachlor	1.25	2.5	5	10	20	40	60	80
Heptachlor Epoxide	1.25	2.5	5	10	20	40	60	80
Endosulfan I	1.25	2.5	5	10	20	40	60	80
4,4’ – DDD	2.5	5	10	20	40	80	120	160
4,4’ – DDE	2.5	5	10	20	40	80	120	160
4,4’ – DDT	2.5	5	10	20	40	80	120	160
Dieldrin	2.5	5	10	20	40	80	120	160
Endrin	2.5	5	10	20	40	80	120	160
Endosulfan II	2.5	5	10	20	40	80	120	160
Endosulfan Sulfate	2.5	5	10	20	40	80	120	160
Endrin Aldehyde	2.5	5	10	20	40	80	120	160
Endrin Ketone	2.5	5	10	20	40	80	120	160
Methoxychlor	12.5	25	50	100	200	400	600	800
2,4’ – DDD	1.25	2.5	5	10	20	40	60	80
2,4’ – DDE	1.25	2.5	5	10	20	40	60	80
2,4’ – DDT	1.25	2.5	5	10	20	40	60	80
Oxychlordane	1.25	2.5	5	10	20	40	60	80
cis-Nonachlor	1.25	2.5	5	10	20	40	60	80
Trans-Nonachlor	1.25	2.5	5	10	20	40	60	80
Mirex	1.25	2.5	5	10	20	40	60	80
Tetrachloro-m-xylene (surrogate)	1.25	2.5	5	10	20	40	60	80
Decachlorobiphenyl (Surrogate)	1.25	2.5	5	10	20	40	60	80
TOXAPHENE	50	100	250	500	750	1000	1500	2000
TECHNICAL CHLORDANE	25	100	250	500	750	1000	1500	2000

Table 2: ICAL STANDARD PREPARATION

Standard #	Compound Name	Intermediate Solution Conc. (µg/L)	Preparation			Final Conc. (µg/L)
			Aliquot (µL)	Solvent	Final Volume (µL)	
PESTICIDES						
1	Pest ICAL Mix1	80 / 160 / 800	12.5	Hexane	800	1.25 /2. 5 / 12.5
2	Pest ICAL Mix1	80 / 160 / 800	25	Hexane	800	2.5 / 5 / 25
3	Pest ICAL Mix1	80 / 160 / 800	50	Hexane	800	5 / 10 / 50
4	Pest ICAL Mix1	80 / 160 / 800	100	Hexane	800	10 / 20 / 100
5	Pest ICAL Mix1	80 / 160 / 800	200	Hexane	800	20 / 40 / 200
6	Pest ICAL Mix1	80 / 160 / 800	400	Hexane	800	40 / 80 / 400
7	Pest ICAL Mix1	80 / 160 / 800	600	Hexane	800	60 / 120 / 600
8	Pest ICAL Mix1	80 / 160 / 800	800	-	800	80 / 160 / 800
TOXAPHENE						
1	Toxaphene ICAL	2000	20	Hexane	800	50
2	Toxaphene ICAL	2000	40	Hexane	800	100
3	Toxaphene ICAL	2000	100	Hexane	800	250
4	Toxaphene ICAL	2000	200	Hexane	800	500
5	Toxaphene ICAL	2000	300	Hexane	800	750
6	Toxaphene ICAL	2000	400	Hexane	800	1000
7	Toxaphene ICAL	2000	600	Hexane	800	1500
8	Toxaphene ICAL	2000	800	-	800	2000
TECHNICAL CHLORDANE						
1	Tech. Chlordane ICAL	2000	10	Hexane	800	25
2	Tech. Chlordane ICAL	2000	40	Hexane	800	100
3	Tech. Chlordane ICAL	2000	100	Hexane	800	250
4	Tech. Chlordane ICAL	2000	200	Hexane	800	500
5	Tech. Chlordane ICAL	2000	300	Hexane	800	750
6	Tech. Chlordane ICAL	2000	400	Hexane	800	1000
7	Tech. Chlordane ICAL	2000	600	Hexane	800	1500
8	Tech. Chlordane ICAL	2000	800	-	800	2000
PESTICIDES MIX 3						
1	Pest ICAL Mix 3	80	12.5	Hexane	800	1.25
2	Pest ICAL Mix 3	80	25	Hexane	800	2.5
3	Pest ICAL Mix 3	80	50	Hexane	800	5
4	Pest ICAL Mix 3	80	100	Hexane	800	10
5	Pest ICAL Mix 3	80	200	Hexane	800	20
6	Pest ICAL Mix 3	80	400	Hexane	800	40
7	Pest ICAL Mix 3	80	600	Hexane	800	60
8	Pest ICAL Mix 3	80	800	-	800	80

Table 3: INTERMEDIATE PRIMARY STANDARD PREPARATION

PESTICIDES MIX 1*: RESTEK*	Stock Std. Conc. (µg/mL)	Final Conc. (µg/L)	Preparation
Aldrin	8	80	Using a gas-tight syringe, measure 1000 µL of (Restek) Pesticides Mix 1 and 40 µL of (Supelco) Pest Surrogate and dilute with hexane to 100 mL.
alpha-BHC	8	80	
beta-BHC	8	80	
delta-BHC	8	80	
gamma-BHC	8	80	
alpha-Chlordane	8	80	
gamma-Chlordane	8	80	
Heptachlor	8	80	
Heptachlor Epoxide	8	80	
Endosulfan I	8	80	
4,4′-DDD	16	160	
4,4′-DDE	16	160	
4,4′-DDT	16	160	
Dieldrin	16	160	
Endrin	16	160	
Endosulfan II	16	160	
Endosulfan Sulfate	16	160	
Endrin Aldehyde	16	160	
Endrin Ketone	16	160	
Methoxychlor	80	800	
Surrogate: *SUPELCO*			
Tetrachloro-m-xylene	200	80	
Decachlorobiphenyl	200	80	
TOXAPHENE: *AccuStandard*			
Toxaphene	1000	2000	Using a gas-tight syringe, measure 200 µL of (AccuStandard) Toxaphene standard and 50 µL of (Supelco) Pest Surrogate and dilute with hexane to 100 mL.
Surrogate: *SUPELCO*			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
TECHNICAL CHLORDANE: *AccuStandard*			
Technical Chlordane	1000	2000	Using a gas-tight syringe, measure 200 µL of (AccuStandard) Tech. Chlordane standard and 50 µL of (AccuStandard) Pest Surrogate and dilute with hexane to 100 mL.
Surrogate: *SUPELCO*			
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
PESTICIDES MIX 3*: SPEXCERTIPREP*			
2,4′-DDD	1000	80	Using a gas-tight syringe, measure 8 µL of (SpexCertiPrep) Pesticides Mix3 and dilute with hexane to 100 mL.
2,4′-DDE	1000	80	
2,4′-DDT	1000	80	
Oxychlordane	1000	80	
cis-Nanochlordane	1000	80	
trans-Nanochlordane	1000	80	
Mirex	1000	80	

Table 4: INTERMEDIATE SECONDARY STANDARD PREPARATION

PESTICIDES MIX 1*: SUPELCO*	Stock Std. Conc. (µg/mL)	Final Conc. (µg/L)	Preparation
Aldrin	2000	200	Using a gas-tight syringe, measure 10 µL of (Supelco) Pesticides Mix and 180 µL of (SpexCertiPrep) Methoxychlor and dilute with hexane to 100 mL.
alpha-BHC	2000	200	
beta-BHC	2000	200	
delta-BHC	2000	200	
gamma-BHC	2000	200	
alpha-Chlordane	2000	200	
gamma-Chlordane	2000	200	
Heptachlor	2000	200	
Heptachlor Epoxide	2000	200	
Endosulfan I	2000	200	
4,4'-DDD	2000	200	
4,4'-DDE	2000	200	
4,4'-DDT	2000	200	
Dieldrin	2000	200	
Endrin	2000	200	
Endosulfan II	2000	2002	
Endosulfan Sulfate	2000	200	
Endrin Aldehyde	2000	200	
Endrin Ketone	2000	200	
Methoxychlor	2000	2000	
Methoxychlor ***(SpexCertiPrep)***	1000		
Tetrachloro-m-xylene	200	200	
Decachlorobiphenyl	200	200	
TOXAPHENE: *Ultra Scientific*			
Toxaphene	2500	2000	Using a gas-tight syringe, measure 20 µL of (Ultra Scientific) Toxaphene standard and 12.5 µL of (Supelco) Pest Surrogate and dilute with hexane to 25 mL.
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
TECHNICAL CHLORDANE: *Ultra Scientific*			
Technical Chlordane	100	2000	Using a gas-tight syringe, measure 500 µL of (Ultra Scientific) Tech. Chlordane standard and 12.5 µL of (Supelco) Pest Surrogate and dilute with hexane to 100 mL.
Tetrachloro-m-xylene	200	100	
Decachlorobiphenyl	200	100	
PESTICIDES MIX 3*: CPI*			
2,4'-DDD	1000	80	Using a gas-tight syringe, measure 4 µL of (CPI) Pesticides Mix3 and 40 µL of (AccuStandard) Mirex and dilute with hexane to 100 mL.
2,4'-DDE	1000	80	
2,4'-DDT	1000	80	
Oxychlordane	1000	80	
cis-Nanochlordane	100	80	
trans-Nanochlordane	100	80	
Mirex ***(AccuStandard)***	100	80	

Note: Table 2 and Table 2A may be interchanged. However, the source of LCS shall follow the source of the secondary standard or from a third vendor.

Table 5: CHECK STANDARD PREPARATION (DCC/ICV)

Standard	Compound Name	Intermediate Soln. Conc. (µg/L)	Source	Preparation			Final Conc. (µg/L)
				Aliquot (µL)	Dil.Soln./ Modifier	Final Vol. (µL)	
PESTICIDES							
DCC	Pest ICAL Mix	80/160/800	Restek	200	Hexane	800	20/40/200
	Surrogate Mix	80	AccuStandard				20
ICV	Pest ICV Mix	200/2000	Supelco / SpexCertiPrep	100	Hexane	1000	20/200
	Surrogate Mix	200	Supelco				20
TOXAPHENE							
DCC	Toxaphene ICAL	2000	AccuStandard	200	Hexane	800	500
	Surrogate Mix	100	AccuStandard				25
ICV	Toxaphene ICV	200	Ultra Scientific	200	Hexane	800	500
	Surrogate Mix	100	Supelco				25
TECHNICAL CHLORDANE							
DCC	Toxaphene ICAL	2000	AccuStandard	200	Hexane	800	500
	Surrogate Mix	100	AccuStandard				25
ICV	Toxaphene ICV	200	Ultra Scientific	200	Hexane	800	500
	Surrogate Mix	100	Supelco				25

Table 6: SURROGATE STANDARD PREPARATION

Compound Name	Stock Soln. Conc. (µg/mL)	Source	Preparation			Final Conc. (µg/L)
			Aliquot (mL)	Dil.Soln./ Modifier	Final Vol. (mL)	
Surrogate Mix (Tetrachloro-m-xylene & Decachlorobiphenyl)	200	Supelco	2.0	Hexane	1,000	400

Table 7: SPIKE STANDARD PREPARATION

Compound Name	Stock/Intermediate Soln. Conc. (µg/mL)	Source	Preparation			Final Conc. (µg/L)
			Aliquot (µL)	Dil.Soln./ Modifier	Dil. Vol. (mL)	
Pesticide Matrix Spike Mix	2,000	Supelco	20	Hexane	100	400/4000
Methoxychlor	1,000	SpexCertiPrep	360			

Table 8: PERFORMANCE EVALUATION MIXTURE PREPARATION

Compound Name	Stock/Intermediate Soln. Conc. (µg/mL)	Source	Preparation			Final Conc (µg/L)
			Aliquot (µL)	Dil.Soln./ Modifier	Dil. Vol. (mL)	
PEM (DDT + Endrin Mix)	500	Supelco	20	Hexane	100	100/100

Table 9: CLP RETENTION TIME WINDOWS (CLP OLM4.2 D-79/PEST)

Compound	Retention Time Window (minutes)	Compound	Retention Time Window (minutes)
alpha-BHC	± 0.05	Endrin Ketone	± 0.07
beta-BHC	± 0.05	4,4'-DDD	± 0.07
gamma-BHC(Lindane)	± 0.05	4,4'-DDE	± 0.07
delta-BHC	± 0.05	4,4'-DDT	± 0.07
Heptachlor	± 0.05	Endosulfan II	± 0.07
Aldrin	± 0.05	Endosulfan Sulfate	± 0.07
alpha-Chlordane	± 0.07	Methoxychlor	± 0.07
gamma-Chlordane	± 0.07	Aroclors	± 0.07
Heptachlor Epoxide	± 0.07	Toxaphene	± 0.07
Dieldrin	± 0.07		
Endrin	± 0.07	Tetrachloro-m-xylene	± 0.05
Endrin Aldehyde	± 0.07	Decachlorobiphenyl	± 0.10

Table 10: ESTABLISHED LIMIT OF DETECTION (LOD) & LIMIT OF QUANTITATION (LOQ)

MATRIX: AQUEOUS	DL	LOD	LOQ	Unit
Aldrin	0.005	0.01	0.1	µg/L
Alpha-BHC	0.005	0.01	0.1	µg/L
Beta-BHC	0.007	0.01	0.1	µg/L
Delta-BHC	0.007	0.01	0.1	µg/L
Gamma-BHC (Lindane)	0.005	0.01	0.1	µg/L
DDD (4,4)	0.005	0.01	0.1	µg/L
DDE (4,4)	0.005	0.01	0.1	µg/L
DDT (4,4)	0.005	0.01	0.1	µg/L
Dieldrin	0.005	0.01	0.1	µg/L
Endosulfan I	0.008	0.01	0.1	µg/L
Endosulfan II	0.005	0.01	0.1	µg/L
Endosulfan Sulfate	0.005	0.01	0.1	µg/L
Endrin	0.008	0.01	0.1	µg/L
Endrin Aldehyde	0.005	0.01	0.1	µg/L
Heptachlor	0.007	0.01	0.1	µg/L
Heptachlor epoxide	0.005	0.01	0.1	µg/L
Methoxychlor	0.05	0.1	1	µg/L
Alpha-Chlordane	0.005	0.01	0.1	µg/L
Gamma-Chlordane	0.005	0.01	0.1	µg/L
Endrin Ketone	0.005	0.01	0.1	µg/L
Toxaphene	0.25	0.5	2	µg/L
Technical Chlordane	0.005	0.25	1	µg/L
SURROGATES				
Tetrachloro-m-xylene	0.005	0.01	0.02	µg/L
Decachlorobiphenyl	0.005	0.01	0.02	µg/L

Reference: Detection Limit Study dated April 20,2010.

PARAMETER (MATRIX: SOIL)	DL	LOD	LOQ	Unit
Aldrin	0.02	0.4	2	µg/Kg
Alpha-BHC	0.02	0.4	2	µg/Kg
Beta-BHC	0.02	0.4	2	µg/Kg
Delta-BHC	0.27	0.4	2	µg/Kg
Gamma-BHC (Lindane)	0.2	0.4	2	µg/Kg
DDD (4,4)	0.02	0.4	2	µg/Kg
DDE (4,4)	0.02	0.4	2	µg/Kg
DDT (4,4)	0.02	0.4	2	µg/Kg
Dieldrin	0.02	0.4	2	µg/Kg
Endosulfan I	0.2	0.4	2	µg/Kg
Endosulfan II	0.2	0.4	2	µg/Kg
Endosulfan Sulfate	0.2	0.4	2	µg/Kg
Endrin	0.2	0.4	2	µg/Kg
Endrin Aldehyde	0.35	0.4	2	µg/Kg
Heptachlor	0.2	0.4	2	µg/Kg
Heptachlor epoxide	0.2	0.4	2	µg/Kg
Methoxychlor	2	4	10	µg/Kg
Alpha-Chlordane	0.2	0.4	2	µg/Kg
Gamma-Chlordane	0.2	0.4	2	µg/Kg
Endrin Ketone	0.2	0.4	2	µg/Kg
Toxaphene	5	10	50	µg/Kg
Technical Chlordane	10	20	50	µg/Kg
SURROGATES				
Tetrachloro-m-xylene	0.167	0.33	0.7	µg/Kg
Decachlorobiphenyl	0.167	0.33	0.7	µg/Kg

Reference: Detection Limit Study dated April 5,2010.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURE

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
5 point Initial Calibration for analytes	Initially, as needed	RSD for all analytes ≤ 20% or Linear – least squares or inverse weighting factor: r ≥ 0.995.	Correct then problem then repeat initial calibration.		
Second –source Calibration Verification	Once per 5-point initial calibration	All analytes within ± 20of expected value from the ICAL.	Repeat injection of ICV. If the problem persists, perform troubleshooting and repeat the ICAL.		
Initial Calibration Verification Check	Daily, before sample analysis	All analytes within ± 20%	Correct the problem. If problem persists, repeat initial calibration		
Calibration Verification	Every 12 hours of analysis time and at the end of the analysis sequence	All analytes within ± 20%	Correct the problem then repeat initial calibration verification and re-analyze all samples since last successful calibration verification		
Breakdown check (Endrin and DDT)	Every 12-hours	Degradation ≤ 15% of each analyte.	Repeat breakdown check		
Method Blank	One per preparation batch	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Re-prep and re-analyze method blank and all samples processed with the contaminated blank		
LCS	One LCS per preparation batch	Within project QC limits	Re-prep and re-analyze the LCS and all associated samples		
Surrogate spike	Every sample, spiked sample, standard and method blank	Within project QC limits	Correct the problem then re-extract and re-analyze sample		
MS/MSD	One MS/MSD per every 20 project samples per matrix	Within project QC limits	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise, check for probable source of error and perform corrective action as necessary		
Confirmation	100% for all positive results	Same as primary column	If quantitation criteria are not met, use confirmation for qualitative identification only.		

Comments:

1. For flagging criteria refer to PSR. Otherwise, if MB is non-compliant, apply B to specific analyte(s) on all associated samples; apply J to all values between LOD and LOQ.

Reviewed By:		
Date		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: EPA 3520C / EPA 8081B

Sample Prep SOP: EMAX-3520 Rev. 5
Analytical SOP: EMAX-8081
Conc Unit: µg/L
Sample Amt(ml): 1000
Extract Volume (mL): 10

Instrument ID: E8
Extraction date: 9/12 & 9/16/13
Extracted by: Iragasa / Jmuertigue
Analysis date: 9/18 & 9/19/13
Analyzed by: E. Santos

PARAMETER	CPI018WL	CPI018WC	CPI023WL	CPI023WC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	RI18020A/B	RI18021A/B	RI18060A/B	RI18061A/B							
Aldrin	0.213	0.222	0.233	0.234	0.2	0.2	113	0.010	4.5	70 - 130	PASSED
alpha-BHC	0.219	0.231	0.250	0.245	0.2	0.2	118	0.014	5.9	70 - 140	PASSED
beta-BHC	0.241	0.275	0.299	0.269	0.2	0.3	135	0.024	8.7	70 - 140	PASSED
delta-BHC	0.235	0.248	0.263	0.261	0.2	0.3	126	0.013	5.3	70 - 140	PASSED
gamma-BHC (Lindane)	0.205	0.213	0.228	0.227	0.2	0.2	109	0.011	5.2	60 - 140	PASSED
DDD (4,4)	0.217	0.223	0.244	0.237	0.2	0.2	115	0.012	5.4	70 - 140	PASSED
DDE (4,4)	0.215	0.224	0.238	0.234	0.2	0.2	114	0.010	4.4	70 - 130	PASSED
DDT (4,4)	0.240	0.251	0.269	0.256	0.2	0.3	127	0.012	4.8	70 - 150	PASSED
Dieldrin	0.218	0.224	0.248	0.236	0.2	0.2	116	0.013	5.8	70 - 130	PASSED
Endosulfan I	0.206	0.213	0.228	0.224	0.2	0.2	109	0.010	4.7	70 - 130	PASSED
Endosulfan II	0.222	0.229	0.250	0.241	0.2	0.2	118	0.013	5.3	70 - 130	PASSED
Endosulfan sulfate	0.224	0.231	0.250	0.244	0.2	0.2	119	0.012	5.0	70 - 140	PASSED
Endrin	0.217	0.225	0.238	0.228	0.2	0.2	113	0.009	3.8	70 - 140	PASSED
Endrin Aldehyde	0.211	0.211	0.247	0.242	0.2	0.2	114	0.019	8.5	70 - 140	PASSED
Heptachlor	0.208	0.218	0.226	0.225	0.2	0.2	110	0.008	3.9	60 - 130	PASSED
Heptachlor epoxide	0.215	0.220	0.236	0.231	0.2	0.2	113	0.010	4.3	70 - 130	PASSED
Methoxychlor	2.160	2.253	2.462	2.477	2	2	117	0.157	6.7	70 - 140	PASSED
alpha-Chlordane	0.211	0.219	0.232	0.228	0.2	0.2	111	0.009	4.2	70 - 130	PASSED
gamma-Chlordane	0.224	0.232	0.248	0.244	0.2	0.2	119	0.011	4.6	70 - 140	PASSED
Endrin Ketone	0.223	0.221	0.240	0.236	0.2	0.2	115	0.009	4.1	70 - 130	PASSED
Tcx	0.365	0.396	0.398	0.406	0.4	0.4	98	0.018	4.6	30 - 130	PASSED
DCB	0.356	0.368	0.368	0.367	0.4	0.4	91	0.006	1.6	60 - 130	PASSED

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: EPA 3550C / EPA 8081B

Sample Prep SOP: EMAX-3550 Rev. 3
Analytical SOP: EMAX-8081 Rev. 7
Conc Unit: µg/Kg
Sample Amt(g): 30
Extract Volume (mL): 10

Instrument ID: E8
Extraction date: 1/16 & 1/21/14
Extracted by: J. Villena
Analysis date: 1/29 & 1/31/14
Analyzed by: E. Santos

PARAMETER	CPA019SL	CPA019SC	CPA033SL	CPA022SC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	MA29007A	MA29008A	MA31013A	MA31014A							
Aldrin	6.30	6.29	7.15	7.07	6.67	6.7	101	0.474	7.1	60 - 130	PASSED
alpha-BHC	6.21	6.20	7.26	7.29	6.67	6.7	101	0.616	9.1	50 - 140	PASSED
beta-BHC	6.28	6.31	7.47	7.44	6.67	6.9	103	0.670	9.7	60 - 140	PASSED
delta-BHC	6.59	6.63	7.59	7.53	6.67	7.1	106	0.546	7.7	60 - 140	PASSED
gamma-BHC (Lindane)	6.29	6.27	7.08	6.96	6.67	6.6	100	0.431	6.5	60 - 130	PASSED
DDD (4,4)	7.53	7.63	7.47	7.42	6.67	7.5	113	0.090	1.2	70 - 140	PASSED
DDE (4,4)	6.67	6.75	7.47	7.39	6.67	7.1	106	0.419	5.9	60 - 140	PASSED
DDT (4,4)	8.07	8.16	8.82	8.89	6.67	8.5	127	0.431	5.1	70 - 150	PASSED
Dieldrin	6.56	6.58	7.45	7.40	6.67	7.0	105	0.493	7.0	60 - 140	PASSED
Endosulfan I	6.14	6.12	7.23	7.11	6.67	6.6	100	0.605	9.1	50 - 130	PASSED
Endosulfan II	6.74	7.00	7.58	7.53	6.67	7.2	108	0.410	5.7	70 - 130	PASSED
Endosulfan sulfate	7.02	7.31	7.79	7.74	6.67	7.5	112	0.365	4.9	60 - 140	PASSED
Endrin	7.16	7.29	7.43	7.34	6.67	7.3	110	0.112	1.5	70 - 140	PASSED
Endrin Aldehyde	6.53	6.68	7.37	7.17	6.67	6.9	104	0.396	5.7	60 - 140	PASSED
Heptachlor	6.19	6.28	7.08	7.14	6.67	6.7	100	0.506	7.6	60 - 130	PASSED
Heptachlor epoxide	6.32	6.59	7.29	7.31	6.67	6.9	103	0.502	7.3	60 - 130	PASSED
Methoxychlor	81.5	84.7	92.7	92.8	66.7	88	132	5.686	6.5	60 - 140	PASSED
alpha-Chlordane	6.59	6.60	7.33	7.28	6.67	6.9	104	0.410	5.9	60 - 130	PASSED
gamma-Chlordane	6.52	6.64	7.41	7.32	6.67	7.0	105	0.458	6.6	60 - 130	PASSED
Endrin Ketone	6.61	6.83	7.52	7.52	6.67	7.1	107	0.471	6.6	70 - 130	PASSED
Tcx	10.71	10.24	11.91	11.83	13.3	11.2	84	0.827	7.4	50 - 140	PASSED
DCB	13.1	12.7	13.9	13.7	13.3	13.4	100	0.545	4.1	50 - 140	PASSED

8081FS: SAMPLE PREPARATION LOG

Prep BatchID	Lab SampleID	Aliquot	Unit	DateTime	Ve (ml)	EA	EVe (ml)	PF	FlorisilCleanup EMAX-3620	SulfurCleanup EMAX-3660	AcidCleanup EMAX-3665	Comments

☐ ExtractionStarted @ **Ve**=ExtractVolume **EA**= ExpectedAliquot **EVe**=ExpectedExtractVolume **PF**=(EA/Aliquot)(Ve/EVe)

☐ Extraction Ended @ Prepared By:

Comment: [1]Acid cleanup is only for PCB anlaysis. Checked By:

Date

8081FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
PESTICIDES/PCBs

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #:	AE8-007
Instrument No.:	E8
Analytical Sequence:	
Method File:	
Analytical Batch:	

SOP #	Rev. #
☐ EMAX-8081	
☐ EMAX-8082	
☐ EMAX-608	
☐ EMAX-	

ICAL REFERENCE

ICAL ID	BATCH	DATE

STANDARDS ID	Conc (µg/L)
Hexane	

Column	☐ A. Elite-CLP I B. Elite-CLP II
	☐ A. RTX/STX CLPEST I B. RTX/STX CLPEST II
	☐ A. ZB-MULTI RES I B. ZB-MULTI RES II

ELECTRONIC DATA ARCHIVAL

Location	Date
☐ EZChrom Elite_PEST E8	

Analyzed By: Date:

Date Disposed: Disposed By:

This page is checked during data review.

8081FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: E8 Month: Year: 201_ Book #: ME8-004

Date							
Column Head Pressure-Initial (psi)							
Column Head Pressure-Final (psi)							
Carrier Gas Flowrate (ml/min)							
Channel A Signal (mV)							
Channel B Signal (mV)							
Autosampler							
Update Cal. Table							
Computer Date/Time							
Septa Change							
Liner Change/Clean-up							
Analyst Initial							
TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

STANDARD OPERATING PROCEDURES

POLYCHLORINATED BIPHENYLS (PCB) AND POLYCHLORINATED TERPHENYLS (PCT) BY GAS CHROMATOGRAPHY

SOP No.:	EMAX-8082	Revision No.	5	Effective Date:	02-Jul-14
Prepared By:	Tu Nisamaneepong			Date:	07-02-14
Approved By:	Kenette Pimentel QA Manager			Date:	07-02-14
Approved By:	Caspar Pang Laboratory Director			Date:	07-02-14

Control Number: 8082-05-

1.0 SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentration of Polychlorinated Biphenyls (PCBs) and Polychlorinated Terphenyls (PCTs) as Aroclors in soil, sediment, sludge, and wastewater samples by gas chromatography method.

1.2. This SOP is an adaptation of EPA 8082A. Since EPA 8082A is an update and enhancement of 8082, this SOP is also applicable to EPA 8082.

2.0 SUMMARY OF METHOD

2.1. This method provides gas chromatographic conditions for the detection of PCB and PCT compounds with dual Electron Capture Detector (ECD). The samples are extracted in methylene chloride, exchanged to hexane and cleaned up by appropriate method before GC analysis.

2.2. **Interferences**

2.2.1. Interferences by phthalate esters co-extracted from the sample or introduced during sample preparation can pose a major problem in PCB and PCT determinations. Interferences can be minimized by avoiding contact with any plastic materials and checking all solvents for phthalate contamination. Glassware must be scrupulously cleaned. Sulfuric acid/permanganate cleanup technique can be used for Phthalate esters removal from the extract.

2.2.2. The presence of elemental sulfur will result in broad peaks that may cause chromatographic interfere with the determination of PCBs and PCTs. Sulfur contamination is most likely present in sediment samples. The TBA procedure, GPC or other cleanup technique can be used for sulfur removal from the extract.

2.2.3. Other interferences such as aliphatic compounds, aromatics and nitrogen-containing compounds may be eliminated by using Florisil cleanup.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Table 6 for established DL, LOD and LOQ values.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and shall require dilution to properly quantitate.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. Typical dynamic ranges are:

	PCBs	PCTs
Water (µg/L)	0.5 - 20.0	2.0 - 10.0
Soil (µg/Kg)	16.67 – 666.67	40 - 500

5.0 SAMPLE HOLDING TIME & PRESERVATION

5.1. **Holding Time**

5.1.1. PCBs and PCTs are very stable in a variety of matrices and holding times may be as long as a year.

5.1.2. Analysis should be within 40 days after extraction completion date.

5.2. **Preservation**

5.2.1. Samples and extract should be kept at ≤ 6°C.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA014 Detection Limit

6.3. EMAX-QA08 Corrective Action

6.4. EMAX-QC02 Analytical Standard Preparation

6.5. EMAX-SM04 Analytical and QC Labeling

6.6. EMAX-3520 Extraction, Continuous Liquid/Liquid

6.7. EMAX-3546 Extraction, Microwave

6.8. EMAX-3550 Extraction, Pulse Sonication

6.9. EMAX-3540 Extraction, Soxhlet

6.10. EMAX-3580 Waste Dilution

6.11. EMAX-3620 Cleanup, Florisil

6.12. EMAX-3660 Cleanup, Sulfur

6.13. EMAX-3665 Cleanup, Acid/Permanganate

7.0 SAFETY

7.1. Read all SDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. ECD contains minute quantity of Radioactive Ni (63), a wipe test performed by experienced personnel or manufacturer should be conducted semiannually or sooner if potential problem is suspected. Observe standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of the body, rinse the affected body part thoroughly with copious amounts of water. If irritations or any other discomfort related to the incident persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS & REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	HP 5890 Series II
Detector	Dual Electron Capture Detectors
Column	RTX CLPESTI (30 m x 0.32 mm x 0.5 μm) RTX CLPESTII (30 m x 0.32 mm x 0.25 μm) (Alternate columns may be used after verification of performance)
Data System	EZ Chrom
Auto Sampler	HP Model 7673B or equivalent
Gas	Ultra-high purity hydrogen Ultra-high purity nitrogen
Microsyringes	10, 25, 100 and 500 μL with a 0.006 mm ID needle
Volumetric Flasks	0,50, and 100 ml with ground glass stopper
Transfer Pipette	Pasteur

8.2. **Chemicals and Reagents**

Solvent (GC-grade)	Pesticide-free grade hexane, methylene chloride, isopropanol

9.0 STANDARDS

9.1. **Preparation**

9.1.1. Prepare and label analytical standards according to EMAX-QC02 and EMAX-SM04.

9.2. **Stock Standard**

9.2.1. Purchase Primary Calibration stock standards as certified solutions at 1000 mg/L. After opening, transfer the stock standard to an inert vial and store with a minimum headspace.

9.2.2. Purchase a Secondary set of stock standards from a different source to verify the concentration of the first set of standards. Treat the secondary standards similarly as the primary standards.

9.2.3. Purchase LCS/MS and surrogate standards as certified solutions at 1000 mg/L and 200 mg/L, respectively.

9.2.4. Store all standards at ≤ 6°C, unless otherwise specified.

9.3. **Intermediate Standard**

9.3.1. Prepare intermediate standards (for both primary and secondary) at 4000 µg/L as suggested in Table 1.

9.4. **Initial Calibration Standard (ICAL)**

9.4.1. Prepare a minimum of five calibration standards using primary intermediate standard according to Table 2.

9.5. **Initial Calibration Verification (ICV)**

9.5.1. Prepare ICV using the secondary intermediate standard as described in Table 3.

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Prepare DCC using the primary intermediate standard as described in Table 3.

9.7. **Surrogate Standard**

9.7.1. Prepare surrogate standard as described in Table 4.

9.8. **LCS/MS Spike Standard**

9.8.1. Prepare LCS/MS spike standard as described in Table 4.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Aqueous samples shall be prepared as described in EMAX-3520.

10.1.2. Solid samples shall be prepared as described in EMAX-3550 or EMAX-3546. If necessary, clean up with sulfuric acid as described in EMAX-3665 is performed.

10.2. **Instrument Parameters**

10.2.1. EPA 8082A requires an analytical system complete with a temperature programmable gas chromatograph equipped with an autosampler suitable for on column injection of 1 to 5 µL.

10.2.2. Gas Pressure

Nitrogen Pressure : 40 psi

Hydrogen Pressure : 50 psi

10.2.3. Temperature Program

	RESTEK **RTX CLPest 1 & 2**
Initial Temp	130°C, hold for 0.5 minute
Rate 1	25°C/min
Temp 1	230°C, hold for 2 minutes
Rate 2	5°C/min
Temp 2	260°C, hold for 0.2 minute
Rate 3	25°C/min
Final Temp	290°C, hold for 1 minute (PCB) 290°C, hold for 17 mins. (PCB+PCT)
Injector	230°C
Detector	300°C
Injection Volume	1 µL

10.3. **Calibration**

10.3.1. Initial Calibration (ICAL)

10.3.1.1. A standard containing a mixture of Aroclor 1016 and Aroclor 1260 will include many of the peaks represented in other five Aroclor mixtures. As a result, a multi-point initial calibration employing a mixture of Aroclor 1016 and 1260 at a minimum of five concentrations should be sufficient to demonstrate the linearity of the detector response without the necessity of performing initial calibration for each of the seven Aroclors.

10.3.1.2. A separate set of calibration standards containing Aroclor 5460 is also prepared.

10.3.1.3. Initial calibration standards (or as suggested in Table 2) of Aroclors 1016, 1260, and 5460 are analyzed by direct injection.

10.3.1.4. Three to five characteristic peaks from each Aroclor are chosen for quantitation. Peaks should be at least 25% of the height of the largest Aroclor peak. Tabulate each peak area response against concentration of injected standard. Calculate each calibration factor according to Eq. 10.6.1.1. A minimum of five sets of calibration factors will be generated for each Aroclor.

10.3.1.5. Application of ICAL Curve for Quantitation

10.3.1.5.1. Generate a summary of calibration factors for each analyte at each concentration using Eq-10.6.1. Calculate the Average Calibration

Factor (ACF), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to, Eq. 10.6.2, Eq. 10.6.3 and Eq. 10.6.4, respectively.

- If RSD is ≤ 20%, ACF may be applied.
- Apply Inverse Weighting Factor (1/y or 1/y2; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.995.
- Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.995.
- It may be appropriate to force the regression through zero for specific analytes[1]. When exercising this option [as included in the data acquisition software], make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.1.6. In situations where a particular Aroclor is of interest for a specific project, a minimum five-point calibration curve of that Aroclor may be employed.

10.3.1.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.1.8. Refer to Appendix 1 for acceptance criteria. If acceptance criteria are not met refer to Section 12 for corrective action.

10.3.2. Initial Calibration Verification (ICV)

10.3.2.1. Prepare a mid-level calibration standard of Aroclors 1260 + 1016 and Aroclor 5460 from a second source. Analyze these after the initial calibration to verify the ICAL.

10.3.2.2. Calculate the %Difference (%D) using Eq. 10.6.2.1. This should be equal to or less than 20%.

10.3.2.3. The standards of the other Aroclors are used to determine a single-point calibration factor for each Aroclor and pattern recognition. It can be analyzed before or after the Aroclor 1016/1260 and 5460 standards.

10.3.3. Daily Calibration Check (DCC)

[1] SW846 Method 8000B, Section 7.5.3; SW846 Method 8000C, Section 11.5.2.1

10.3.3.1. For daily run, analyze DCC (mid-level Aroclor 1016 + 1260 and 5460 standards) at the start of the 12-hour shift prior to sample analysis, and close the analytical run with an ending DCC. A 12-hour shift interval must not exceed 20 samples.

10.3.3.2. The calibration check process does not require analysis of the other Aroclor standards used for pattern recognition.

10.3.3.3. Calculate the %D by using Eq. 10.6.2.1. Refer to Appendix 1 for acceptance criteria.

10.3.3.4. For projects wherein specific PCB is expected to be found, analyze DCC of that particular PCB at 500 µg/L.

10.4. **Analysis**

10.4.1. Analytical Sequence

10.4.1.1. Following the instrument data acquisition software, prepare the analytical sequence file as suggested below:

- Instrument Blank
- Minimum Five Calibration Standards of Aroclors 1016/1260
- Minimum Five Calibration Standards of Aroclor 5460
- Calibration Standards of Aroclor 1254, 1248, 1242, 1232, 1221, 1262, 5432 and 5442 (as necessary) *
- Initial Calibration Verification of Aroclor 1016/1260 and Aroclor 5460
- Method Blank
- Lab Control Sample
- Samples (up to 12 hours but not more than 20 samples)
- Continuing Calibration Standard of of Aroclor 1016/1260 and Aroclor 5460 or other calibrated Aroclors

10.4.2. Sample Analysis

10.4.2.1. Transfer a minimum of 0.5 mL of extract to a 2-mL autosampler vial (or equivalent) using a Pasteur pipette. Cap the vial with a teflon septum and seal with an aluminum rim.

10.4.2.2. Introduce extract into the gas chromatograph using direct injection technique (1 to 5 µl) after all quality control criteria have been met.

10.4.2.3. If the response exceeds the linear range of the system, dilute the sample and re-analyze.

10.4.3. Sample Result Evaluation

* Include Calibration standards for Aroclor 1254, 1248, 1242, 1232, 1221, 1262, 1268, 5432 and 5442 if pattern is found in the sample.

10.4.3.1. Check QC parameters as soon as the data is available.

- ✓ Check LCS recovery that it is within QC limits (Appendix 1).
- ✓ Check MB that is project compliant.
- ✓ Check retention time.
- ✓ Check surrogate recoveries against Appendix 1.
- ✓ Check concentration of target analytes. If the response exceeds the calibration range, dilute and re-analyze the sample until the response falls within the calibration range.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. If re-analysis results are the same as the initial result, consult the Supervisor for further action. If results indicate extraction problem, order re-extraction for the affected sample(s).

10.4.3.2. Identification of a multicomponent analyte in the sample is based on pattern recognition in conjunction with the elution of three to five peaks on both GC columns.

10.4.3.3. Positive identification is made when a target peak falls within the retention time window on both columns established by the standard reference compound.

10.4.3.3.1. If one column meets the retention time criteria and a retention time shift is suspected on the other column, use the following guideline in reporting the data:

- ✓ Check that the expanded window does not exceed the RTW of the column in control or the established RTW or the CLP RTW[2] whichever is greater.
- ✓ If the above condition is met, report the data and include a description of the observation in the case narrative.

10.4.3.4. The agreement between the quantitative results should be evaluated after the identification is made. Calculate the relative percent difference (RPD) between the two results according to Eq. - 10.6.4.2.

- If the RPD is less than 40% and the pattern peaks do not indicate any anomalies, report the higher result.
- If the RPD is less than 40% and the pattern peaks indicate an anomaly, report the result from the better pattern peaks.
- If the RPD is greater than 40%, use professional judgment. If no anomaly is found, report the higher result.

10.4.4. Retention Time Window

10.4.4.1. **Establishing RTW**

[2] CLP-OLM4.2 Table 1 D-79/PEST

10.4.4.1.1. Collect at least three Daily Calibration Standards analyzed over a period of 72 hours.

10.4.4.1.2. Calculate the Standard Deviation (SD) of absolute retention time obtained for each of the major peaks used for calibration.

10.4.4.1.3. Determine the width of RTW by ±3X SD.

10.4.4.2. **Evaluating RTW**

10.4.4.2.1. If the SD is equal to 0.00, default to the previous study until historical data is obtained.

10.4.4.2.2. For new instruments, in the interim use the CLP retention time window for Aroclors (±0.07 min) until RTW is obtained for the new instrument parameters condition.

10.4.4.3. **Application of RTW**

10.4.4.3.1. Establish the center of absolute retention time for each of the characteristic peak to include the surrogate(s) from the daily calibration check at the beginning of the analytical shift then apply the established RTW.

10.4.4.3.2. Whenever the observe retention time is outside the established RTW, the analyst is advised to determine the cause and perform necessary corrective action before continuing analyses.

10.4.4.4. **Updating RTW**

10.4.4.4.1. Re-establish the RTW as described in Section 10.4.4.1 when any of the following conditions occur:

- Yearly RTW update
- Significant shifting is observed (e.g. succeeding calibration checks or LCS are out of RTW)
- Major instrument maintenance (e.g. replacements of detector or column; temperature program change, etc.)

10.4.5. Manual Integration

10.4.5.1. Refer to EMAX-DM01 for details of manual integration.

10.4.6. Dealing with Carryover

10.4.6.1. Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

10.4.6.2. If there was no target analyte detected (as found in the sample that exceeded calibration range), proceed with data reduction.

10.4.6.3. If there was a target analyte detected (as found in the sample that exceeded the calibration range), re-analyze the sample to rule-out carry-over. If carry-over is confirmed, proceed with data reduction and report the data from the re-analyzis.

10.5. **Data Reduction**

10.5.1. Make a copy of the analytical run log and highlight the data to be reported.

10.5.2. Collate the reportable raw data. Segregate raw data for samples, QC data and calibration data using section dividers.

10.5.3. Keep all other unused data generated during the analysis in the analytical folder and marke with "For record only".

10.5.4. Proceed to report generation.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. **Calculate for Calibration Factor (CF)**

$$CF = \frac{R_a}{C_a}$$ Eq.-10.6.1.1

where:

R_a - response for analyte measured in peak area

C_a - Concentration of analyte (µgL) x 1/N

N - number of identification peak in each Aroclor

10.6.1.2. **Calculate for Average Calibration Factor (ACF)**

$$ACF = \frac{\sum CF_a}{n}$$ Eq.-10.6.1.2

where:

ACF - average calibration factor

ΣCF_a - sum of calibration factors

n - number of calibration points

10.6.1.3. **Calculate for Standard Deviation**

$$SD = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}}$$

Eq.-10.6.1.3

where:

SD - standard deviation

x_i - result at I^{th} measurement

$\bar{x}$ - mean of all x measurements

N - number of measurements

10.6.1.4. **Calculate for % Relative Standard Deviation (%RSD)**

$$\%RSD = \frac{SD}{ACF} * 100\% \qquad \text{Eq.-10.6.1.4}$$

where:

RSD - relative standard deviation

SD - standard deviation

ACF - average calibration factor

10.6.1.5. **Calculate for Least Square Line Regression**

$$y = ax + b \qquad \text{Eq.-10.6.1.5}$$

where:

y – Response Factor

x – Concentration

a = x1 = slope of the line

$$a = \frac{\sum (x - \bar{x})(y - \bar{y})}{(x - \bar{x})^2}$$

$\bar{x}$ - Average of amount ratios

$\bar{y}$ - Average of response ratios

b = x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.6.1.6. **Calculate for Inverse Weighting Factor**

$$y = ax + b \qquad \text{Eq.-10.6.1.6}$$

where:

y – Response Factor

x – Concentration

a – x1 = slope of the line

$$a = \frac{\sum [(x - x_a)(y - y_a)]}{\sum (x - x_a)^2}$$

where:

$$x_a = \sum[x(1/x)/\sum(1/x)]$$

$$y_a = \sum[y(1/x)/\sum(1/x)]$$

$$x_a = \sum[x(1/x^2)/\sum(1/x^2)]$$

$$y_a = \sum[y(1/x^2)/\sum(1/x^2)]$$

b = x0 = intercept of the line

$$b = y_a - a * x_a$$

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. **Calculate Percent Difference**

$$\%D = \frac{ACF - CF}{ACF} * 100\% \qquad \text{Eq.-10.6.2.1}$$

where:

ACF - average calibration factor

CF - calibration factor at calibration check standard

10.6.3. Sample Results

10.6.3.1. Identify 3 to 5 major peaks as quantitative peaks for each Aroclor. Establish the ACF of each peak as outlined in Section 10.6.1.1. Calculate the concentration of each peak in Aroclor according to Eq. - 10.6.3.2 or Eq. - 10.6.3.3. The concentration of Aroclor equals the sum of the concentrations of these major peaks according to Eq, - 10.6.3.4.

10.6.3.2. **Water Samples**

$$C_n = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a}\right)DF \qquad \text{Eq-10.6.3.2}$$

where:

C_n - Concentration of characteristic peak n measured (µg/L)

R_a - Total response of analyte in peak area

ACF - Average calibration factor

V_e - Volume of extract in ml

S_a - Sample amount in ml

DF - Dilution factor of sample extract

10.6.3.3. **Soil Samples**

$$C_n = \left(\frac{R_a}{ACF}\right)\left(\frac{V_e}{S_a(\%Solid)}\right)DF \qquad \text{Eq.10.6.3.3}$$

where

C_n	-	Concentration of characteristic peak n measured (µg/kg)
R_a	-	Total response of analyte in peak area
ACF	-	Average calibration factor
V_e	-	Volume of extract in ml
S_a	-	Sample Amount in g
% Solid	-	$\frac{100 - \%\,moisture}{100}$
DF	-	Dilution factor of the sample extract

10.6.3.4. **Final Aroclor Concentration**

$$C = C_1 + C_2 + \ldots + C_n \qquad \text{Eq.-10.6.3.4}$$

where:

C	-	Concentration of Aroclor in sample (µg/L or µg/kg)
C_1	-	Concentration of characteristic peak 1
C_2	-	Concentration of characteristic peak 2
n	-	Characteristic peak number in each Aroclor

10.6.4. Accuracy and Precision

10.6.4.1. **Percent Recovery**

$$\%R = \frac{C_f - C}{C_s} * 100 \qquad \text{Eq.-10.6.4.1}$$

where:

%R	-	percent recovery
C_f	-	concentration of spiked sample
C_s	-	concentration of spike
C	-	concentration of unspiked sample (For LCS recovery, C=0)

10.6.4.2. **Relative Percent Difference**

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.6.4.2}$$

where:

%RPD - Relative Percent Difference

C_1 - Measured concentration of the first sample aliquot

C_2 - Measured concentration of the second sample aliquot

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C .exe

10.7.2. Generate Lab Chronicle using LABCHRN1.exe

10.7.3. Generate sample results using F1NV3C .exe

10.7.4. Generate the QC Summary file using QCV3CN .exe

10.7.5. Generate the case narrative using CN1.exe.

10.7.6. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analysis.

10.7.6.1. Case Narrative

10.7.6.2. Lab Chronicle

10.7.6.3. Sample Results

10.7.6.4. LCS Summary

10.7.6.5. MS/MSD Summary

10.7.6.6. ICAL Summary

10.7.6.7. ICV Summary

10.7.6.8. DCC Summary

10.7.6.9. Analytical Run Log

10.7.6.10. Sample Preparation Log

10.7.6.11. Non-Conformance Report (if any)

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01 and the project specific requirements (PSR).

10.8.1.1. If any of the checkpoints below indicate a problem, re-analysis is required.

- ✓ Check that all samples required for analysis are analyzed.
- ✓ Check that samples are extracted and analyzed within holding time.
- ✓ Check that all calibration requirements are fulfilled.
- ✓ Check the chromatogram of all positively identified Aroclor patterns that they are qualitatively identified and qualitatively accurate.
- ✓ Check surrogate recoveries against required limits.

✓ Check that concentration of target analytes are within calibration range.

10.8.2. Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to Form 8082FM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back in control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	Description	Frequency
Autosampler Check	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check liner as necessary. Check instrument performance (e.g., daily calibration check, instrument blank, DDT/Endrin breakdown).	Daily prior to analysis
Documentation	Record maintenance in instrument service logs.	Daily prior to analysis
Leak Test	Perform inlet pressure decay test.	Every 6 months or as necessary
System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector where applicable.	Every 6 months or as necessary
Check Flow Path Components	Check and replace the following as necessary: tubing assembly, union, sample probe, and loop.	Once a year or as necessary
Complete Inspection	Perform general inspection of the complete system. Inspect autosampler cabling and configuration setting.	Once a year

11.0 QUALITY CONTROL

11.1. **Preparative Batch**

11.1.1. A preparative batch shall consist of a method blank, LCS, MS/MSD and a maximum of 20 field samples of similar matrix.

11.1.2. In the absence of MS/MSD, LCS/LCD is prepared.

11.1.3. Surrogate standard shall be added to all samples, including method blank LCS/LCD and MS/MSD. Check PSR for QC Control Limits.

11.1.4. Perform QC check prior to utilizing the surrogate and LCS/MS spike standards by analyzing the prepared standard at the spiking level. Results should be within ± 20% of the expected value.

11.2. **Analytical Batch QC**

11.2.1. Instrument Blank must be analyzed daily to establish zero baseline or background value.

11.2.2. A continuing calibration shall be performed before any other analysis is done. The continuing calibration procedure and the acceptance criteria are discussed in Section 10.3.2 and Appendix 1.

11.3. **Method QC**

11.3.1. Analyst demonstration of proficiency is a must prior to performing this analysis.

11.3.2. A valid LOD and LOQ must exist prior to sample analysis.

11.3.3. A valid ICAL must exist prior to sample analysis.

11.3.4. Instrument performance must be checked prior to sample analysis. Check Appendix 1 for acceptance criteria.

11.3.5. Prepare and analyze QC samples, to include, method blank, LCS (LCD), and MS/MSD. QC Control Limits shall follow the Project Specific Requirement (PSR) in each analytical folder.

12.0 CORRECTIVE ACTION

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. If Initial calibration is non-compliant, consider the following suggestions to correct the problem:

12.2.1. If %RSD is out of acceptance criteria, review result and identify presence of an outlier.

12.2.2. If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and reanalyze.

12.2.3. If the highest ICAL point appears to be saturated, drop the highest point.

12.2.4. If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects to which the ICAL will be used.

12.2.5. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

12.2.5.1. Check the connections and make sure they are air-tight and perform maintenance as needed.

12.2.5.2. Check the gas flow

12.2.5.3. Prepare a fresh standard and repeat calibration

12.2.6. If the problem persists, inform the supervisor.

12.3. If the ICV is non-compliant, consider the following suggestions to correct the problem:

12.3.1. Re-analyze ICV (to rule out poor injection)

12.3.2. If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error

12.3.3. If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration

12.3.4. If the problem persists, inform the supervisor

12.4. If the instrument blank is non-compliant, consider the following suggestions to correct problem:

12.4.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new auto sampler syringe.

12.4.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.4.3. Rule out preparation contamination by preparing a new instrument blank

12.4.4. If the problem persists, inform the supervisor.

12.5. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

12.5.1. Change the liner

12.5.2. Clean injection port

12.5.3. Prepare new standard

12.5.4. Cut or replace column

12.5.5. Clean the detector

12.5.6. Rule out leaks by checking all connections

12.5.7. If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL

12.6. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.6.1. Rule out instrument contamination by checking instrument blank

12.6.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01

12.6.3. Rule out glassware contamination used for extraction as described in EMAX-QC07

12.6.4. Re-extract MB and the associated samples with reagents free of contamination or with newly

opened reagents

12.6.5. If the problem persists, inform the supervisor

12.7. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.7.1. If result is bias-high or bias-low, check the LCS Standard by analyzing at the spike level

12.7.2. If LCS check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.7.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.8. Initiate a Non-Conformance Report (NCR) when the following circumstances occur:

- Anomalies other than specified in Appendix 1 is observed.
- Sample is out of technical holding time.

12.8.1. Refer to EMAX-QA08 for NCR details.

12.9. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standard s in fume hoods.

14.0 WASTE MANAGEMENT

14.1. No samples shall be dumped on the laboratory sink.

14.2. Separate and properly identify all unused and expired analytical standards for proper disposal.

14.3. Place all waste generated during analytical process in properly labeled satellite waste containers for proper collection.

14.4. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation Batch** – is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical Batch** – is compose of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – is defined as the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type I error) is 1%.

15.1.4. Limit of Detection (LOD) – is defined as the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative result rate (Type II error) is 1%.

15.1.5. Limit of Quantitation (LOQ) – is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.1.6. Safety Data Sheet (SDS) – is written information concerning a chemical physical properties, toxicity, health hazards, fire hazard and reactivity data including storage, spill and handling precautions.

15.1.7. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.8. Calibration Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.9. Characteristic Peaks – are major identifying and quantifying peaks for each type of Aroclor.

15.1.10. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.11. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.12. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.13. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.14. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.15. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.16. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.17. Matrix – is a component or form of a sample.

15.1.18. Matrix Spike (MS) – is a sample spiked with a verified known amount of target anayte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.19. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.20. Surrogate – are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard; used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be detected in environmental media.

15.1.21. Reagent Water – is purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.22. Reagent Soil – organic-free Ottawa sand or equivalent.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing PCB analysis by GC/MS. In instances where there is a project or program QAPP, the requirements given in the project takes precedence over this SOP.

15.3. **Department of Defense (DoD) and Department of Energy (DoE) Projects**

15.3.1. Samples from DoD and DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluating Solid Waste, Physical and Chemical Methods" (SW846) Method 8082A Rev. 1, Feb. 2007 and Method 8082 Rev. 0, Dec. 1996

16.2. "Test Methods for Evaluating Solid Waste, Physical and Chemical Methods" (SW846) Method 8000B, Rev. 2 Dec. 1996 and Method 8000C Rev. 3, March 2003

16.3. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. **Figures**

17.1.1.	Figure 1	Peak Evaluation Technique
17.1.2.	Figure 2A	Typical PCB Patterns
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17.2. **Tables**

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17.3. **Appendices**

17.3.1. Appendix 1 Summary of Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.4. **Forms**

17.4.1. 8082FPA Sample Preparation Log

17.4.2. 8082FP Analytical Run Log

17.4.3. 8082FM Instrument Maintenance Log

Figure 1: PEAK EVALUATION TECHNIQUE

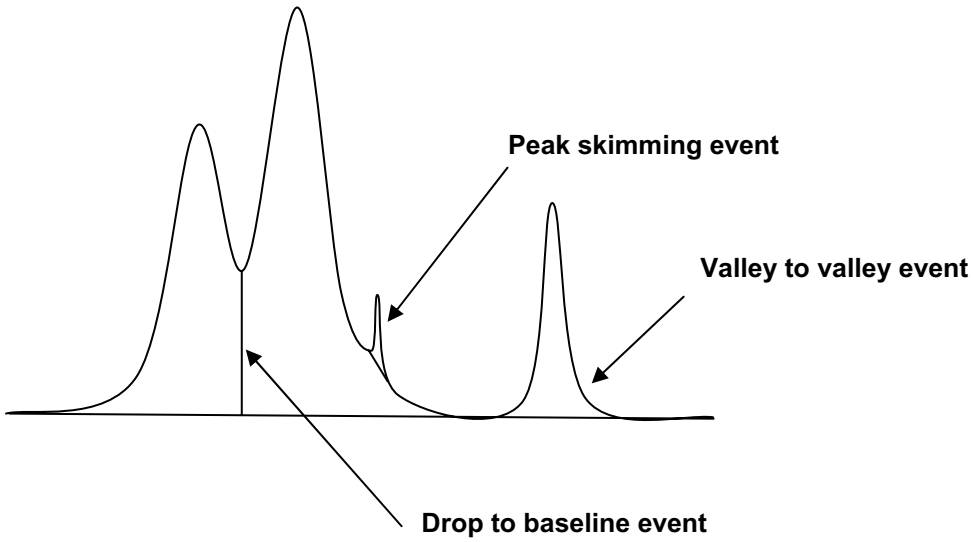

Figure 2A: **TYPICAL PCB PATTERNS**

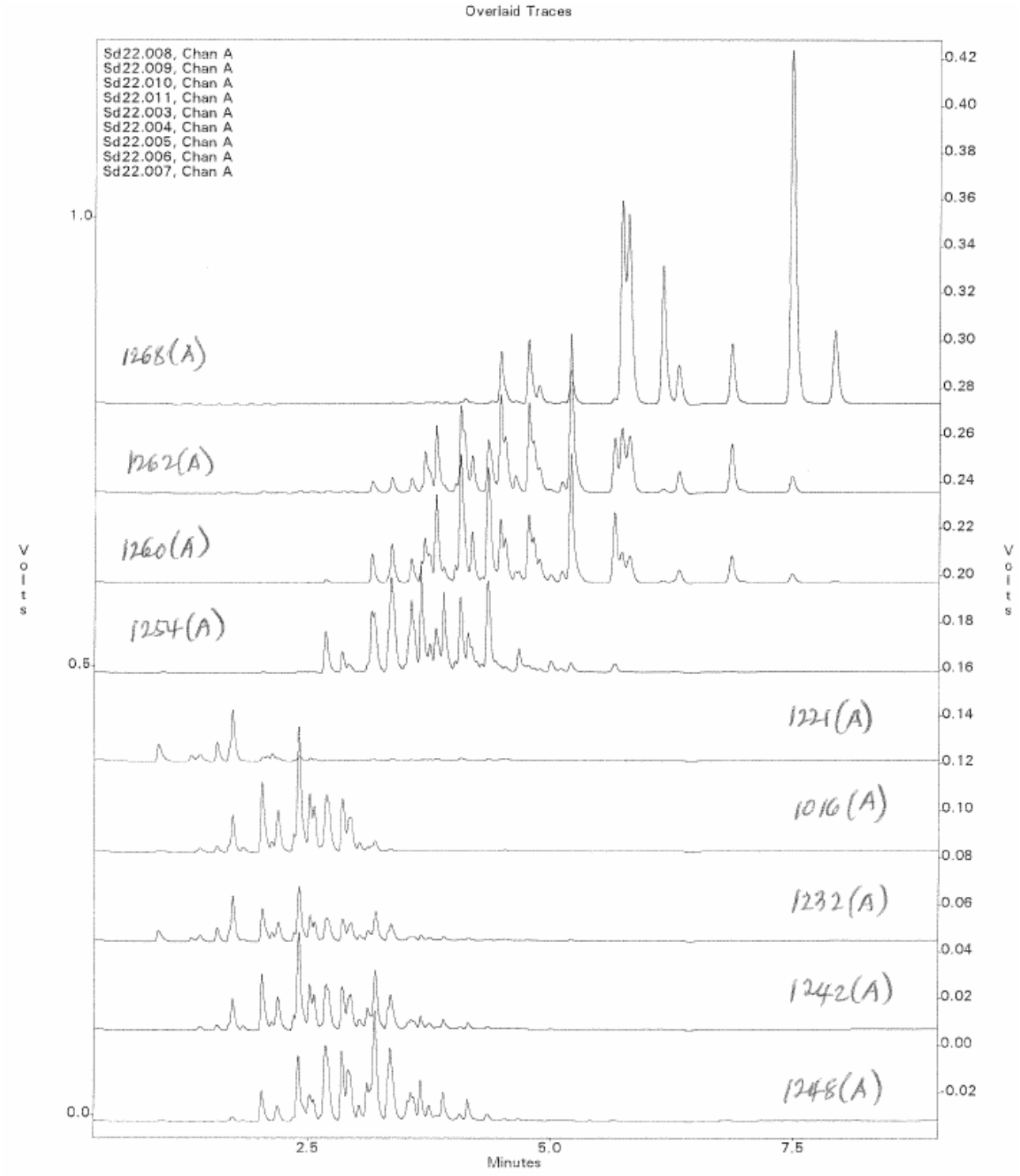

Figure 2A: **TYPICAL PCB PATTERNS**

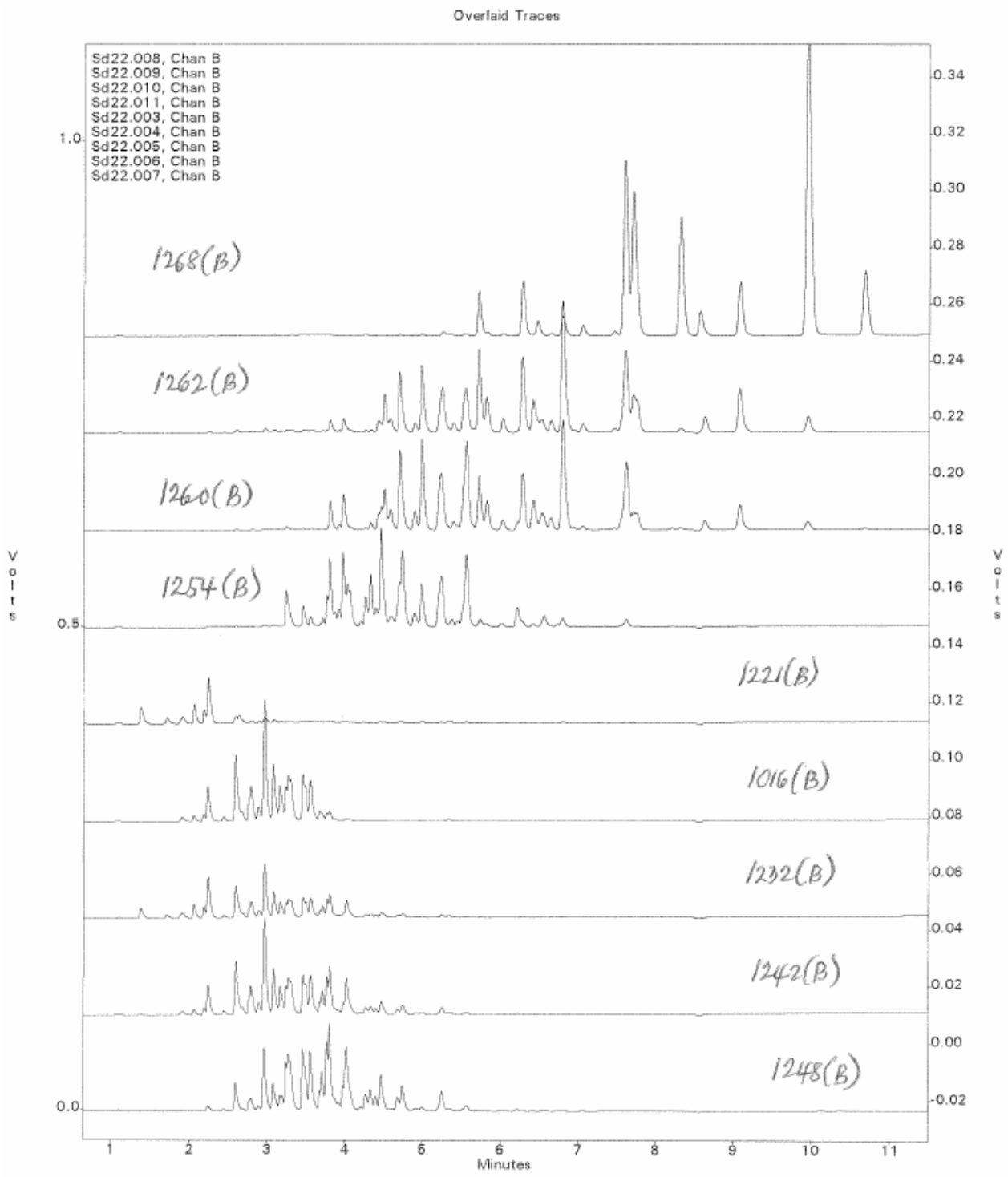

Figure 2B: **TYPICAL PCT PATTERNS**

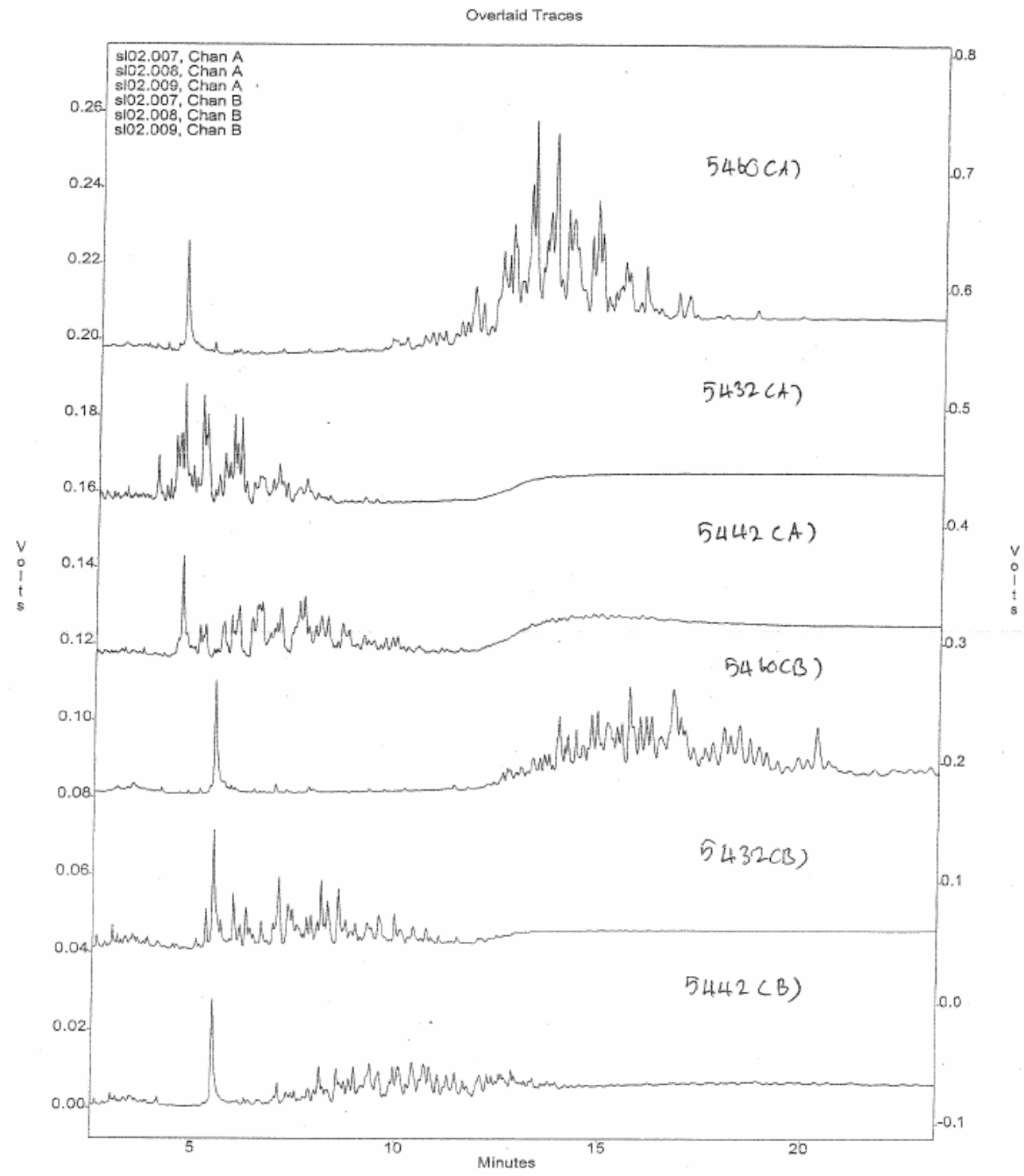

Figure 3A: TYPICAL 1016 / 1260 CHROMATOGRAM

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\sd22\sd22.019
Method : c:\ezchrom\methods\6008d22.met
Sample ID : I6008D2201 500 PPB
Acquired : Apr 22, 2013 16:28:14
Printed : Apr 23, 2013 09:56:16
User : Supakit

Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
10	TCX	1.397	209505	8027.4	26.10	VV
13	1016-1	1.727	117262	1105.5	106.07	SV
15	1016-2	2.030	208123	2115.1	98.40	VV
17	1016-3	2.193	144013	1406.5	102.39	VV
20	1016-4	2.523	147943	1483.4	99.73	VV
25	1016-5	2.857	158991	1530.6	103.88	VV
37	1260-1	3.817	243941	2385.4	102.26	VV
41	1260-2	4.067	324054	3403.5	95.21	VS
45	1260-3	4.350	381390	4078.6	93.51	VV
50	1260-4	4.773	214219	1885.8	113.60	VV
56	1260-5	5.657	244643	2242.9	109.08	VV
64	DCB	7.923	244745	9822.7	24.92	VV

Channel A Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
G1	PCB1016		776332	0.0	510.48	
G2	PCB1260		1408247	0.0	513.66	

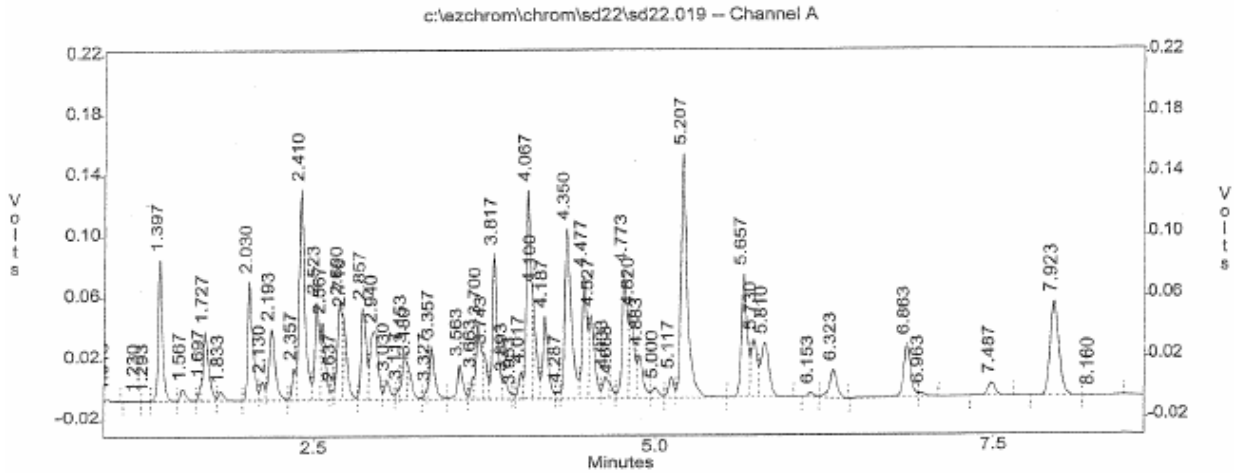

Figure 3A: TYPICAL 1016 / 1260 CHROMATOGRAM

Page 2 of 2

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\sd22\sd22.019
Method : c:\ezchrom\methods\6008d22.met
Sample ID : I6008D2201 500 PPB
Acquired : Apr 22, 2013 16:28:14
Printed : Apr 23, 2013 09:56:16
User : Supakit

Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
7	TCX	1.790	172868	6723.8	25.71	BV
11	1016-1	2.250	96727	909.1	106.40	SV
17	1016-2	2.977	318468	3162.3	100.71	VV
18	1016-3	3.090	146352	1445.4	101.25	VV
21	1016-4	3.470	96205	884.6	108.76	VS
23	1016-5	3.567	138939	1220.9	113.80	VV
36	1260-1	4.710	242972	2525.2	96.22	VV
38	1260-2	4.993	274421	2771.6	99.01	VV
47	1260-3	6.290	219416	1956.9	112.12	SV
51	1260-4	6.810	452413	3935.2	114.97	VV
55	1260-5	7.627	314588	2861.2	109.95	VV
63	DCB	10.680	213337	8570.9	24.89	BB

Channel B Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
G1	PCB1016		796691	0.0	530.92	
G2	PCB1260		1503810	0.0	532.27	

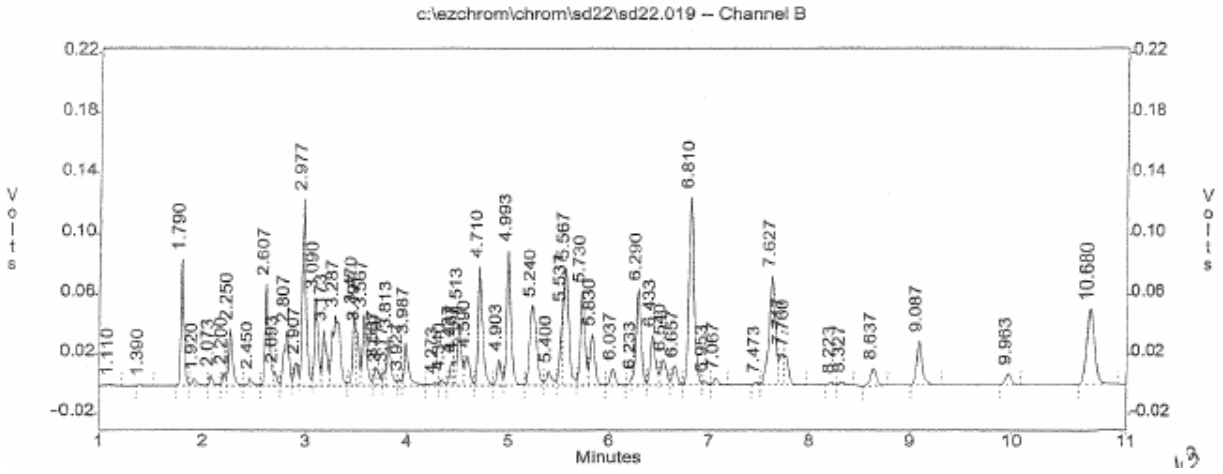

Figure 3B: TYPICAL 5460 CHROMATOGRAM

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\sl06\sl06.006
Method : c:\ezchrom\methods\4608102.met
Sample ID : I4608L0202
Acquired : Dec 06, 2013 21:01:25
Printed : Dec 09, 2013 09:04:41
User : Supakit

Channel A Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
45	5460-1	11.787	42879	382.9	111.99	vv
57	5460-2	13.240	117349	1162.2	100.98	vv
61	5460-3	13.753	204346	1900.6	107.52	vv
68	5460-4	14.790	76920	737.2	104.34	vv
79	5460-5	15.997	58866	523.6	112.42	vv

Channel A Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
G1	PCB5460		500360	0.0	537.24	

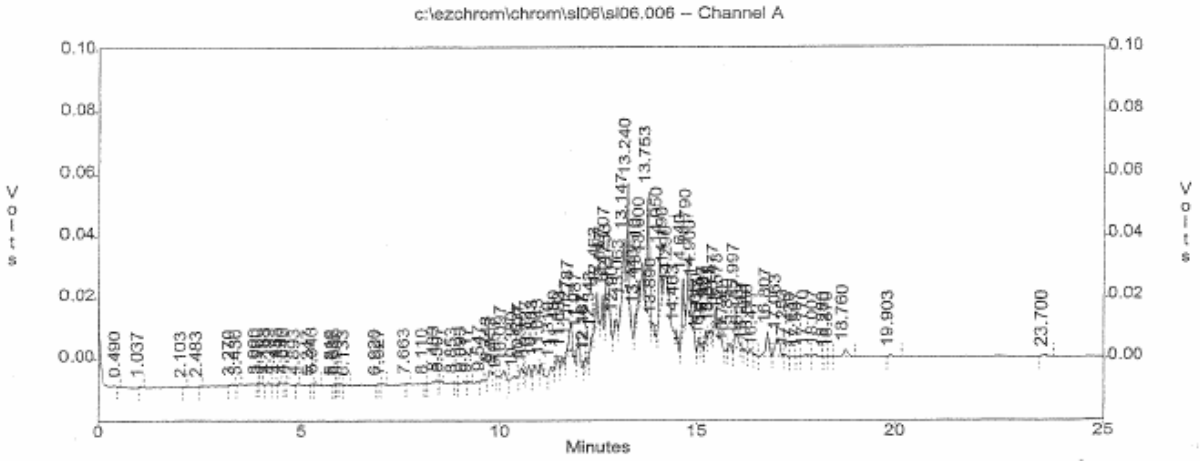

Figure 3B: **TYPICAL 5460 CHROMATOGRAM**

EPA 8082 by GC/ECD
EMAX Analytical Laboratories, Inc.

File : c:\ezchrom\chrom\sl06\sl06.006
Method : c:\ezchrom\methods\4608102.met
Sample ID : I4608L0202
Acquired : Dec 06, 2013 21:01:25
Printed : Dec 09, 2013 09:04:42
User : Supakit

Channel B Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
43	5460-1	14.400	30916	272.9	113.27	vv
48	5460-2	14.923	34318	314.8	109.03	vv
57	5460-3	16.143	35980	350.9	102.54	vv
71	5460-4	18.470	62839	598.4	105.01	vv
79	5460-5	20.390	88685	788.4	112.49	vv

Channel B Group Results

#	Peak Name	Ret.Time(min)	Area	Ave. CF	ESTD Conc.(ppb)	ICODE
G1	PCB5460		252738	0.0	542.35	

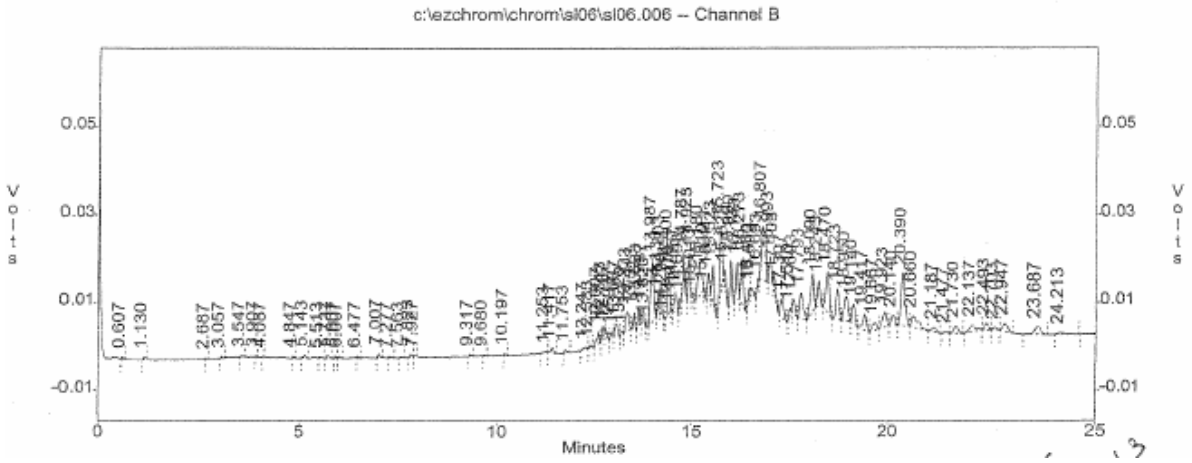

Figure 4: TYPICAL INITIAL CALIBRATION SUMMARY

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCTO08 HP-5890
GC Column : STX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: SD22012A 04/22/13 14:20
LFID & Datetime: SD22013A 04/22/13 14:38
LFID & Datetime: SD22014A 04/22/13 14:56
LFID & Datetime: SD22015A 04/22/13 15:15
LFID & Datetime: SD22016A 04/22/13 15:33
LFID & Datetime: SD22017A 04/22/13 15:51
LFID & Datetime: SD22018A 04/22/13 16:10
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	5.00X	10.00X	20.00X	30.00X	40.00X	MEAN	%RSD
PCB1016-1	10.00	1245.80	1264.50	1189.94	1111.22	1010.28	970.48	946.21	1105.489	12.0
PCB1016-2	10.00	2536.40	2564.95	2311.70	2102.99	1854.57	1753.11	1681.63	2115.051	17.3
PCB1016-3	10.00	1425.10	1582.55	1504.94	1450.07	1336.32	1287.07	1259.39	1406.492	8.4
PCB1016-4	10.00	1681.50	1707.10	1566.14	1517.35	1348.08	1288.97	1274.67	1483.401	12.2
PCB1016-5	10.00	1690.30	1689.80	1631.86	1592.19	1427.36	1351.14	1331.22	1530.552	10.2
PCB1260-1	10.00	2497.40	2832.70	2665.04	2481.41	2177.64	2050.89	1993.05	2385.447	13.4
PCB1260-2	10.00	3973.20	3956.45	3780.56	3401.57	3098.52	2868.50	2745.90	3403.528	15.1
PCB1260-3	10.00	4233.80	4253.40	4335.62	4243.01	3950.23	3785.45	3748.53	4078.577	6.0
PCB1260-4	10.00	2101.50	2081.20	2016.72	1916.13	1751.73	1651.76	1681.37	1885.773	10.1
PCB1260-5	10.00	2134.00	2214.35	2293.60	2318.44	2251.94	2258.33	2229.40	2242.865	2.7
SURROGATE	**X**	**1.00X**	**2.00X**	**5.00X**	**10.00X**	**20.00X**	**30.00X**	**40.00X**	**MEAN**	**%RSD**
TCX	2.50	7622.80	7776.60	8055.92	8271.16	8180.68	8129.51	8155.13	8027.399	3.0
DCB	2.50	10453.20	10399.60	10218.48	9930.28	9407.84	9295.45	9054.34	9822.742	5.8

Figure 4: TYPICAL INITIAL CALIBRATION SUMMARY

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT008 HP-5890
GC Column : STX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: SD22012B 04/22/13 14:20
LFID & Datetime: SD22013B 04/22/13 14:38
LFID & Datetime: SD22014B 04/22/13 14:56
LFID & Datetime: SD22015B 04/22/13 15:15
LFID & Datetime: SD22016B 04/22/13 15:33
LFID & Datetime: SD22017B 04/22/13 15:51
LFID & Datetime: SD22018B 04/22/13 16:10
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	5.00X	10.00X	20.00X	30.00X	40.00X	MEAN	%RSD
PCB1016-1	10.00	1034.90	1003.55	953.56	920.08	849.59	802.65	799.27	909.085	10.4
PCB1016-2	10.00	3364.00	3348.40	3263.74	3246.16	3052.13	2942.87	2918.57	3162.267	5.9
PCB1016-3	10.00	1584.70	1590.05	1499.06	1500.07	1363.26	1304.63	1275.93	1445.386	9.0
PCB1016-4	10.00	963.20	981.50	1005.26	968.37	838.92	732.73	702.08	884.580	14.3
PCB1016-5	10.00	1367.40	1287.35	1139.18	1278.94	1183.28	1143.45	1146.65	1220.892	7.4
PCB1260-1	10.00	2912.20	2828.30	2682.28	2523.60	2337.13	2210.23	2182.43	2525.167	11.6
PCB1260-2	10.00	3263.30	3140.35	2941.88	2793.55	2541.98	2376.99	2343.39	2771.633	13.2
PCB1260-3	10.00	2107.30	2115.55	2022.06	1964.61	1867.61	1817.69	1803.59	1956.917	6.7
PCB1260-4	10.00	4053.80	4073.20	4062.68	4003.42	3836.75	3766.36	3750.01	3935.174	3.7
PCB1260-5	10.00	2839.40	2874.40	2904.04	2900.47	2847.30	2830.45	2832.44	2861.214	1.1
SURROGATE	X	1.00X	2.00X	5.00X	10.00X	20.00X	30.00X	40.00X	MEAN	%RSD
TCX	2.50	6348.80	6425.00	6637.36	6860.32	6902.80	6900.67	6991.45	6723.771	3.8
DCB	2.50	8916.00	8977.60	8898.88	8667.16	8279.26	8188.12	8069.01	8570.861	4.5

Figure 4: TYPICAL INITIAL CALIBRATION SUMMARY

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : 08 HP-5890
GC Column : STX-CLPESTICIDES
Column size ID : .32MMID X 30MM X 0.32UM DF
LFID & Datetime: SL02010A 12/02/13 22:05
LFID & Datetime: SL02011A 12/02/13 22:40
LFID & Datetime: SL02012A 12/02/13 23:15
LFID & Datetime: SL02013A 12/02/13 23:50
LFID & Datetime: SL02014A 12/03/13 00:25
LFID & Datetime: SL02015A 12/03/13 00:59
LFID & Datetime: SL02016A 12/03/13 01:34
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	5.00X	10.00X	20.00X	30.00X	40.00X	MEAN	%RSD
PCB5460-1	10.00	345.60	408.85	400.44	387.18	378.08	381.47	378.63	382.893	5.3
PCB5460-2	10.00	1402.30	1398.15	1239.96	1139.28	1034.54	973.24	947.60	1162.152	16.4
PCB5460-3	10.00	2122.80	2141.90	1980.30	1872.49	1786.00	1726.26	1674.43	1900.597	9.8
PCB5460-4	10.00	809.60	825.05	770.08	736.05	694.23	671.68	653.54	737.176	9.1
PCB5460-5	10.00	499.30	538.00	653.86	496.06	496.83	492.63	488.66	523.620	11.4

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT008 HP-5890
GC Column : STX-CLPESTICIDES II
Column size ID : .32MMID X 30MM X 0.25UM DF
LFID & Datetime: SL02010B 12/02/13 22:05
LFID & Datetime: SL02011B 12/02/13 22:40
LFID & Datetime: SL02012B 12/02/13 23:15
LFID & Datetime: SL02013B 12/02/13 23:50
LFID & Datetime: SL02014B 12/03/13 00:25
LFID & Datetime: SL02015B 12/03/13 00:59
LFID & Datetime: SL02016B 12/03/13 01:34
CONC UNIT: PPB

COMPOUND	CONC X	CALIBRATION FACTORS (AREA or HEIGHT)/UNIT 1.00X	2.00X	5.00X	10.00X	20.00X	30.00X	40.00X	MEAN	%RSD
PCB5460-1	10.00	304.40	303.00	284.96	269.06	256.69	249.62	242.87	272.944	9.2
PCB5460-2	10.00	350.10	358.55	334.00	310.81	293.42	281.35	275.07	314.758	10.6
PCB5460-3	10.00	387.10	393.65	364.36	346.38	331.02	319.98	313.67	350.880	9.1
PCB5460-4	10.00	634.40	657.85	611.10	589.84	573.43	563.00	559.06	598.383	6.3
PCB5460-5	10.00	826.70	839.15	797.92	775.96	766.59	756.85	755.39	788.364	4.3

Figure 5: TYPICAL RETENTION TIME WINDOW SUMMARY

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT008 HP-5890
GC Column : STX-CLPEST
Column size ID : .32MMX30M
LFID & Datetime: SD22012A 04/22/13 14:20
LFID & Datetime: SD22013A 04/22/13 14:38
LFID & Datetime: SD22014A 04/22/13 14:56
LFID & Datetime: SD22015A 04/22/13 15:15
LFID & Datetime: SD22016A 04/22/13 15:33
LFID & Datetime: SD22017A 04/22/13 15:51
LFID & Datetime: SD22018A 04/22/13 16:10

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	5.0X	10.0X	20.0X	30.0X	40.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB1016-1	1.727	1.727	1.727	1.727	1.723	1.723	1.723	1.725	1.713	1.737	0.012
PCB1016-2	2.033	2.033	2.033	2.030	2.030	2.030	2.030	2.031	2.020	2.042	0.011
PCB1016-3	2.197	2.193	2.193	2.193	2.190	2.193	2.190	2.193	2.182	2.204	0.011
PCB1016-4	2.523	2.520	2.523	2.520	2.520	2.520	2.520	2.521	2.510	2.532	0.011
PCB1016-5	2.857	2.857	2.857	2.857	2.853	2.857	2.853	2.856	2.845	2.867	0.011
PCB1260-1	3.817	3.813	3.817	3.813	3.813	3.813	3.813	3.814	3.798	3.830	0.016
PCB1260-2	4.070	4.067	4.067	4.067	4.063	4.067	4.063	4.066	4.046	4.086	0.020
PCB1260-3	4.350	4.347	4.350	4.347	4.347	4.347	4.347	4.348	4.327	4.369	0.021
PCB1260-4	4.773	4.773	4.773	4.770	4.770	4.773	4.770	4.772	4.746	4.798	0.026
PCB1260-5	5.657	5.657	5.657	5.653	5.657	5.657	5.653	5.656	5.625	5.687	0.031
SURROGATE	1.0X	2.0X	5.0X	10.0X	20.0X	30.0X	40.0X	RT	FROM	TO	WIDTH
TCX	1.393	1.393	1.397	1.393	1.393	1.393	1.393	1.394	1.383	1.405	0.011
DCB	7.920	7.920	7.923	7.917	7.920	7.920	7.920	7.920	7.874	7.966	0.046

Figure 5: TYPICAL RETENTION TIME WINDOW SUMMARY

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT008 HP-5890
GC Column : STX-CLPESTII
Column size ID : .32MMX30M
LFID & Datetime: SD22012B 04/22/13 14:20
LFID & Datetime: SD22013B 04/22/13 14:38
LFID & Datetime: SD22014B 04/22/13 14:56
LFID & Datetime: SD22015B 04/22/13 15:15
LFID & Datetime: SD22016B 04/22/13 15:33
LFID & Datetime: SD22017B 04/22/13 15:51
LFID & Datetime: SD22018B 04/22/13 16:10

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	5.0X	10.0X	20.0X	30.0X	40.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB1016-1	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.239	2.261	0.011
PCB1016-2	2.977	2.977	2.977	2.977	2.973	2.977	2.977	2.976	2.964	2.988	0.012
PCB1016-3	3.090	3.090	3.093	3.090	3.090	3.090	3.090	3.090	3.078	3.102	0.012
PCB1016-4	3.470	3.467	3.470	3.467	3.467	3.467	3.467	3.468	3.452	3.484	0.016
PCB1016-5	3.567	3.563	3.567	3.567	3.563	3.567	3.563	3.565	3.554	3.576	0.011
PCB1260-1	4.713	4.710	4.713	4.710	4.707	4.710	4.707	4.710	4.684	4.736	0.026
PCB1260-2	4.993	4.993	4.993	4.990	4.990	4.993	4.990	4.992	4.968	5.016	0.024
PCB1260-3	6.287	6.287	6.290	6.287	6.287	6.287	6.287	6.287	6.252	6.322	0.035
PCB1260-4	6.810	6.807	6.810	6.807	6.807	6.810	6.810	6.809	6.770	6.848	0.039
PCB1260-5	7.623	7.623	7.627	7.623	7.623	7.627	7.627	7.625	7.579	7.671	0.046
SURROGATE	1.0X	2.0X	5.0X	10.0X	20.0X	30.0X	40.0X	RT	FROM	TO	WIDTH
TCX	1.787	1.790	1.790	1.790	1.787	1.787	1.787	1.788	1.776	1.800	0.012
DCB	10.677	10.677	10.680	10.677	10.673	10.677	10.680	10.677	10.650	10.704	0.027

Figure 5: TYPICAL RETENTION TIME WINDOW SUMMARY

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : 08 HP-5890
GC Column : STX-CLPESTICIDES
Column size ID : .32MMID X 30MM X 0.32UM DF
LFID & Datetime: SL02010A 12/02/13 22:05
LFID & Datetime: SL02011A 12/02/13 22:40
LFID & Datetime: SL02012A 12/02/13 23:15
LFID & Datetime: SL02013A 12/02/13 23:50
LFID & Datetime: SL02014A 12/03/13 00:25
LFID & Datetime: SL02015A 12/03/13 00:59
LFID & Datetime: SL02016A 12/03/13 01:34

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	5.0X	10.0X	20.0X	30.0X	40.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB5460-1	11.757	11.763	11.767	11.773	11.783	11.787	11.793	11.775	11.763	11.787	0.012
PCB5460-2	13.227	13.233	13.233	13.237	13.240	13.247	13.247	13.238	13.231	13.245	0.007
PCB5460-3	13.737	13.743	13.747	13.750	13.753	13.763	13.763	13.751	13.735	13.767	0.016
PCB5460-4	14.767	14.780	14.780	14.787	14.790	14.803	14.803	14.787	14.775	14.799	0.012
PCB5460-5	15.970	15.983	15.990	15.993	16.003	16.017	16.020	15.997	15.986	16.008	0.011

INITIAL CALIBRATION
METHOD EPA 8082

Lab Name : EMAX Inc
Instrument ID : GCT008 HP-5890
GC Column : STX-CLPESTICIDES II
Column size ID : .32MMID X 30MM X 0.25UM DF
LFID & Datetime: SL02010B 12/02/13 22:05
LFID & Datetime: SL02011B 12/02/13 22:40
LFID & Datetime: SL02012B 12/02/13 23:15
LFID & Datetime: SL02013B 12/02/13 23:50
LFID & Datetime: SL02014B 12/03/13 00:25
LFID & Datetime: SL02015B 12/03/13 00:59
LFID & Datetime: SL02016B 12/03/13 01:34

COMPOUND	RT OF STANDARDS (MIN) 1.0X	2.0X	5.0X	10.0X	20.0X	30.0X	40.0X	MEAN RT	RT WINDOW FROM	TO	RTWINDOW WIDTH
PCB5460-1	14.380	14.390	14.393	14.393	14.400	14.413	14.413	14.397	14.388	14.406	0.009
PCB5460-2	14.900	14.913	14.917	14.920	14.927	14.940	14.940	14.922	14.911	14.933	0.011
PCB5460-3	16.120	16.133	16.140	16.143	16.153	16.167	16.170	16.147	16.132	16.162	0.015
PCB5460-4	18.443	18.460	18.470	18.470	18.497	18.507	18.513	18.480	18.460	18.500	0.020
PCB5460-5	20.363	20.373	20.393	20.397	20.423	20.433	20.440	20.403	20.366	20.440	0.037

Figure 6: TYPICAL SAMPLE RESULT SUMMARY

METHOD 3546/8082
PCBs

Client : XYZ, INC.	Date Collected: 05/13/14
Project : CLEAN LAND	Date Received: 05/14/14
Batch No. : 14E102	Date Extracted: 05/20/14 13:18
Sample ID: BVBS1265S001	Date Analyzed: 05/22/14 19:37
Lab Samp ID: E102-03	Dilution Factor: 1
Lab File ID: SE22008A	Matrix : SOIL
Ext Btch ID: CPE022S	% Moisture : 3.6
Calib. Ref.: SE22002A	Instrument ID : GCT008

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
AROCLOR 1016	(ND)|ND	18	8.8|8.8
AROCLOR 1221	(ND)|ND	34	18|18
AROCLOR 1232	(ND)|ND	18	8.8|8.8
AROCLOR 1242	(ND)|ND	18	8.8|8.8
AROCLOR 1248	(ND)|ND	18	8.8|8.8
AROCLOR 1254	(ND)|ND	18	8.8|8.8
AROCLOR 1260	(ND)|ND	18	8.8|8.8
AROCLOR 1262	(ND)|ND	34	18|18
AROCLOR 1268	(ND)|ND	34	18|18
AROCLOR 5432	(ND)|ND	52	26|26
AROCLOR 5442	(ND)|ND	52	26|26
AROCLOR 5460	(ND)|ND	52	26|26

SURROGATE PARAMETERS	RESULTS	SPK_AMT	% RECOVERY	QC LIMIT
DECACHLOROBIPHENYL	(14.21)|12.68	13.83	(103)|91.7	45-120

Left of | is related to first column ; Right of | related to second column
Final result indicated by ( )
* Out side of QC Limit

Figure 7: **TYPICAL LCS/LCSD SUMMARY**

EMAX QUALITY CONTROL DATA
LCS ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND
BATCH NO.: 14E102
METHOD: METHOD 3546/8082

MATRIX: SOIL % MOISTURE: NA
DILUTION FACTOR: 1 1
SAMPLE ID: MBLK1S
LAB SAMP ID: 60E022SB 60E022SL
LAB FILE ID: SE22005A SE22006A
DATE EXTRACTED: 05/20/1413:18 05/20/1413:18 DATE COLLECTED: NA
DATE ANALYZED: 05/22/1417:52 05/22/1418:27 DATE RECEIVED: 05/20/13
PREP. BATCH: CPE022S CPE022S
CALIB. REF: SE22002A SE22002A

ACCESSION:

PARAMETER	BLNK RSLT (ug/kg)	SPIKE AMT (ug/kg)	BS RSLT (ug/kg)	BS % REC	SPIKE AMT (ug/kg)	BSD RSLT (ug/kg)	BS % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Aroclor 1016	(ND)|ND	167	(171)|163	(103)|98	167	(173)|161	(104)|96	(1)|1	50-150	30
Aroclor 1260	(ND)|ND	167	159|(162)	95|(97)	167	158|(165)	95|(99)	1|(2)	50-150	30
Aroclor 5460	(ND)|ND	83.3	(88.3)|84.9	(106)|102	83.3	(90.0)|86.1	(108)|103	(2)|1	50-150	30

SURROGATE PARAMETER	SPIKE AMT (ug/kg)	BS RSLT (ug/kg)	BS % REC	SPIKE AMT (ug/kg)	BS RSLT (ug/kg)	BS % REC	QC LIMIT (%)
Decachlorobiphenyl	13.33	16.87|(14.87)	127*|(112)	13.33	16.13|15.01	121*|(113)	45-120

Figure 8: **TYPICAL MS/MSD SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN LAND
BATCH NO.: 14E102
METHOD: METHOD 3546/8082

MATRIX: SOIL % MOISTURE: 3.6

DILUTION FACTOR:	1	1	1
SAMPLE ID:	BVBS1265S001		
LAB SAMP ID:	E102-03	E102-03M	E102-03S
LAB FILE ID:	SE22008A	SE22009A	SE22010A
DATE EXTRACTED:	05/20/1413:18	05/20/1413:18	05/20/1413:18
DATE ANALYZED:	05/22/1419:37	05/22/1420:11	05/22/1420:46
PREP. BATCH:	CPE022S	CPE022S	CPE022S
CALIB. REF:	SE22002A	SE22002A	SE22002A

DATE COLLECTED: 05/13/14
DATE RECEIVED: 05/14/14

ACCESSION:

PARAMETER	SMPL RSLT (ug/kg)	SPIKE AMT (ug/kg)	MS RSLT (ug/kg)	MS % REC	SPIKE AMT (ug/kg)	MSD RSLT (ug/kg)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Aroclor 1016	(ND)|ND	173	(155)|176	(90)|102	173	(163)|152	(94)|88	(4)|15	29-135	30
Aroclor 1260	(ND)|ND	173	(165)|165	(95)|95	173	(164)|141	(95)|82	(1)|16	29-135	30
Aroclor 5460	(ND)|ND	86.4	90.1|(93.3)	104|(108)	86.4	(83.9)|79.5	(97)|92	(7)|16	29-135	30

SURROGATE PARAMETER	SPIKE AMT (ug/kg)	MS RSLT (ug/kg)	MS % REC	SPIKE AMT (ug/kg)	MSD RSLT (ug/kg)	MSD % REC	QC LIMIT (%)
Decachlorobiphenyl	13.83	(16.36)|14.64	(118)|106	13.83	(14.44)|12.73	(104)|92.1	45-120

Figure 9: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN LAND

SDG : 14E102

METHOD 3520C/3546/8082
PCBs

A total of six (6) soil samples were received on 05/14/14 for PCBs and PCTs analysis, Method 3546/8082 in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source (ICV). Continuing calibration (CCV) verifications were carried on a frequency specified by the project. All calibration requirements were within acceptance criteria. Refer to calibration summary forms of ICAL, ICV and CCV for details.

Method Blank
Method blanks were analyzed at the frequency required by the project. For this SDG, one (1) method blank was analyzed with the samples. Results were compliant to project requirement.

Lab Control Sample
A set of LCS/LCD and lab control sample was analyzed with the samples in this SDG.
Percent recoveries for 60E022SL/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for E102-03M/S were within project QC limits.

Surrogate
Surrogate was added on QC and field samples. Surrogate recoveries were within project QC limits. Refer to sample result forms for details.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met; otherwise, anomalies were discussed within the associated QC parameter. Sample extracts subjected to appropriate cleanup technique to reduce matrix interference are recorded in extraction log.

Table 1: INTERMEDIATE STANDARD PREPARATION

Standard Name	Stock Standard Conc. (ppm)	Preparation			Final Conc. (µg/L)
		Aliquot (ml)	Solvent	Final Vol. (ml)	
PCB 1016	1000	0.4	Hexane	100	4000
PCB 1260	1000	0.4	Hexane	100	4000
PCB 1221	1000	0.4	Hexane	100	4000
PCB 1232	1000	0.4	Hexane	100	4000
PCB 1242	1000	0.4	Hexane	100	4000
PCB 1248	1000	0.4	Hexane	100	4000
PCB 1254	1000	0.4	Hexane	100	4000
PCB 1262	1000	0.4	Hexane	100	4000
PCB 1268	1000	0.4	Hexane	100	4000
PCT 5460	1000	0.4	Hexane	100	4000
PCT 5432	1000	0.4	Hexane	100	4000
PCT5442	1000	0.4	Hexane	100	4000
Surrogate					
TCX	200	0.1	Hexane	100	200
DCB	200	0.1	Hexane	100	200

Table 2: INITIAL CALIBRATION STANDARD PREPARATION

Standard #	Standard Name	Intermediate Std. (µg/L)	Preparation			Final Conc. (µg/L)
			Aliquot (µl)	Solvent	Final Vol. (µl)	
1	PCB 1660 / PCT 5460	4000	10	Hexane	800	50
	Surrogate	200				2.5
2	PCB 1660 / PCT 5460	4000	20	Hexane	800	100
	Surrogate	200				5
3	PCB 1660 / PCT 5460	4000	50	Hexane	800	250
	Surrogate	200				12.5
4	PCB 1660 / PCT 5460	4000	100	Hexane	800	500
	Surrogate	200				25
5	PCB 1660 / PCT 5460	4000	200	Hexane	800	1000
	Surrogate	200				50
6	PCB 1660 / PCT 5460	4000	300	Hexane	800	1500
	Surrogate	200				75
7	PCB 1660 / PCT 5460	4000	400	Hexane	800	2000
	Surrogate	200				100

Table 3: CALIBRATION CHECK STANDARD PREPARATION

Standard Name	Intermediate Standard Conc. (µg/L)	Preparation			Final Conc. (µg/L)
		Aliquot (µl)	Solvent	Final Vol. (µl)	
PCB 1016	4000	100	Hexane	800	500
PCB 1260	4000	100	Hexane	800	500
PCB 1221	4000	100	Hexane	800	500
PCB 1232	4000	100	Hexane	800	500
PCB 1242	4000	100	Hexane	800	500
PCB 1248	4000	100	Hexane	800	500
PCB 1254	4000	100	Hexane	800	500
PCB 1262	4000	100	Hexane	800	500
PCB 1268	4000	100	Hexane	800	500
PCT 5460	4000	100	Hexane	800	500
PCT 5432	4000	100	Hexane	800	500
PCT 5442	4000	100	Hexane	800	500
Surrogate					
TCX	200	100	Hexane	800	25
DCB	200	100	Hexane	800	25

Table 4: SPIKE STANDARD AND SURROGATE STANDARD PREPARATION

Standard Name	Stock Standard Conc. (mg/L)	Preparation			Final Conc. (µg/L)
		Aliquot (ml)	Solvent	Final Vol. (ml)	
PCB 1016	1000	1.0	50% Isopropanol 50% Hexane	100	10,000
PCB 1260	1000	1.0	50% Isopropanol 50% Hexane		
PCT 5460	1000	1.0	50% Isopropanol 50% Hexane	100	10,000
Surrogate					
TCX	200	2	50% Isopropanol 50% Hexane	1000	400
DCB	200	2	50% Isopropanol 50% Hexane	1000	400

Table 5: COMPOUND LIST

Analytes		Surrogates
PCB 1016	PCT 5432	Decachlorobiphenyl
PCB 1221	PCT 5442	Tetrachloro-m-xylene
PCB 1232	PCT 5460	
PCB 1242		
PCB 1248		
PCB 1254		
PCB 1260		
PCB 1262		
PCB 1268		

Table 6: ESTABLISHED LIMIT OF DETECTION (LOD) AND LIMIT OF QUANTITATION (LOQ)

ANALYTES	AQUEOUS (µg/L)			SOIL (µg/Kg)		
	DL	LOD	LOQ	DL	LOD	LOQ
PCB 1016	0.45	0.45	0.45	13.2	16.7	33.3
PCB 1221	0.29	0.29	0.29	8.3	16.7	33.3
PCB 1232	0.25	0.25	0.25	9.0	16.7	33.3
PCB 1242	0.25	0.25	0.25	9.3	16.7	33.3
PCB 1248	0.25	0.25	0.25	8.3	16.7	33.3
PCB 1254	0.25	0.25	0.25	8.3	16.7	33.3
PCB 1260	0.31	0.31	0.31	9.9	16.7	33.3
PCB 1262	0.25	0.25	0.25	8.3	16.7	33.3
PCB 1268	0.25	0.25	0.25	8.3	16.7	33.3
PCT 5432	0.5	0.5	0.5	10	20	40
PCT 5442	0.5	0.5	0.5	10	20	40
PCT 5460	0.5	0.5	0.5	10	20	40
Tetrachloro-m-xylene	0.020	0.020	0.020	0.42	0.83	1.67
Decachlorobiphenyl	0.025	0.025	0.025	0.42	0.83	1.67

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
Min. 5 Point Initial Calibration for PCB 1016 + 1260 and PCT 5460	Initially, as needed	RSD for all analytes ≤ 20%. Linear – least squares regression r ≥ 0.995.	Correct then problem then repeat initial calibration.		
Second-source Calibration Verification for PCB 1016/1260 and PCT 5460	Once per 5-point initial calibration	All analytes within ± 20% of expected value from the ICAL.	Correct the problem. If problem persists, repeat initial calibration.		
Initial Calibration Verification Check for PCB 1016/1260 and PCT 5460	Daily, before sample analysis	All analytes within ± 20%	Correct the problem. If problem persists, repeat initial calibration		
Calibration verification for PCB 1016/1260 and PCT 5460	After every 12 hours and at the end of the analytical sequence	All analytes within ± 20% of expected value	Correct the problem then repeat initial calibration verification and re-analyze all samples since last successful calibration verification.		
Method Blank	One per preparation batch (≤ 20 samples per matrix)	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Re-prep and re-analyze method blank and all samples processed with the contaminated blank		
LCS (PCB 1016/1260 and PCT 5460)	One LCS per analytical batch (≤20 samples per matrix)	Within project QC Limits	Correct the problem, then re-prep and re-analyze the LCS and all associated samples.		
Surrogate Spike	Every sample, spiked sample, standard, and method blank	Within project QC Limits	Correct the problem then re-extract and re-analyze sample		
Matrix Spike/ Matrix Spike Duplicate (PCB 1016/1260 and PCT 5460	One MS/MSD per 20 project samples per matrix	Within project QC Limits	If chromatogram is indicative of matrix interference, discuss in case narrative. Otherwise, check for probable source of error and perform corrective action as necessary.		
Confirmation	100% for all positive results	Same as primary column	If quantitation criteria are not met, use confirmation for qualitative identification only.		

Comments:

1. For flagging criteria refer to PSR. Otherwise, if MB is non-compliant, apply "B" to specific analyte(s) on all associated samples, apply "J" to all values between LOD and LOQ.

Reviewed By:		
Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
PCBs
METHOD: EPA 8082/ 8082A

MATRIX: WATER

Analytical SOP: EMAX-8082 Rev. 4
Sample Preparation SOP: EMAX-3520 Rev. 5
Conc Unit: µg/L
Sample Amount(mL): 1000
Extract Volume (mL): 10

Instrument ID: 08
Extraction batches: CPE002W - 5/5/14
CPE009W - 5/7/14
Extracted by: J. Muertigue
Analysis date: 5/7/14 & 5/14/14
Analyzed by: R. Zhou

PARAMETER	60E002WL	60E002WC	60E009WL	60E009WC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SE07006A	SE07007A	SE12012A	SE12013A							
PCB 1016	5.11	4.91	5.44	4.66	5	5.03	101	0.3	7	60 - 130	PASSED
PCB 1260	4.65	4.44	5.03	4.46	5	4.65	93	0.3	6	70 - 130	PASSED
PCT 5460	2.34	2.45	2.42	2.41	2.5	2.41	96	0.05	2	50 - 150	PASSED
TCX	0.396	0.385	0.399	0.391	0.4	0.393	98	0.006	2	60 - 130	PASSED
DCB	0.406	0.402	0.433	0.432	0.4	0.418	105	0.016	4	70 - 130	PASSED

PARAMETER	60E002WL	60E002WC	60E009WL	60E009WC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SE07006B	SE07007B	SE12012B	SE12013B							
PCB 1016	5.02	4.83	4.86	4.69	5	4.85	97	0.1	3	60 - 130	PASSED
PCB 1260	4.70	4.68	4.86	4.76	5	4.75	95	0.1	2	70 - 130	PASSED
PCT 5460	2.17	2.28	2.16	2.14	2.5	2.19	88	0.1	3	50 - 150	PASSED
TCX	0.409	0.399	0.405	0.407	0.4	0.405	101	0.004	1	60 - 130	PASSED
DCB	0.372	0.367	0.389	0.384	0.4	0.378	95	0.010	3	70 - 130	PASSED

MATRIX: SOIL

Analytical SOP: EMAX-8082 Rev. 4
Sample Preparation SOP: EMAX-3550 Rev. 4
Conc Unit: µg/Kg
Sample Amount(g): 30
Extract Volume (mL): 10

Instrument ID: 08
Extraction batches: CPF006S - 6/5/14
CPF018S - 6/10/14
Extracted by: J. Villena
Analysis date: 6/6/14 & 6/10/14
Analyzed by: R. Zhou

PARAMETER	60F006SL	60F006SC	60F018SL	60F018SC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SF06006A	SF06007A	SF10006A	SF10007A							
PCB 1016	181	171	163	163	167	169.56	102	8.5	5	70 - 130	PASSED
PCB 1260	159	154	156	155	167	155.63	93	2.2	1	70 - 140	PASSED
PCT 5460	76.5	77.4	84.3	82.9	83.3	80.29	96	3.9	5	50 - 150	PASSED
TCX	14.6	13.6	14.3	14.4	13.3	14.251	107	0.421	3	50 - 140	PASSED
DCB	14.2	14.1	14.9	14.8	13.3	14.508	109	0.446	3	70 - 140	PASSED

PARAMETER	60F006SL	60F006SC	60F018SL	60F018SC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SF06006B	SF06007B	SF10006B	SF10007B							
PCB 1016	190	184	164	170	167	176.93	106	12.0	7	70 - 130	PASSED
PCB 1260	161	159	168	168	167	164.13	98	4.7	3	70 - 140	PASSED
PCT 5460	71.8	73.2	77.5	76.8	83.3	74.84	90	2.8	4	50 - 150	PASSED
TCX	16.2	15.5	15.7	15.7	13.3	15.756	118	0.305	2	50 - 140	PASSED
DCB	12.2	12.1	13.4	13.2	13.3	12.733	95	0.657	5	70 - 140	PASSED

8082FS: **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

FileID: CP.xls

EXTRACTION LOG FOR PESTICIDES/PCBs

PrepBatchID	LabSampleID	Aliquot	Unit	DateTime	Ve	EA	EVe	PF	FlorisilCleanup EMAX-3620	SulfurCleanup EMAX-3660	[1]AcidCleanup EMAX-3665	Comments

☐ ExtractionStarted @ Ve=ExtractVolume EA= ExpectedAliquot EVe=ExpectedExtractVolume PF=(EA/Aliquot)(Ve/EVe)

☐ Extraction Ended @ Prepared By:

Comment: [1]Acid cleanup is only for PCB anlaysis. Checked By:

Date

8082FA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

ANALYSIS RUN LOG
for
PESTICIDES/PCBs

Page 1

Note: For samples and relevant QCs/Standards analyzed, refer to attached analytical sequence.

Comments:

Book #: A71-032

Instrument No.: 71

Analytical Sequence:

Method File:

Analytical Batch:

SOP #	Rev. #
☐ EMAX-8081	7
☐ EMAX-8082	3
☐ EMAX-608	1
☐ EMAX-CLP-PEST	
☐ EMAX-	

ICAL REFERENCE

ICAL ID	BATCH	DATE

STANDARDS ID	Conc (µg/L)
Hexane	

Column	A. ZB-MULTI RES I B. ZB-MULTI RES I I

ELECTRONIC DATA ARCHIVAL

Location	Date
☐ EZC_4_Pesticides	
☐ EZC_10_Pesticides	

Analyzed By: Date:

Date Disposed: Disposed By:

This page is checked during data review.

8082FM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: 71 Month: Year: 201_ Book #: M71-004

Date							
Column Head Pressure (8-15psi)							
Column Temperature							
Signal # 1 10-150							
Signal #2 10-150							
Autosampler							
Update Cal. Table							
Computer Date/Time							
Computer Paper							
Septa Change							
Liner Clean-up							
Analyst Initial							
TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

SOP REVIEW FORM

EMAX-8270SIM	Rev. 2	SEMIVOLATIVE ORGANICS BY GC/MS
SOP No.	Revision Number	Title

Document the review process and comment. Check the "NA" box if it is not applicable to the SOP, check the "Yes" box if you have fully understood the section, check "No" if you have any questions or if there are discrepancies with the current practice. Discuss the issue with the mentor/supervisor. If you need more space use the allocated space below or attach additional page.

SECTION	Yes	No	NA	COMMENTS
Scope & Application	✓			
Summary of Method	✓			
Detection Limits	✓			
Dynamic Range	✓			
Sample Holding Time & Preservation	✓			
Associated SOPs	✓			SA 7/3/14
Safety	✓			I have read all MSDS of chemicals listed in this SOP.
Instruments, Chemicals & Reagents	✓			
Standards	✓			
Procedures	✓			
- Sample Preparation	✓			
- Instrument Parameters	✓			
- Calibration	✓			
- Analysis	✓			
- Calculations	✓			
- Data Reduction	✓			
- Report Generation	✓			
- Data Review	✓			
- Preventive Maintenance	✓			
Quality Control	✓			
Corrective Action	✓			
Pollution Prevention	✓			
Waste Management	✓			
Supplementary Notes	✓			
References	✓			
Appendices	✓			

This is to acknowledge that I have read, understood and agree to perform the procedures set forth in this SOP. Print your name & affix your signature.

Reviewed By Sonzan S. Gneas Sonzan Gneas Date: 7/3/14

STANDARD OPERATING PROCEDURES

SEMIVOLATILE ORGANICS BY GC/MS SIM

SOP No.:	EMAX-8270SIM	Revision No.	2	Date:	05-Jul-11
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Control Number: **8270SIM-02-**

1.0 SCOPE AND APPLICATION

1.1. This method is used to determine the trace levels of semi-volatile organic compounds extracted from many types of solid waste matrices, soil and water samples. Analytes that are listed in Table 7 were determined when this SOP was established. Additional analytes may be added upon completion of similar validation as the analytes that are listed in Table 7. This SOP is an adaptation of method SW846 8270D. Since 8270D is an update and enhancement of 8270C, this SOP is also applicable to 8270C.

2.0 SUMMARY OF METHOD

2.1. Samples are extracted with methylene chloride. Extracts are concentrated and appropriate clean-up procedure is applied if necessary.

2.2. Internal standards are added to an aliquot of the final extract and are qualitatively and quantitatively analyzed by gas chromatography equipped with mass spectrometry (GC/MS).

2.3. **Interference**

2.3.1. Solvents, reagents, glassware, and other sample processing devices are all possible sources of artifacts and/or interferences to sample analysis. Hence, quality control of chemicals and proper decontamination of re-usable glassware and proofing the analytical instrument to be free from contamination shall be observed.

2.3.2. Raw GC/MS data from all blanks, samples and spikes must be evaluated for interference. Determine source of interference in the preparation and/or cleanup of the samples and perform corrective action to eliminate the problem.

2.3.3. Contamination by carry-over can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carry-over, rinse the sample syringe with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

2.3.4. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Table 7 for established limits.

4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The dynamic range established for this method are:

Water (µg/L)	Soil (µg/kg)
1 - 100 µg/L	5 - 3300 µg/kg

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Sample Preservation**

5.1.1. Store water and soil samples at ≤ 6°C away from light without freezing.

5.1.2. Store all extracts at ≤ 6°C without freezing.

5.2. **Holding Time**

5.2.1. Extract water samples within 7 days from sampling date.

5.2.2. Extract soil samples within 14 days from sampling date.

5.2.3. Analyze all extracts within 40 days from extraction completion date.

6.0 ASSOCIATED SOPs

6.1. EMAX-3510 Extraction of Organic Compounds by Separatory Funnel

6.2. EMAX-3520 Extraction of Organic Compounds by Continuous Liquid/Liquid Extraction

6.3. EMAX-3540 Soxhlet Extraction

6.4. EMAX-3550 Extraction of Organic Compounds from Solid Samples by Pulse Sonication

6.5. EMAX-3580 Waste Dilution

6.6. EMAX-3640 Clean Up, GPC

6.7. EMAX-DM01 Data Flow and Review

6.8. EMAX-QA05 Training

6.9. EMAX-QA04 Detection Limit Study

6.10. EMAX-QA08 Corrective Action

6.11. EMAX-QC01 Quality Control for Chemicals

6.12. EMAX-QC02 Analytical Standard Preparation

6.13. EMAX-QC07 Glassware Cleaning

6.14. EMAX-SM01 Sample Management

6.15. EMAX-SM03 Waste Disposal

6.16. EMAX-SM04 Analytical and QC Sample Labeling

7.0 SAFETY

7.1. Read all MSDS for all chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. Place all wastes generated during analytical process in the designated satellite waste containers. Endorse these wastes to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

Gas Chromatography	Agilent Technologies 7890A with split/splitless injection, Shimadzu GC-17A, or equivalent
Mass Spectrometer	Agilent Technologies 5975C MSD or Shimadzu GCMS – GP 5000 capable of scanning from 1.6 to 1050 amu every 1 second using 70 volts electrode energy in the electron impact ionization mode or equivalent
GC/MS Interface	Capillary-direct into the mass spectrometer source or equivalent
Chromatographic Column	ZB-5MS (20m x 0.18 mm x 0.32 µm) or equivalent
Data System	MS-ChemStation with Enviroquant software or equivalent
GC Autosampler	Agilent Technologies 7683B series injector or Shimadzu AOC-20i capable of direct injection of 1 µl and 10 µl of extract.
Gases	Ultra high purity helium
Syringes	10 µl, 25 µl, 50 µl, 100 µl, 250 µl, 500 µl and 1000 µl syringe Hamilton 202N or equivalent
Vials	Autosampler vials with teflon lined septa

8.2. **Chemicals and Reagents**

Solvents	Methylene chloride pesticides grade, high purity methanol
Reagents	Na_2SO_4 reagent grade

9.0 STANDARDS

9.1. Standard Preparation

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

9.2. Stock Standard

9.2.1. Purchase stock standards as certified solutions from AccuStandard or other reputable vendor (refer to Table 1 for the listing of all certified solutions). The standard is expected to be at 96% purity. Read vendor's note if correction has been applied to certified values otherwise corrections must be applied.

9.2.2. Transfer the stock standard solutions into 2 ml amber vial with Teflon lined screw caps and store at -10°C to -20°C.

9.3. Intermediate Standard

9.3.1. Using stock standard solutions, prepare the intermediate standard in Methylene Chloride according to table 1.

9.4. Internal Standard

9.4.1. The internal standard shall include 1,4-Dichlorobenzene-d_4, Phenanthrene-d_{10} and Perylene-d_{12} in methylene chloride solution.

9.4.2. Purchase internal standard solutions as certified solution from AccuStandard or other reputable vendor at 4,000 µg/ml.

9.4.3. Prepare a 10 ml of 2,000 µg/ml of working internal standard from 4,000 µg/ml (refer to Table 2). Transfer the solution in a properly labeled 10 ml amber vial and store in -10°C to -20°C.

9.5. GC/MS Tuning

9.5.1. The tuning standard shall include decafluorotriphenylphosphine (DFTPP), 4,4-DDT, Pentachlorophenol, and Benzidine.

9.5.2. Purchase tuning standard solution as certified standard at 1000 µg/ml.

9.5.3. Prepare a 500 µl of 50 µg/ml of working standard tuning solution (refer to Table 2). Transfer the solution in a 1 ml amber vial and store in -10°C to -20°C.

9.6. Surrogate Standard

9.6.1. Purchase surrogate stock standards as certified standard.

9.6.1.1. The acid surrogate mixture includes Phenol-d_5, 2-Fluorophenol and 2,4,6-Tribromophenol at 150 µg/ml.

9.6.1.2. The basic neutral surrogate mixture includes Nitrobenzene-d_5, 2-Fluorobiphenyl, Terphenyl-d_{14} and 1,2-Dichlorobenzene-d_4 at 50 µg/ml.

9.6.2. For typical extraction [soil: 30 g - 2 ml or water: 1000 ml - 2 ml], add 0.4 ml of surrogate spiking standard to the sample prior to extraction. Spike volume may be adjusted to normalize with the final extract and yield the same concentration.

9.7. **Calibration Standard**

9.7.1. Prepare working standard solutions for initial calibration and daily calibration (refer to Table 2 for details). Transfer the solutions in 1 ml amber vial and store them at ≤ 6°C without freezing.

9.8. **ICAL Verification Standard (Second Source Verification) (ICV)**

9.8.1. Purchase a certified ICV standard from a different vendor. The ICV standard contains the same list of compounds as the stock standard (refer to Table 1b for the standard mix and the corresponding vendors).

9.8.2. Prepare a 500 µl of 25 µg/ml check standard solution (refer to Table 2). Transfer the solution in a properly labeled 1 ml amber vial and store at ≤ 6°C without freezing.

9.9. **LCS/MS Spiking Standards**

9.9.1. Purchase spiking standards as certified solutions. The spiking solution may be from the same source as the initial calibration standard[1].

9.9.2. Spike MS/MSD/LCS/LCD samples with 0.2 ml of full spiking solution prior to sample extraction.

9.9.3. Spike volume may be adjusted to normalize with the final extract volume and yield the same concentration.

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. For aqueous samples, refer to EMAX-3510 or EMAX-3520. Check the extraction log for presence of residual chlorine.

10.1.2. For solid samples, refer to EMAX-3550 or EMAX-3540.

10.1.3. For waste samples, refer to EMAX-3580.

10.1.4. After extraction, examine the color and consistency of the extract. If the extract appears to be opaque and/or viscous, it is advisable to perform extract cleanup preferably GPC. Refer to EMAX-3640.

10.2. **Instrument Parameters**

10.2.1. Set the instrument parameters as suggested in Table 3. Fine tune the instrument to obtain optimum instrument condition.

10.2.2. Print and display current condition on the instrument for easy access when performing daily instrument routine check.

10.2.3. In the event that instruments parameters necessitate a change, replace the instrument parameter print-out with the new parameter setup and archive the previous instrument parameters in the instrument maintenance log.

10.2.4. Set injection volume to 1 µl to 2 µl.

[1] SW846 Method 8270D, Section 7.9

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

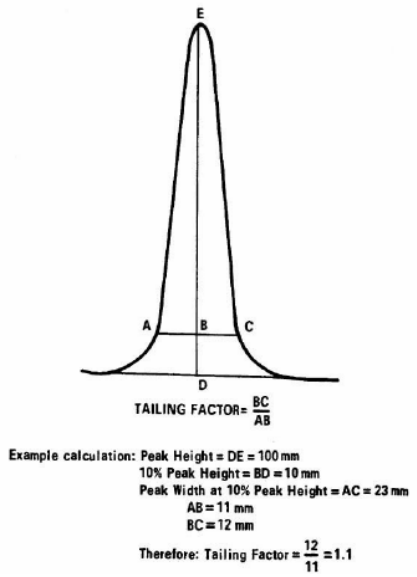
10.3.2. Perform Tune Check

10.3.2.1. Analyze a solution containing 50 µg/ml of tuning standard working solution, DFTTP DDT, benzidine and pentachlorophenol.

10.3.2.2. Evaluate the tune check by averaging of three scans (the peak apex scan and the scan immediately preceding and the scan immediately following the apex). Apply a background subtraction using a single scan no more than 20 scans prior to the elution of DFTPP. Do not subtract part of the DFTPP peak or any other discrete peak that does not coelute with DFTPP. Use the DFTPP mass intensity criteria in the manufacturer's instructions as primary tuning acceptance criteria otherwise refer to Table 4 for acceptance criteria.

10.3.2.3. Evaluate column performance and injection port inertness using the data acquisition software.

- Degradation of DDT to DDE and DDD must be less than 20% based on area obtained from the total ion chromatogram.
- Benzidine and Pentachlorophenol must be present at their normal responses. Evaluate the tailing factor of benzidine and pentachlorophenol. Tailing factor should not be > 2. Refer to the attached Figure for peak evaluation.



10.3.2.4. If tune check is non-compliant, refer to Section 12 for corrective action.

10.3.3. Initial Calibration (ICAL)

10.3.3.1. Perform ICAL when one of the conditions occurs:

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Optimize the instrument condition prior to ICAL:

- Ensure that instrument parameters are set up properly
- Ensure that there is no evidence of leak
- Ensure that instrument maintenance as scheduled is performed
- Ensure that instrument tune check and column performance is not indicative that it is at the threshold of failing the acceptance criteria

10.3.3.3. Analyze a multi-point initial calibration curve as suggested in Figure 3 after a valid tune check.

10.3.3.4. Generate a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRFm), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq-10.5.1.1, Eq-10.5.1.2, Eq-10.5.1.5 and Eq-10.5.1.6, respectively.

10.3.3.5. **Evaluate the ICAL Acceptance**

10.3.3.5.1. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.5.2. Evaluate retention time of each analyte with respect to the nearest internal standard. The relative retention time (RRT) of each analyte should agree within ± 0.06 RRT units.

10.3.3.5.3. Check the response factors for each analyte as suggested in Table 6. Meeting the minimum response factor is indicative that the analytes are behaving as expected.

10.3.3.5.4. Check RSD and correlation coefficient. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Perform necessary instrument maintenance and repeat calibration. Refer to 10.3.3.2., Section 12 for corrective action.

10.3.3.6. **Application of ICAL Curve for Quantitation**

10.3.3.6.1. If RSD is $\leq$20% average response factor may be applied.

10.3.3.6.2. Apply Inverse Weighting Factor (1/y or $1/y^2$; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.99.

10.3.3.6.3. Apply linear least squares regression if past experience or prior knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.99.

10.3.3.6.4. It may be appropriate to force the regression through zero for specific analytes[2]. When exercising this option (as included in the data acquisition software), make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

[2] SW846 Method 8000B, Section 7.5.3

10.3.3.6.5. Re-quantitate the calibration point near or at LOQ and calculate for percent recovery. Percent recovery within ± 30%[3] of their expected values is indicative that calibration accuracy at the lower calibration range is good.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. Initial Calibration Verification (ICV)

10.3.4.1. Verify the concentration of the ICAL by analyzing the ICV from a secondary source (refer to Table 2 for standard preparation). Result should be within ± 30% of expected value unless otherwise specified by the project.

10.3.4.2. Evaluate the ICV for minimum response factor, internal standard retention time and internal standard response as described in 10.3.5.2.

10.3.4.3. If any of above criteria is non-compliant, refer to Section 12 for corrective action.

10.3.5. Daily Continuing Calibration (DCC)

10.3.5.1. Analyze DCC (refer to Table 2 for standard preparation) to check the validity of the ICAL every 12 hour shift unless otherwise specified by the project.

10.3.5.2. **DCC Evaluation**

- Check that RF is ≥ minimum response factor listed in Table 6.
- Check that all analytes are ≤ 20 %D (% Difference for ARF and %Drift for other quantitation technique) unless otherwise specified by the project.
- Check Internal Standard Retention time. Expected retention time is within ± 30 seconds from that of the midpoint of the ICAL.
- Check Internal Standard Response. Expected response of Extracted Ion Current Profile (EICP) is no greater that a factor of two (-50% to +100%).
- If any of the above criteria is non-compliant, refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. Extract Preparation

10.4.1.1. Allow extracts to equilibrate with room temperature.

10.4.1.2. Measure 300 µl of extract, transfer into an autosampler vial.

10.4.1.3. Add 6 µl of 2000 ng/µl of internal standard (refer to 9.4.3).

10.4.1.4. Seal the vial with Teflon-lined septa cap.

10.4.2. Analytical Sequence

10.4.2.1. Analyze instrument blank.

10.4.2.2. Analyze DFTPP and evaluate tuning.

10.4.2.3. Analyze DCC and check ICAL validity.

[3] SW846 Method 8270D, Section 11.4.5.6

10.4.2.4. Analyze Method Blank.

10.4.2.5. Analyze Lab Control Sample and Lab Control Sample Duplicate (optional).

10.4.2.6. Analyze matrix spikes (MS/MSD) as per project requirement.

10.4.2.7. Analyze samples to a maximum of 12-hours from the time of DFTPP injection.

10.4.3. Sample Result Evaluation

10.4.3.1. **Check QC criteria**

- Check method blank. If result is non-compliant and analyte in question is not detected in any sample or contamination is < 10X of the sample concentration, results maybe reportable. Verify with the PM if results can be reported.
- Check surrogate recoveries against PSR. In the absence of PSR, default to EMAX QC limits.
- Check concentration of target analytes. Dilute and re-analyze samples having result(s) exceeding calibration range unless otherwise specified by the project. Maintain IS concentration on diluted samples.
- Check Internal Standard Response. Expected response of EICP is no greater that a factor of two (-50% to +100%).
- Check Internal Standard Retention Time. Expected retention time is within ± 30 seconds of the ICAL midpoint.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.4.3.2. **Qualitative Identification**

- The intensities of the characteristic ions must maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Manually integrate the peak if necessary in accordance to EMAX-DM01.
- Investigate visible peaks in the chromatogram that were not identified in the data output. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification[4] (TIC).
- Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting.

10.4.3.3. **Quantitation**

[4] Library search is performed only when indicated in the PSR.

- Apply the appropriate quantitation method (refer to Section 10.5.3) to calculate the concentration of any positively identified target analyte. Apply the sample preparation and dilution factor to calculate for the final concentration of the sample.

10.4.3.4. **Manual Integration**

10.4.3.4.1. Refer to EMAX-DM01 for details of manual integration.

10.4.3.5. **Dealing with Carryover**

- Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction. Otherwise, clean up the system and re-analyze the sample suspected to contain carryover.

10.5. **Calculations**

10.5.1. Initial Calibration

10.5.1.1. **Calculate for Relative Response Factor (RRF)**

$$RRF = \frac{(AX)(CIS)}{(AIS)(CX)} \qquad \text{Eq.-10.5.1.1}$$

where:

AX – Area of characteristic ion for the compound being measured

AIS – Area of characteristic ion for the specific internal standard

CX – Concentration of the compound being measured

CIS – Concentration of the specific internal standard

10.5.1.2. **Calculate for Average Relative Response Factor (RRFm)**

$$RRFm = \frac{\sum RRF}{n} \qquad \text{Eq.-10.5.1.2}$$

where:

$RRFm$ – average response factor

$\sum RRF$ – summation of response factors

n – number of measurements

10.5.1.3. **Calculate for Least Square Linear Regression**

$$y = ax + b \qquad \text{Eq.-10.5.1.3}$$

where:

y – Response Ratio *(AX/AIS)*

x – Amount Ratio (CX/CIS)

a – x1 = slope of the line

$$a = \frac{\sum(x-\bar{x})(y-\bar{y})}{(x-\bar{x})^2}$$

where:

$\bar{x}$ – Average of amount rations

$\bar{y}$ – Average of response ratios

b = x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.5.1.4. **Calculate for Inverse Weighting Factor**

$$y = ax + b \qquad \text{Eq.-10.5.1.4}$$

where:

y – Response Ratio *(AX/AIS)*

x – Amount Ratio *(CX/CIS)*

a – x1 = slope of the line

$$a = \frac{\sum[(x-x_a)(y-y_a)]}{\sum(x-x_a)^2}$$

where:

x_a – $\sum[x(1/x)/\sum(1/x)]$

y_a – $\sum[y(1/x)/\sum(1/x)]$ or

x_a – $\sum[x(1/x^2)/\sum(1/x^2)]$

y_a – $\sum[y(1/x^2)/\sum(1/x^2)]$

b = x0 = intercept of the line

$$b = y_a - a * x_a$$

10.5.1.5. **Calculate for Standard Deviation**

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}} \qquad \text{Eq.-10.5.1.5}$$

where:

SD – standard deviation

x_i – result at ith measurement

$\bar{x}$ – mean

n – number of measurements

10.5.1.6. **Calculate for % relative standard deviation (%RSD)**

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \text{Eq.-10.5.1.6}$$

where:

SD – standard deviation

$RRFm$ – average response factor

10.5.2. Calibration Check/Continuing Calibration

10.5.2.1. **Calculate Percent Difference (%D) when RRFm is used for quantitation**

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \text{Eq.-10.5.2.1}$$

where:

$RRFc$ – response factor from continuing calibration standard

$RRFm$ – average response factor

10.5.2.2. **Calculate Percent Deviation (%D_t) when applied calculation is other than ARF**

$$\%D_t = \frac{|T_t - T_f|}{T_t} * 100\% \qquad \text{Eq.-10.5.2.2}$$

where:

T_t – true value of standard in µg/L

T_f – found value of standard in µg/L

10.5.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.5.3.1. **Water Samples**

$$Concentration\ (ug/L) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(V_t)} \qquad \text{Eq.-10.5.3.1}$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard added

V_e – extract final volume from sample extraction, usually 1 ml

DF – dilution factor = $\frac{aliquot(\mu l) + solvent(\mu l)}{aliquot(\mu l)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1 µl

V_t – volume of water extracted in ml, usually 1000 ml

10.5.3.2. **Soil/Sediment Samples (Dry weight basis)**

$$Concentration(\mu g / Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} \qquad \text{Eq.-10.5.3.2}$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injected in ng

V_e – volume of extract in ml, usually 1 ml[5]

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

A_{is} – area of characteristic ion for the internal standard

RRF_m – average response factor

V_i – volume of extract injected in µl, usually 1 µl

W_s – wet soil weight in kg

DW – % solid = $\frac{100 - \%moisture}{100}$

10.5.3.3. **Calculation for results subjected to cleanup by GPC**

$$Concentration(\mu g / Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} * \frac{V_{bg}}{V_{ig}} \qquad \text{Eq.-10.5.3.3}$$

where:

A_x – area of characteristic ion for the compound to be measured

I_s – amount of internal standard injected in ng

V_e – volume of extract in ml

DF – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

[5] For extracts subjected to GPC V_i = 0.5 ml

A_{is} – area of characteristic ion for the internal standard

RF_m – average response factor

V_i – volume of extract injected in µl, usually 1 µl

W_s – wet soil weight in kg

DW – % solid = $\frac{100 - \%moisture}{100}$

V_{bg} – total volume of extract before GPC clean-up in ml

V_{ig} – injected volume of extract to GPC in ml

10.5.4. Base all sample result calculations on the ICAL curve, e.g., area ratio of Ax/Ais versus concentration using inverse weighting factor fitted to the initial calibration is also used for determination of sample concentration.

10.5.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.5.5.1. The area "Ax" and "Ais" are derived from total ion chromatogram. "Ais" refers to the closest internal standard (IS) free of interference.

10.5.5.2. RRF of the TIC is 1.

10.5.6. <u>Accuracy and Precision</u>

10.5.6.1. **Percent Recovery**

$$\%\ \text{Recovery} = \frac{Cf - C}{Cs} * 100 \qquad \text{Eq.-10.5.6.1}$$

where:

Cf – concentration found

C – concentration of sample (use 0 for LCS)

Cs – concentration of spike

10.5.6.2. **Relative Percent Difference (%RPD)**

$$\%RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.6.2}$$

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.5.7. <u>DDT Degradation</u>

$$\%B = \frac{A_{DDD} + A_{DDE}}{A_{DDT} + A_{DDD} + A_{DDE}}(100) \qquad \text{Eq.-10.6.7}$$

where:

$\%B$ – percent breakdown

$ADDD$ – area of DDD

$ADDE$ - area of DDE

$ADDT$ - area of DDT

10.6. **Data Reduction**

10.6.1. Make a copy of the analytical run log and highlight the data to be reported.

10.6.2. Print a copy of the raw data and the QC report.

10.6.3. Check that all positively identified analytes are within the calibration range.

10.6.4. Collate the reportable raw data separating the QC results from the sample results.

10.6.5. Keep all other data generated with the analytical folder marked with “For Record Only”.

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe

10.7.2. Generate the sample results using F1NV3C.exe

10.7.3. Generate the QC summary using QCV3CN.exe

10.7.4. Generate the Instrument Performance Check (ICAL and DCC for 8270C) using F5SVTEST.exe

10.7.5. Generate the Instrument Performance Check (ICAL and DCC for 8270D) using F5SVN.exe

10.7.6. Generate the IS and RT Summary using F8SV.exe

10.7.7. Generate Lab Chronicle using LABCHRN1.exe

10.7.8. Generate the Case Narrative using CN1.exe

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Case Narrative
- Lab Chronicle
- Sample Results
- Method Blank Results
- LCS/LCSD Summary
- MS/MSD Summary
- Instrument Performance Check (ICAL)
- ICAL Summary

- ICV Summary
- Instrument Performance Check (DCC)
- IS and RT Summary
- DCC Summary
- Analytical Run Log
- Sample Preparation Log
- Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- Check internal standard area. They should be within -50 to +100% of the ICAL midpoint to be acceptable, otherwise follow PSR.
- Check retention time of each IS to the ICAL midpoint. They should be within ± 30 seconds to be acceptable, otherwise follow PSR.
- Check surrogate recoveries against Project Specific Requirements (PSR). In the absence of PSR, default to in-house QC limits.
- Check concentrations of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.3. Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.4. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to form 8270SIMFM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back to control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

Maintenance Activity	**Description**	**Frequency**
Autosampler	Inspect and clean syringe. Check autosampler response.	Daily prior to analysis
Vacuum System Verification	Verify pressure. Perform system tune check.	Daily prior to analysis
Verification	Check instrument parameters to ensure normal operating conditions. Check instrument performance	Daily prior to analysis

	(e.g., Daily calibration check, instrument blank, DDT/Endrin breakdown).	
Source Cleaning	Remove and clean the Mass Spec ion source.	Every 6 months or as necessary
Vacuum System Maintenance	Inspect vacuum pumps, and replace mechanical/diffusion pump oil	Every 6 months
Documentation	Record maintenance in instrument service logs.	Daily prior to analysis to include services done by third party.

11.0 QUALITY CONTROL

11.1. Sample Preparation Batch QC

11.1.1. Analyze Method Blank (MB) to demonstrate that preparation of sample was free from contamination.

11.1.2. Analyze Lab Control Sample (LCS) to assess preparative batch accuracy.

11.1.3. Analyze Matrix Spike (MS/MSD) to assess matrix interference (when required by the project) and a maximum of 20 field samples of similar matrix.

11.1.4. In the absence of MS/MSD prepare LCS/LCSD to check for precision.

11.1.5. All lab wares used in the sample preparation shall be properly treated as specific in EMAX-QC07.

11.1.6. All solvents and reagents shall undergo quality control check in the stationary laboratory prior to its use.

- Verify that the spike amount is accurate by checking the record.
- If LCS is within acceptance criteria and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the problem matrix interference in the case narrative.

11.2. Analytical Batch QC

11.2.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.2.2. Perform Initial Calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest.

11.2.3. Establish Retention Time window position for each analyte every after ICAL for proper qualitative identification.

11.2.4. Perform Initial Calibration Verification (ICV) every after ICAL to verify accuracy of ICAL.

11.2.5. Perform Continuing Calibration Verification (CCV) every 12 hours to verify that the instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.2.6. Evaluate Relative Retention Time for each analytes in every sample to be within ± 0.06 RRT

units.

11.2.7. Verify Internal Standards (IS) for quantitative accuracy and that its Retention Time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -50 to +100% of ICAL midpoint standard.

11.2.8. Evaluate Surrogate recovery to monitor instrument response on every sample.

11.3. **Method QC**

11.3.1. Establish Detection Limit (DL) to determine the smallest analyte concentration that can be demonstrated to be different from zero.

11.3.2. Establish Limit of Detection (LOD) to determine the smallest concentration of an analyte that can be qualitatively identified in a sample with 99% confidence level.

11.3.3. Establish Limit of Quantitation (LOQ) to determine the lowest concentration that produces a quantitative result within specified limits of precision and bias.

11.3.4. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05.

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency, acceptance criteria and corrective action.

12.0 CORRECTIVE ACTIONS

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. **Sample Preparation QC**

12.2.1. If the instrument blank is non-compliant, consider the following suggestions to correct the problem:

12.2.1.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new autosampler syringe.

12.2.1.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.2.1.3. Rule out preparation contamination by preparing a new instrument blank.

12.2.1.4. If the problem persists, inform the supervisor for further advice.

12.2.2. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.2.2.1. Rule out instrument contamination by checking instrument blank.

12.2.2.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01.

12.2.2.3. Rule out glassware contamination used for extraction as described in EMAX-QC07.

12.2.2.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents.

12.2.2.5. If the problem persists, inform the supervisor for further advice.

12.2.3. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.2.3.1. If result is bias-high or bias low, check the LCS Standard by analyzing at the spike level.

12.2.3.2. If LCS Check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.2.3.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.2.3.4. If LCS is within acceptance then and the right amount of spike is added into sample then it is indicative of matrix interference. Discuss the probable matrix interference in Case Narrative.

12.2.4. If MS is non-compliant consider the following suggestions to correct the problem:

12.2.4.1. Verify that the spike amount added is accurate by checking the record and the micropipette calibration.

12.2.4.2. If LCS is within acceptance criteria then and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the probable matrix interference in the Case Narrative.

12.3. **Analytical Batch QC**

12.3.1. Tune Check

12.3.1.1. If tune check is non-complaint consider the following suggestion to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check gas flow.
- Perform autotune or visual optimization.
- If the problem persists, inform the supervisor for further actions.

12.3.1.2. If instrument performance is non-compliant, consider the following suggestions to correct the problem:

- Excessive degradation of DDT and/or poor chromatography demonstrated by too much tailing are indications of dirty injection port. Clean or replace the injection port. If problem persist, cut off the first 6-12 inches of the capillary column.

12.3.2. Initial Calibration (ICAL)

12.3.2.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

- If RSD% is out of acceptance criteria, review result and identify presence of an outlier.

- If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

Note: The lowest calibration point identifies the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects where the ICAL will be used.

12.3.2.2. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

- Check the connections and make sure they are air-tight and perform maintenance as needed.
- Check the gas flow.
- Re-tune the MS.
- Prepare a fresh standard and repeat calibration.
- Clean the MS source and repeat the calibration.

12.3.2.3. If the problem persists, inform the supervisor for further action.

12.3.3. Initial Calibration Verification (ICV)

12.3.3.1. If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Re-analyze ICV to rule out poor injection.
- If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error.
- If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.
- If problem persist, inform the supervisor for further action.

12.3.4. Daily Calibration Check (DCC)

12.3.4.1. If DCC is non-compliant consider the following suggestions to correct the problem:

- If majority of the analyte response are low and no evidence of leak in the system is apparent, it is indicative of a poor injection or leak in the vial. Re-analyze DCC
- If problem persist, rule out standard degradation. Prepare a fresh standard and repeat DCC.

12.3.4.2. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

- Change the liner.
- Clean the injection port.

- Prepare a new standard.
- Cut or replace column.
- Rule out leaks by checking all connections.
- If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL.

12.3.5. Instrument Blank. If instrument blank is non-compliant, consider the following suggestions to correct the problem:

- Rule out instrument contamination.
- Rule out reagent contamination by testing each reagent used as described in EMAX-QC01.
- Rule vials and glassware contamination as described in EMAX-QC07.
- If the problem persists, inform the supervisor for further advice.

12.4. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.4.1. If corrective action needs the function of the department; e.g. if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.4.2. If corrective action needs the assistance of the project manager; e.g. if the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.5. For other problems encountered, inform the supervisor immediately for further instructions.

13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standards in fume hoods.

13.3. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.4. Separate and properly identify all unused expired analytical standards for proper disposal.

14.0 WASTE MANAGEMENT

14.1. Practice the "Less is Better" strategies when preparing for analytical standards. This will minimize the production of surplus chemical wastes.

14.2. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group

of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation Batch** – is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical Batch** – is composed of prepared samples (extracts, digestates or concentrates) which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – The lowest concentration or amount of the target analyte that can be identified, measured and reported with confidence that the analyte concentration is not false positive.

15.1.4. Limit of Detection (LOD) – An estimate of the minimum amount of substance that an analytical process can reliably detect.

15.1.5. Limit of Quantitation (LOQ) – The minimum levels, concentrations or quantities of target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

15.1.6. Material Safety Data Sheet (MSDS) – is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.7. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.8. Carry-over – are contaminants retained in the instruments/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.9. Calibration Check Compounds (CCC) – evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.10. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.11. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.12. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.13. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.14. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.15. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.16. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.17. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.18. Matrix – is a component or form of a sample.

15.1.19. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.20. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.21. Re-analysis – is a repeated analysis from the same extract/digestate or sample, identified with the Lab Sample ID suffixed with "W".

15.1.22. Re-extract/digest – is a repeated sample preparation process identified with the Lab Sample ID suffixed with "R".

15.1.23. Response Factor – is the ratio of the peak area of the target compound in the sample or sample extract.

15.1.24. Surrogate – are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be expected to be detected in environmental media.

15.1.25. System Performance Check Compounds (SPCC) – are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing Semi Volatile analysis by GC/MS SIM unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

16.0 REFERENCES

16.1. "Test Methods for Evaluation of Solid Wastes", EPA SW846, Methods 8000B and 8270D.

16.2. EMAX Quality Systems Manual (EMAX-QS00), as updated.

17.0 APPENDICES

17.1. Tables

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17.3. Appendices

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17.4. Forms

17.4.1.	8270SIMFS	Sample Preparation Log
17.4.2.	8270SIMFA	Analytical Run Log
17.4.3.	8270SIMFM	Instrument Maintenance Log

Table 1: INTERMEDIATE STANDARD PREPARATION

A. Primary Source: Restek, CPI or equivalent

Compound Name	Stock / Internal Soln. Conc. (µg/ml)	Source	Preparation			Final Conc. (µg/ml)
			Aliquot (µl)	Dil. Solution	Final Vol. (ml)	
8270 Mega Mix	1000	Restek	1000	MeCl2	5	200
8270 Custom Std.	2000	CPI	500	MeCl2	5	200
Benzidine Mix	2000	Restek	500	MeCl2	5	200
Benzoic Mix	2000	Restek	500	MeCl2	5	200
Acid Surrogate Mix	7500	Restek	133.3	MeCl2	5	200
Base/Neutral Surrogate Mix	5000	Restek	200	MeCl2	5	200

B. Secondary Source: CPI, AccuStandard or equivalent

Compound Name	Stock Soln. Conc. (µg/ml)	Source
Custom Semi Volatile Standard	2000	CPI
8270 LCS Solution	200	CPI
8270 Internal Standard	2000	AccuStandard

Table 2a: WORKING STANDARD CALIBRATION

Standard Name	Intermediate Standard µl of 200 µg/ml	Internal Standard µl of 2000 µg/ml	Dil. Solvent	Final Volume (µl)	Final Conc.
1	0.19	10	$MeCl_2$	500	0.075 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
2	0.375	10	$MeCl_2$	500	0.15 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
3	1.25	10	$MeCl_2$	500	0.5 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
4	2.5	10	$MeCl_2$	500	1 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
5	5	10	$MeCl_2$	500	2 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
6	12.5	10	$MeCl_2$	500	5 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
7	25	10	$MeCl_2$	500	10 µg/ml of Cal Std. 40 µg/ml of Internal Std.
8	50	10	$MeCl_2$	500	20 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
9	62.5	10	$MeCl_2$	500	25 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
10	75	10	$MeCl_2$	500	30 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
11	100	10	$MeCl_2$	500	40 µg/ml of Cal. Std. 40 µg/ml of Internal Std.
12	125	10	$MeCl_2$	500	50 µg/ml of Cal. Std. 40 µg/ml of Internal Std.

Table 2b: WORKING SECONDARY SOURCE STANDARD

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (µl)	Dil. Solvent	Final Vol. (µl)	
Custom Semi Volatile Standard	2000	6.25	$MeCl_2$	500	25
8270 LCS Solution	2000	62.5	$MeCl_2$	500	25
8270 Internal Standard	2000	10	$MeCl_2$	500	40

Table 2c: WORKING INTERNAL STANDARD PREPARATION

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (ml)	Dil. Solvent	Final Vol. (ml)	
Internal Standard Mix	4000	5	$MeCl_2$	10	2000

Table 2d: WORKING GC/MS TUNING (DFTPP) STANDARD

Standard Name	Soln. Conc. (µg/ml)	Preparation			Final Conc. (µg/ml)
		Aliquot (µl)	Dil. Solvent	Final Vol. (µl)	
GC/MS Tuning Mix	1000	25	$MeCl_2$	500	50

Table 3: INSTRUMENT PARAMETERS

	Inst. E4 / Inst. E7	Inst. 052
Carrier Gas	Helium at 90 psi at outlet	Helium at 90 psi at outlet
Column head pressure	15 - 35 psi at 40°C	15-35 psi at 50°C
Injection port temperature	280-300°C	280-300°C
Interface	Direct column interference at 280-300°C	Direct column interference at 2 80-300°C
Valve time	Split 0.2 minute	Split 0.2 minutes
Oven Temperature Program		
Initial Temperature	50°C/min; hold for 0min.	50°C/min; hold for 0.2min.
Rate	30°C/min to 100°C; hold for 0.0 min.; 20°C/min to 200°C; hold for 0.0 min.; 25°C/min to 320°C; hold for 2.53 min.	10°C/min to 100°C; hold for 0 min. 38°C/min to 280°C; hold for 0 min.
Run Time	14 minutes	9.94 minutes
Scan Parameters		
Scan start time	After solvent peak	After solvent peak
Mass range	10 to 1050 AMU	40 to 500 AMU
Multiplier voltage	1000-3000	0.7-3
Number of sampling rate	1	0.4
Threshold	300	500-1500
Tuning File	DFTPP	DFTPP

Table 4: DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
51	10 – 80% of mass 198
68	< 2.0% of mass 69
69	present
70	< 2.0% of mass 69
127	10 – 80% of mass 198
197	< 2% of mass 198
198	Base peak, 100% relative abundance (See Note), or > 50% of mass 442
199	5 to 9% of mass 198
275	10 to 60% of mass 198
365	> 1% of mass 198
441	Present but < 24% of mass 442
442	Base peak or > 50% of mass 198
443	15 to 24% of mass 442

Note: All ion abundance MUST be normalized to m/z 198, the nominal base peak.

Table 5: ANALYTE LISTS, QUANTITATION IONS, INTERNAL STANDARDS & SURROGATES

Analyte	Type	Quantitation Ions	
		Primary	Secondary
1,4-Dichlorobenzene-d_4	IS	152	115
N-nitrosodimethylamine	T	74.1	42.1
Phenol-d_5	S	99.1	71.1
2-Fluorophenol	S	112	64
Phenol	T	94	65.1
Bis(2-Chloroethyl)ether	T	93	63
2-Chlorophenol	T	128	64
N-Nitroso-di-n-propylamine	T	70.1	42.1
Nitrobenzene-d_5	S	82.1	128
2,4-Dimethylphenol	T	107	122.1
2,4-Dichlorophenol	T	162	163.9
Naphthalene	T	128.1	129.1
4-Chloro-3-methylphenol	T	107	77
2-Methylnaphthalene	T	142.1	141.1
1-Methylnaphthalene	T	142.1	141.1
2,4,6-Trichlorophenol	T	195.9	197.9
2,4,5-Trichlorophenol	T	195.9	197.9
2-Fluorobiphenyl	S	172.1	171.1
Biphenyl	T	154	153
2,6-Dimethylnaphthalene	T	156	141
Dimethylphthalate	T	163	164
Acenaphthene	T	153.1	152.1
Acenaphthylene	T	152.1	151.1
2,3,5-Trimethylnaphthalene	T	170	155
Diethylphthalate	T	149	177
Fluorene	T	166.1	165.1
Phenanthrene-d_{10}	IS	188	93.9
Azobenzene	T	77	105
2,4,6-Tribromophenol	S	329.8	331.8
Hexachlorobenzene	T	283.8	141.9
Pentachlorophenol	T	265.8	164.9
Phenanthrene	T	178.1	152.1
Anthracene	T	178.1	152.1
Carbazole	T	167.1	139
Di-n-butylphthalate	T	149	150
1-Methylphenanthrene	T	192	165
Fluoranthene	T	202	101
Pyrene	T	202	101
Terphenyl-d_{14}	S	244.2	122.1
Butylbenzylphthalate	T	149	91
Benzo(a)anthracene	T	228.1	113
Chrysene	T	228.1	226.1

Table 5 (cont.): ANALYTE LISTS, QUANTITATION IONS, INTERNAL STANDARDS & SURROGATES

Analyte	Type	Quantitation Ions	
		Primary	Secondary
bis(2-Ethylhexyl)phthalate	T	149	167
Perylene-d_{12}	IS	264.1	130
Di-n-octylphthalate	T	149	150
Benzo(b)fluoranthene	T	149	125
Benzo(k)fluoranthene	T	252.1	125
Benzo(e)pyrene	T	252	125
Benzo(a)pyrene	T	252	125
Perylene	T	252	125
Indeno(1,2,3-cd)pyrene	T	276.1	138
Dibenzo(a,h)anthracene	T	278.1	139
Benzo(g,h,i)perylene	T	276.1	138

Notes: T – Target Compound

S – Surrogate

IS –Internal Standard

Table 6: RECOMMENDED MINIMUM RESPONSE FACTOR

ANALYTE	Minimum Response Factor(RF)	ANALYTE	Minimum Response Factor(RF)
N-nitrosodimethylamine	0.010	Hexachlorobenzene	0.100
Phenol	0.800	Pentachlorophenol	0.050
Bis(2-chloroethyl)ether	0.700	Phenanthrene	0.700
2-Chlorophenol	0.800	Anthracene	0.700
N-Nitroso-di-n-propylamine	0.500	Carbazole	0.010
2,4-Dimethylphenol	0.200	Di-n-butyl phthalate	0.010
2,4-Dichlorophenol	0.200	1-Methylphenanthrene	0.010
Naphthalene	0.700	Fluoranthene	0.600
4-Chloro-3-methylphenol	0.200	Pyrene	0.600
2-Methylnaphthalene	0.400	Butyl benzyl phthalate	0.010
1-Methylnaphthalene	0.010	Benzo(a)anthracene	0.800
2,4,6-Trichlorophenol	0.200	Chrysene	0.700
2,4,5-Trichlorophenol	0.200	Bis-(2-ethylhexyl)phthalate	0.010
Biphenyl	0.010	Di-n-octyl phthalate	0.010
2,6-Dimethylnapthalene	0.010	Benzo(b)fluoranthene	0.700
Dimethyl phthalate	0.010	Benzo(k)fluoranthene	0.700
Acenaphthylene	0.900	Benzo(e)pyrene	0.010
Acenaphthene	0.900	Benzo(a)pyrene	0.700
2,3,5-Trimethylnaphthalene	0.010	Perylene	0.010
Diethyl phthalate	0.010	Indeno(1,2,3-cd)pyrene	0.500
Fluorene	0.900	Dibenz(a,h)anthracene	0.400
Azobenzene	0.010	Benzo(g,h,i)perylene	0.500

Notes:
1. PSR supersedes Table 6.
2. Other analytes not listed above must have a minimum response factor of 0.01.
3. Table 6 is from SW846 Method 8270D, Table 4.

Table 7: ESTABLISHED DL, LOD AND LOQ

Parameter	Water (µg/l)			Soil (µg/Kg)		
	DL	LOD	LOQ	DL	LOD	LOQ
Acenaphthylene	0.05	0.1	0.2	1.25	2.5	5
Anthracene	0.05	0.1	0.2	1.25	2.5	5
Azobenzene	0.05	0.1	1	1.25	2.5	5
Benzo(a)anthracene	0.09	0.1	0.2	2.45	2.5	5
benzo(a)pyrene	0.05	0.1	0.2	1.25	2.5	5
Benzo(b)fluoranthene	0.05	0.1	0.2	1.25	2.5	5
Benzo(e)pyrene	0.05	0.1	0.2	1.25	2.5	5
Benzo(g,h,i)perylene	0.05	0.1	0.2	1.25	2.5	5
Benzo(k)fluoranthene	0.05	0.1	0.2	1.25	2.5	5
Biphenyl	0.05	0.1	1	1.25	2.5	5
bis(2-chloroethyl)ether	0.05	0.1	1	1.5	2.5	5
bis(2-Ethylhexyl)phthalate	0.57	1	2	25	50	100
Carbazole	0.05	0.1	1	1.25	2.5	5
4-Chloro-3-methylphenol	0.05	0.1	1	2.5	5	10
2-Chlorophenol	0.05	0.1	1	2.5	5	10
Chrysene	0.06	0.1	0.2	2.2	2.5	5
Dibenzo(a,h)anthracene	0.05	0.1	0.2	1.25	2.5	5
2,4-Dichlorophenol	0.05	0.1	1	2.5	5	10
2,6-Dimethylnaphthalene	0.05	0.1	0.2	1.25	2.5	5
2,4-Dimethylphenol	0.07	0.1	1	2.5	5	10
Fluoranthene	0.05	0.1	1	1.25	2.5	5
Fluorene	0.05	0.1	0.2	1.25	2.5	5
Hexachlorobenzene	0.05	0.1	1	1.25	2.5	5
Indeno(1,2,3-cd)pyrene	0.05	0.1	0.2	1.25	2.5	5
1-Methylnaphthalene	0.05	0.1	0.2	1.25	2.5	5
2-Methylnaphthalene	0.05	0.1	0.2	1.25	2.5	5
1-Methylphenanthrene	0.05	0.1	0.2	1.25	2.5	5
Naphthalene	0.05	0.1	0.2	1.25	2.5	5
n-Nitrosodimethylamine	0.05	0.1	1	1.25	2.5	5
n-Nitroso-di-n-propylamine	0.05	0.1	1	1.25	2.5	5
Pentachlorophenol	0.4	0.5	1	18	25	50
Perylene	0.05	0.1	0.2	1.25	2.5	5
Phenanthrene	0.05	0.1	0.2	1.25	2.5	5
Phenol	0.05	0.1	1	2.5	5	10
Pyrene	0.05	0.1	0.2	1.25	2.5	5
2,4,5-Trichlorophenol	0.05	0.1	1	2.5	5	10
2,4,6-Trichlorophenol	0.05	0.1	1	2.5	5	10

Table 7 (cont.): ESTABLISHED DL, LOD AND LOQ

Parameter	Water (µg/l)			Soil (µg/Kg)		
	DL	LOD	LOQ	DL	LOD	LOQ
2,3,5-Trimethylnaphthalene	0.05	0.1	0.2	1.25	2.5	5
Phenol-d5	0.15	0.3	0.6	3.75	7.5	15
2-Fluorobiphenyl	0.05	0.1	0.2	1.25	2.5	5
Nitrobenzene-d5	0.05	0.1	0.2	1.25	2.5	5
2,4,6-Tribromophenol	0.15	0.3	0.6	3.75	7.5	15
Terphenyl-d14	0.05	0.1	0.2	1.5	2.5	5
2-Fluorophenol	0.15	0.3	0.6	3.75	7.5	15
Dimethylphthalate	0.1	0.2	0.4	2.5	5	10
Diethylphtlate	0.1	0.2	0.4	2.5	5	10
Acenaphthene	0.05	0.1	0.2	1.25	2.5	5
Di-n-butylphtlate	0.1	0.2	0.4	2.5	5	10
Butylbenzene phthalate	0.1	0.2	0.4	2.5	5	10
Di-n-octylphthalate	0.1	0.2	0.4	2.5	5	10

Note:
1. PSR supersedes Table 7
2. LOD and LOQ were established at the time this SOP is written

Figure 1: PEAK EVALUATION TECHNIQUE

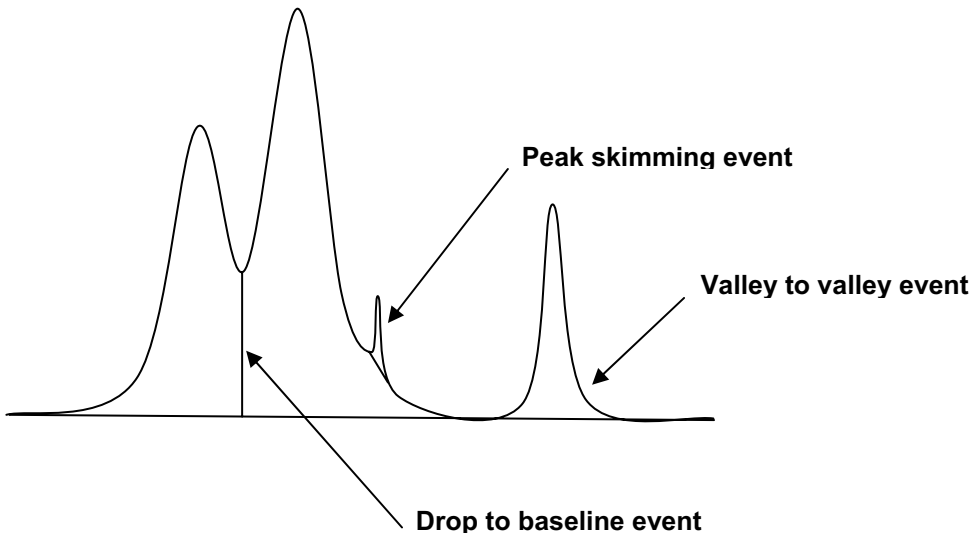

Figure 2: **TYPICAL CHROMATOGRAM**

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                    Quantitation Report     (QT Reviewed)
Data File : D:\DATA\11E11\REH073.D                          Vial: 7
Acq On    : 11 May 2011  15:47                         Operator: KV
Sample    : SVE7E11S 20PPM                             Inst    : E7
Misc      :                                            Multiplr: 1.00
Integrator: RTE
Quant Time: May 12 10:00:07 2011
Quant Results File: SVE7E11S.RES
Quant Method : C:\msdchem\1\METHODS\SVE7E11S.M
Quant Title  : SEMIVOLATILES - SIM
QLast Update : Thu May 12 09:51:52 2011
Response via : Initial Calibration
DataAcq Meth:SVE7E11S.M
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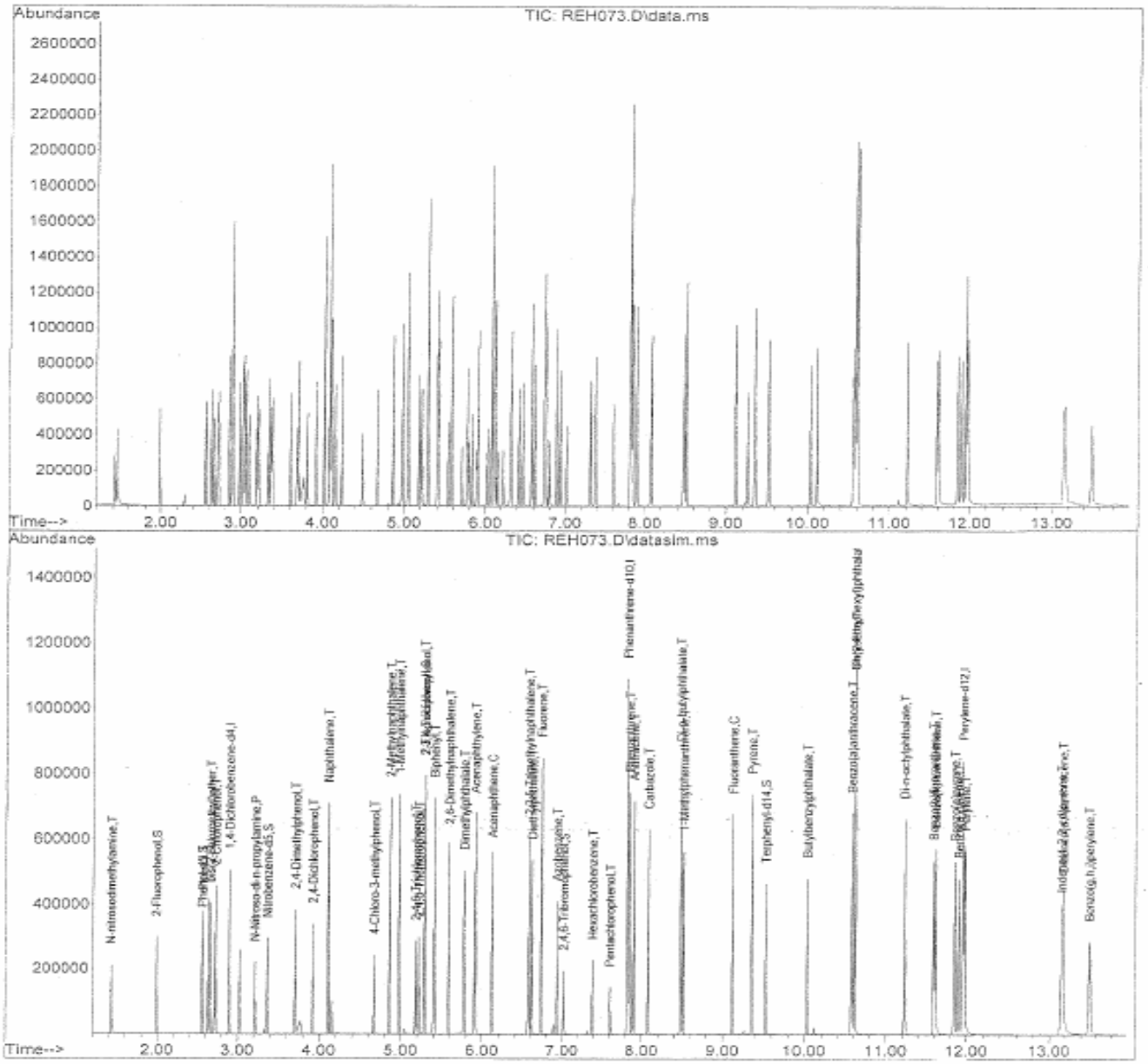

SVE7E11S.M Thu May 12 10:00:20 2011 Page: 3

Figure 3: **TYPICAL ICAL SUMMARY**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E7
Beginning DateTime :05/11/11 14:33
Spike Units :PPM
IC File :REH072

Column Spec :ZB-5MS ID :0.18MM
Ending DateTime :05/11/11 17:57
HPChem Method :SVE7E11S

IDX	Parameters	-075 17:57 REH080	-15 17:39 REH079	-5 17:20 REH078	1 17:02 REH077	2 16:43 REH076	5 16:25 REH075	10 16:06 REH074	20 15:47 REH073	25 15:29 REH072	30 15:10 REH071	40 14:52 REH070	50 14:33 REH069	Av_RRF	%_RSD	Av_Rt_M
1	1,4-Dichlorobenzene-d4	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2.8919
2	N-nitrosodimethylamine	0.367	0.419	0.448	0.471	0.467	0.505	0.480	0.480	0.474	0.485	0.481	0.488	0.464	8.07	1.4270
3	2-Fluorophenol	1.250	1.173	1.084	1.073	1.016	1.091	1.060	1.048	1.042	1.038	1.031	1.030	1.078	6.33	1.9891
4	Phenol-d5	1.391	1.330	1.259	1.238	1.159	1.259	1.233	1.200	1.187	1.186	1.185	1.181	1.234	5.55	2.5517
5	Phenol	1.547	1.409	1.335	1.315	1.237	1.311	1.269	1.245	1.229	1.222	1.221	1.213	1.296	7.63	2.5631
6	bis(2-chloroethyl)ether	1.312	1.145	1.059	1.025	0.970	1.033	0.993	0.960	0.950	0.942	0.938	0.937	1.022	10.78	2.6575
7	2-Chlorophenol	1.520	1.427	1.358	1.348	1.285	1.375	1.336	1.299	1.295	1.290	1.283	1.276	1.341	5.43	2.7204
8	N-Nitroso-di-n-propylamine	0.642	0.601	0.594	0.589	0.584	0.640	0.626	0.622	0.614	0.610	0.611	0.604	0.611	3.05	3.2140
9	Nitrobenzene-d5	1.178	1.108	1.047	1.037	1.003	1.097	1.078	1.076	1.067	1.063	1.061	1.058	1.073	4.00	3.3653
10	2,4-Dimethylphenol	1.227	1.125	1.112	1.118	1.118	1.216	1.182	1.169	1.162	1.164	1.152	1.145	1.157	3.26	3.7082
11	2,4-Dichlorophenol	1.237	1.117	1.110	1.104	1.090	1.215	1.197	1.193	1.185	1.180	1.186	1.182	1.166	4.13	3.9220
12	Naphthalene	4.902	4.475	4.145	3.991	3.836	4.018	3.870	3.788	3.745	3.710	3.702	3.663	3.987	9.26	4.1078
13	4-Chloro-3-methylphenol	1.054	0.892	0.874	0.867	0.880	0.986	0.984	0.993	0.988	0.979	0.982	0.974	0.954	6.30	4.6730
14	2-Methylnaphthalene	2.896	2.643	2.519	2.449	2.396	2.546	2.463	2.421	2.395	2.374	2.368	2.343	2.485	6.27	4.8651
15	1-Methylnaphthalene	3.000	2.736	2.610	2.541	2.485	2.619	2.533	2.482	2.459	2.427	2.417	2.396	2.559	6.66	4.9771
16	2,4,6-Trichlorophenol	------	0.783	0.789	0.789	0.806	0.907	0.898	0.902	0.897	0.894	0.893	0.890	0.859	6.24	5.1800
17	2,4,5-Trichlorophenol	------	0.858	0.847	0.831	0.844	0.954	0.960	0.970	0.962	0.958	0.961	0.954	0.918	6.35	5.2159
18	2,3,4-Trichlorophenol	------	0.765	0.727	0.728	0.740	0.829	0.851	0.849	0.839	0.834	0.827	0.821	0.801	6.24	5.2912
19	2-Fluorobiphenyl	3.660	3.320	3.147	3.059	2.970	3.127	3.005	2.948	2.908	2.858	2.829	2.795	3.052	7.97	5.2877
20	Biphenyl	4.109	3.688	3.570	3.432	3.360	3.524	3.386	3.311	3.274	3.229	3.201	3.151	3.436	7.71	5.4047
21	2,6-Dimethylnaphthalene	2.683	2.422	2.453	2.363	2.319	2.464	2.379	2.336	2.308	2.277	2.258	2.228	2.374	5.16	5.5877
22	Dimethylphthalate	3.291	2.916	2.959	2.865	2.890	3.100	3.023	3.003	2.962	2.925	2.895	2.854	2.974	4.12	5.7703
23	Acenaphthylene	4.235	3.776	3.879	3.869	3.919	4.259	4.122	4.101	4.047	4.008	3.960	3.890	4.005	3.77	5.9106
24	Acenaphthene	3.221	2.812	2.749	2.634	2.584	2.711	2.604	2.553	2.516	2.481	2.461	2.420	2.645	8.20	6.1198
25	2,3,5-Trimethylnaphthalene	2.356	2.089	2.066	2.036	2.039	2.190	2.129	2.096	2.073	2.040	2.019	1.983	2.093	4.72	6.5807
26	Diethylphthalate	4.947	3.783	3.226	3.008	2.995	3.196	3.129	3.103	3.062	3.008	2.960	2.902	3.276	17.50	6.6215
27	Fluorene	3.211	2.831	2.878	2.808	2.817	3.011	2.927	2.891	2.847	2.814	2.765	2.715	2.876	4.52	6.7368
28	Phenanthrene-d10	1	1	1	1	1	1	1	1	1	1	1	1	1	0	7.8177
29	Azobenzene	0.563	0.516	0.542	0.562	0.576	0.631	0.616	0.604	0.598	0.601	0.599	0.601	0.584	5.66	6.9342
30	2,4,6-Tribromophenol	------	0.167	0.155	0.154	0.158	0.181	0.183	0.186	0.187	0.188	0.190	0.191	0.176	8.38	7.0176
31	Hexachlorobenzene	0.431	0.380	0.353	0.359	0.347	0.358	0.344	0.333	0.329	0.329	0.328	0.327	0.353	8.65	7.3790
32	Pentachlorophenol	------	------	0.148	0.139	0.140	0.166	0.173	0.183	0.185	0.189	0.192	0.196	0.171	12.76	7.6016
33	Phenanthrene	1.517	1.372	1.317	1.243	1.200	1.256	1.210	1.191	1.176	1.176	1.167	1.168	1.249	8.46	7.8429
34	Anthracene	1.351	1.241	1.190	1.168	1.153	1.240	1.212	1.193	1.174	1.174	1.166	1.162	1.202	4.61	7.8989
35	Carbazole	1.080	1.042	0.988	0.986	0.995	1.072	1.053	1.045	1.043	1.044	1.050	1.047	1.037	2.99	8.0794
36	Di-n-butylphthalate	1.073	1.019	1.021	1.017	1.079	1.273	1.298	1.327	1.315	1.324	1.319	1.316	1.198	11.71	8.4808
37	1-Methylphenanthrene	0.883	0.840	0.823	0.809	0.817	0.877	0.846	0.823	0.818	0.816	0.805	0.803	0.830	3.19	8.5137
38	Fluoranthene	1.260	1.195	1.147	1.110	1.113	1.202	1.175	1.170	1.161	1.163	1.162	1.156	1.168	3.41	9.1198
39	Pyrene	1.361	1.298	1.270	1.237	1.245	1.338	1.298	1.266	1.261	1.255	1.255	1.246	1.278	3.04	9.3545
40	Terphenyl-d14	0.822	0.798	0.815	0.753	0.766	0.811	0.794	0.771	0.771	0.769	0.766	0.759	0.783	3.04	9.5254
41	Butylbenzylphthalate	0.338	0.331	0.352	0.326	0.373	0.459	0.492	0.516	0.526	0.530	0.537	0.537	0.443	20.54	10.0318
42	Benzo(a)anthracene	2.502	1.892	1.380	1.188	1.129	1.188	1.148	1.119	1.117	1.119	1.116	1.102	1.333	32.28	10.5784
43	Chrysene	1.457	1.420	1.222	1.174	1.138	1.165	1.105	1.071	1.058	1.050	1.044	1.029	1.161	12.30	10.6132
44	bis(2-Ethylhexyl)phthalate	------	------	0.520	0.503	0.575	0.710	0.742	0.745	0.754	0.753	0.756	0.744	0.680	15.30	10.6116
45	Perylene-d12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	11.9565
46	Di-n-octylphthalate	0.629	0.558	0.677	0.630	0.755	0.994	1.099	1.214	1.226	1.226	1.252	1.266	0.960	29.91	11.2261
47	Benzo(b)fluoranthene	1.126	1.039	1.094	0.988	1.003	1.112	1.091	1.130	1.119	1.082	1.089	1.095	1.081	4.32	11.5864
48	Benzo(k)fluoranthene	1.180	1.129	1.125	1.055	1.061	1.142	1.135	1.103	1.100	1.123	1.111	1.107	1.114	3.03	11.6124
49	Benzo(e)pyrene	1.285	1.161	1.140	1.055	1.035	1.119	1.108	1.098	1.091	1.088	1.087	1.083	1.113	5.76	11.8460
50	Benzo(a)pyrene	1.031	0.982	1.000	0.936	0.947	1.060	1.055	1.060	1.059	1.054	1.059	1.060	1.025	4.57	11.8975
51	Perylene	1.554	1.396	1.306	1.227	1.159	1.213	1.175	1.153	1.145	1.135	1.130	1.127	1.227	10.70	11.9802
52	Indeno(1,2,3-cd)pyrene	1.207	1.242	1.117	1.076	1.087	1.221	1.233	1.223	1.234	1.249	1.252	1.263	1.200	5.57	13.1516
53	Dibenzo(a,h)anthracene	0.959	1.024	0.936	0.885	0.904	1.009	1.013	1.002	1.007	1.017	1.018	1.021	0.983	5.02	13.1712
54	Benzo(g,h,i)perylene	1.068	1.069	0.956	0.874	0.891	0.978	0.979	0.958	0.965	0.973	0.973	0.976	0.972	5.84	13.5082

Ave_%RSD : 7.8 Max_%RSD : 32.3

Use Least Square Linear Regression with weighting factor of inverse concentration
Resp_Ratio = xo + x1 * Amt_Ratio

IDX	Parameter	x0	x1	CCF
26	Diethylphthalate	0.00358	2.99059	0.9996
41	Butylbenzylphthalate	-0.00105	0.52641	0.9988
42	Benzo(a)anthracene	0.00277	1.11218	0.9999
44	bis(2-Ethylhexyl)phthalate	-0.00470	0.75491	0.9998
46	Di-n-octylphthalate	-0.00332	1.22607	0.9978

Figure 4: **TYPICAL DFTPP TUNE SUMMARY**

```
Data Path  : D:\DATA\11E11\
Data File  : REH068.D
Acq On     : 11 May 2011  14:23
Operator   : KV
Sample     : DFTE7E1101
Misc       :
ALS Vial   : 2   Sample Multiplier: 1

Integration File: rteint.p

Method     : C:\msdchem\1\METHODS\DFTPPD.M
Title      : Semivolatiles DFTPP
Last Update  : Wed May 11 16:53:22 2011
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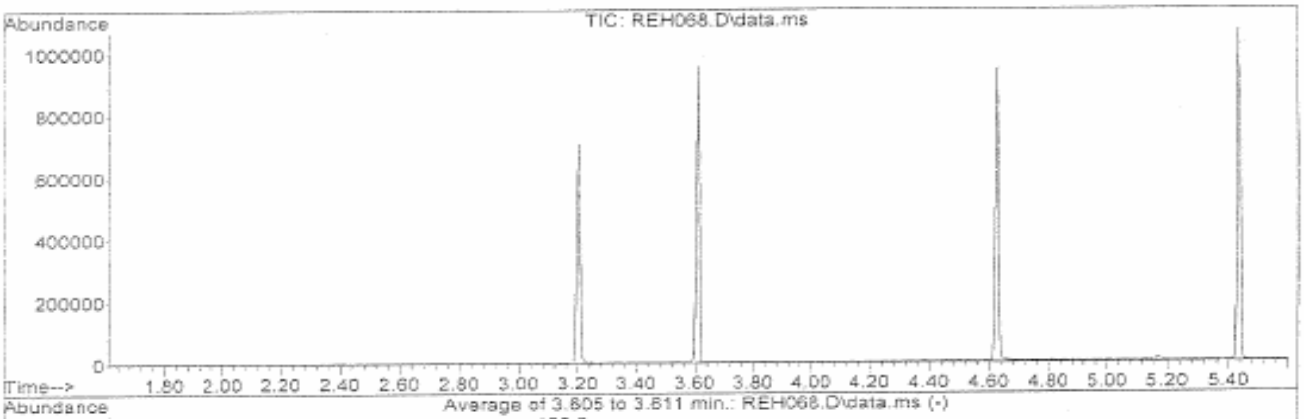

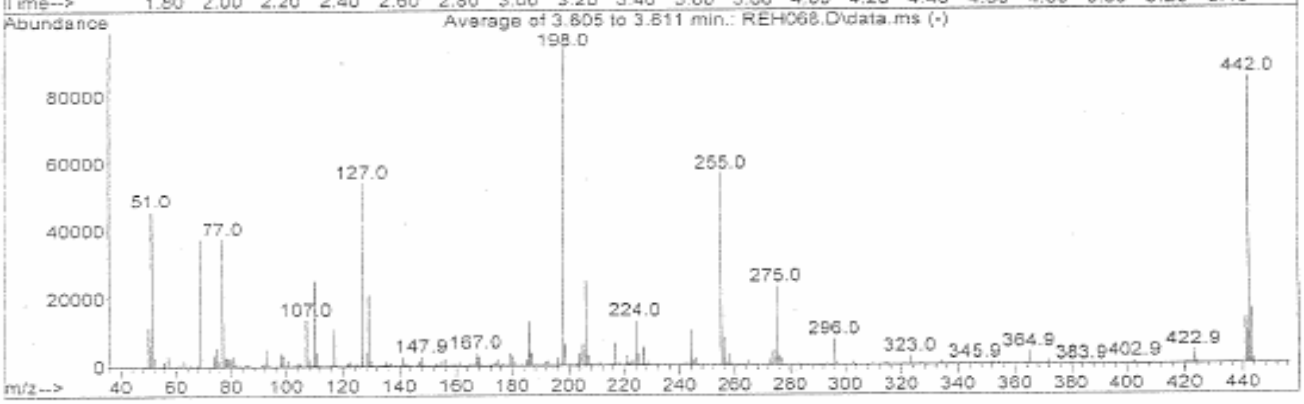

AutoFind: Scans 717, 718, 719; Background Corrected with Scan 710

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
51	198	10	80	48.5	45907	PASS
68	69	0.00	2	1.5	559	PASS
70	69	0.00	2	0.4	152	PASS
127	198	10	80	57.4	54259	PASS
197	198	0.00	2	0.4	418	PASS
198	198	100	100	100.0	94557	PASS
199	198	5	9	6.6	6247	PASS
275	198	10	60	24.5	23205	PASS
365	198	1	100	3.9	3675	PASS
441	442	0.01	24	15.8	13420	PASS
442	198	50	100	89.6	84768	PASS
443	442	15	24	19.4	16412	PASS

Figure 4a: TYPICAL INSTRUMENT PERFORMANCE CHECK SUMMARY

5B
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: RFH026
Instrument ID: TOE7

Project: CLEAN PROJECT
SDG No.: 11F017
DFTPP Injection Date: 06/07/11
DFTPP Injection Time: 09:57

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	44.23
68	Less than 2% of mass 69	0.58(1.5)1
69	Relative abundance of mass 198	39.33
70	Less than 2.0% of mass 69	0.00(0.0)1
127	40.0 - 60.0% of mass 198	54.42
197	Less than 1.0% of mass 198	0.00
198	Base Peak, 100% relative abundance	100.00
199	5.0 - 9.0% of mass 198	6.98
275	10.0 - 30.0% of mass 198	23.77
365	Greater than 1.00% of mass 198	3.32
441	Present, but less than mass 443	14.66(84.4)3
442	Greater than 40.0% of mass 198	88.14
443	17.0 - 23.0% of mass 442	17.37(19.7)2

1-Value is % mass 69 2-Value is % mass 442
3-Value is % mass 443

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
1	SSTD025	CSVE7E1107	RFH027	06/07/11	10:11
2	MBLK1S	SVF005SB	RFH031	06/07/11	11:28
3	LCS1S	SVF005SL	RFH032	06/07/11	11:47
4	LCD1S	SVF005SC	RFH033	06/07/11	12:06
5	IR9SB01-2MS	F017-02M	RFH036	06/07/11	13:03
6	IR9SB01-2MSD	F017-02S	RFH037	06/07/11	13:22
7	IR9SB01-2	F017-02	RFH040	06/07/11	14:22
8	IR9SB01-3	F017-03	RFH041	06/07/11	14:41
9	IR9SB02-2	F017-05	RFH042	06/07/11	15:00
10	IR9SB02-3	F017-06	RFH043	06/07/11	15:19
11	IR9SB01-1	F017-01	RFH044	06/07/11	15:38
12	IR9SB02-1	F017-04	RFH045	06/07/11	15:56

page 1 of 1

FORM V SV OLM02.0

Figure 5: TYPICAL CONTINUING CALIBRATION SUMMARY

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :E7
IC_Beginning DateTime :05/11/11 14:33
Spike Amount :25 PPM
CC/CV File :RFH090
IC File :REH072

Column Spec :ZB-5MS ID :0.18MM
IC_Ending DateTime :05/11/11 17:57
HPChem Method :SVE7E11S
Date_Time :06/09/11 11:50

M IDX	Parameters	CC_Con	CC%_D	CC_Resp	CCRRF	AvRRF	CC_Rtm	AvRtm	%_RSD	Co_X0	Co_X1	Co_X2	Co_Cor
1	1,4-Dichlorobenzene-d4	40.000	0	261180	1	1	2.893	2.892	0				
2	N-nitrosodimethylamine	25.609	2.4	77549	0.475	0.464	1.423	1.427	8.07				
3	2-Fluorophenol	23.348	-6.6	164332	1.007	1.078	1.992	1.989	6.33				
4	Phenol-d5	23.975	-4.1	193161	1.183	1.234	2.557	2.552	5.55				
5	Phenol	23.261	-7.0	196861	1.206	1.296	2.570	2.563	7.63				
6	bis(2-chloroethyl)ether	22.190	-11.2	148089	0.907	1.022	2.661	2.658	10.78				
7	2-Chlorophenol	24.053	-3.8	210596	1.290	1.341	2.723	2.720	5.43				
8	N-Nitroso-di-n-propylamine	25.628	2.5	102306	0.627	0.611	3.218	3.214	3.05				
9	Nitrobenzene-d5	25.568	2.3	179083	1.097	1.073	3.370	3.365	4.00				
10	2,4-Dimethylphenol	25.328	1.3	191402	1.173	1.157	3.713	3.708	3.26				
11	2,4-Dichlorophenol	25.463	1.9	193919	1.188	1.166	3.930	3.922	4.13				
12	Naphthalene	22.422	-10.3	583729	3.576	3.987	4.110	4.108	9.26				
13	4-Chloro-3-methylphenol	26.415	5.7	164622	1.008	0.954	4.681	4.673	6.30				
14	2-Methylnaphthalene	24.533	-1.9	397987	2.438	2.485	4.868	4.865	6.27				
15	1-Methylnaphthalene	22.821	-8.7	381284	2.336	2.559	4.979	4.977	6.66				
16	2,4,6-Trichlorophenol	27.175	8.7	152439	0.934	0.859	5.189	5.180	6.24				
17	2,4,5-Trichlorophenol	27.402	9.6	164294	1.006	0.918	5.226	5.216	6.35				
18	2,3,4-Trichlorophenol	27.642	10.6	144544	0.885	0.801	5.298	5.291	6.24				
19	2-Fluorobiphenyl	24.513	-1.9	488532	2.993	3.052	5.290	5.288	7.97				
20	Biphenyl	23.505	-6.0	527356	3.231	3.436	5.406	5.405	7.71				
21	2,6-Dimethylnaphthalene	24.243	-3.0	375819	2.302	2.374	5.593	5.588	5.16				
22	Dimethylphthalate	24.245	-3.0	470765	2.884	2.974	5.777	5.770	4.12				
23	Acenaphthylene	24.357	-2.6	636997	3.902	4.005	5.916	5.911	3.77				
24	Acenaphthene	23.245	-7.0	401510	2.460	2.645	6.125	6.120	8.20				
25	2,3,5-Trimethylnaphthalene	25.829	3.3	352975	2.162	2.093	6.586	6.581	4.72				
26	Diethylphthalate	25.051	0.2	490102	3.002	3.276	6.626	6.622	17.50	0.0036	2.9906		0.9996
27	Fluorene	24.472	-2.1	459608	2.816	2.876	6.741	6.737	4.52				
28	Phenanthrene-d10	40.000	0	970741	1	1	7.821	7.818	0				
29	Azobenzene	24.518	-1.9	347489	0.573	0.584	6.939	6.934	5.66				
30	2,4,6-Tribromophenol	25.284	1.1	108168	0.178	0.176	7.023	7.018	8.38				
31	Hexachlorobenzene	22.596	-9.6	193649	0.319	0.353	7.385	7.379	8.65				
32	Pentachlorophenol	27.589	10.4	114552	0.189	0.171	7.609	7.602	12.76				
33	Phenanthrene	21.607	-13.6	655171	1.080	1.249	7.850	7.843	8.46				
34	Anthracene	22.765	-8.9	664058	1.095	1.202	7.904	7.899	4.61				
35	Carbazole	23.290	-6.8	586187	0.966	1.037	8.086	8.079	2.99				
36	Di-n-butylphthalate	25.859	3.4	752057	1.240	1.198	8.486	8.481	11.71				
37	1-Methylphenanthrene	23.652	-5.4	476455	0.785	0.830	8.519	8.514	3.19				
38	Fluoranthene	24.549	-1.8	695869	1.147	1.168	9.125	9.120	3.41				
39	Pyrene	23.078	-7.7	715520	1.179	1.278	9.361	9.354	3.04				
40	Terphenyl-d14	24.082	-3.7	457518	0.754	0.783	9.528	9.525	3.04				
41	Butylbenzylphthalate	24.029	-3.9	305959	0.504	0.443	10.036	10.032	20.54	-0.0010	0.5264		0.9988
42	Benzo(a)anthracene	24.008	-4.0	650699	1.072	1.333	10.586	10.578	32.28	0.0028	1.1122		0.9999
43	Chrysene	21.791	-12.8	614002	1.012	1.161	10.620	10.613	12.30				
44	bis(2-Ethylhexyl)phthalate	24.234	-3.1	439413	0.724	0.680	10.616	10.612	15.30	-0.0047	0.7549		0.9998
45	Perylene-d12	40.000	0	876270	1	1	11.966	11.957	0				
46	Di-n-octylphthalate	27.244	9.0	728845	1.331	0.960	11.230	11.226	29.91	-0.0033	1.2261		0.9978
47	Benzo(b)fluoranthene	26.486	5.9	627061	1.145	1.081	11.596	11.586	4.32				
48	Benzo(k)fluoranthene	24.784	-0.9	604978	1.105	1.114	11.622	11.612	3.03				
49	Benzo(e)pyrene	25.233	0.9	615067	1.123	1.113	11.856	11.846	5.76				
50	Benzo(a)pyrene	26.038	4.2	584791	1.068	1.025	11.909	11.898	4.57				
51	Perylene	23.843	-4.6	640732	1.170	1.227	11.993	11.980	10.70				
52	Indeno(1,2,3-cd)pyrene	24.940	-0.2	655775	1.197	1.200	13.176	13.152	5.57				
53	Dibenzo(a,h)anthracene	24.818	-0.7	534379	0.976	0.983	13.199	13.171	5.02				
54	Benzo(g,h,i)perylene	23.966	-4.1	510179	0.932	0.972	13.539	13.508	5.84				

Figure 6: TYPICAL INTERNAL STANDARD AND RETENTION TIME SUMMARY SV-1

8B

SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REH072
Instrument ID: TOE7

Project:CLEAN PROJECT
SDG No.: 11F017
Date Analyzed: 05/11/11
Time Analyzed: 15:29

		IS1(DCB) AREA #	RT #	IS2(NPT) AREA #	RT #	IS3(ANT) AREA #	RT #
	12 HOUR STD	238989	2.89	0	0.00	0	0.00
	UPPER LIMIT	477978	3.39	0	0.50	0	0.50
	LOWER LIMIT	119495	2.39	0	-0.50	0	-0.50
	SAMPLE ID						
1	SSTD025	254879	2.89	0	0.00	0	0.00
2	MBLK1S	266877	2.89	0	0.00	0	0.00
3	LCS1S	265949	2.89	0	0.00	0	0.00
4	LCD1S	254835	2.89	0	0.00	0	0.00
5	IR9SB01-2	256778	2.89	0	0.00	0	0.00
6	IR9SB01-2MS	242434	2.89	0	0.00	0	0.00
7	IR9SB01-2MSD	254841	2.89	0	0.00	0	0.00
8	IR9SB01-3	255334	2.89	0	0.00	0	0.00
9	IR9SB02-2	258958	2.89	0	0.00	0	0.00
10	IR9SB02-3	266333	2.89	0	0.00	0	0.00
11	IR9SB01-1	264200	2.89	0	0.00	0	0.00
12	IR9SB02-1	261557	2.89	0	0.00	0	0.00

IS1 (DCB) = 1,4-Dichlorobenzene-d4
IS2 (NPT) = Naphthalene-d8
IS3 (ANT) = Acenaphthene-d10

AREA UPPER LIMIT = +100% of internal satndard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

Figure 6a: TYPICAL INTERNAL STANDARD AND RETENTION TIME SUMMARY SV-2

8C

SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REH072
Instrument ID: TOE7

Project:CLEAN PROJECT
SDG No.: 11F017
Date Analyzed: 05/11/11
Time Analyzed: 15:29

		IS4(PHN) AREA #	RT #	IS5(CRY) AREA #	RT #	IS6(PRY) AREA #	RT #
	12 HOUR STD	851554	7.82	0	0.00	819432	11.96
	UPPER LIMIT	1703108	8.32	0	0.50	1638864	12.46
	LOWER LIMIT	425777	7.32	0	-0.50	409716	11.46
	SAMPLE ID						
1	SSTD025	937174	7.82	0	0.00	859034	11.95
2	MBLK1S	1038693	7.81	0	0.00	878855	11.95
3	LCS1S	992821	7.81	0	0.00	886858	11.95
4	LCD1S	968484	7.82	0	0.00	870884	11.95
5	IR9SB01-2	1005382	7.82	0	0.00	863249	11.95
6	IR9SB01-2MS	901345	7.82	0	0.00	811987	11.95
7	IR9SB01-2MSD	956943	7.81	0	0.00	868837	11.95
8	IR9SB01-3	997058	7.82	0	0.00	870425	11.95
9	IR9SB02-2	998287	7.81	0	0.00	868458	11.95
10	IR9SB02-3	1030872	7.82	0	0.00	890670	11.95
11	IR9SB01-1	836721	7.81	0	0.00	725554	11.95
12	IR9SB02-1	858320	7.82	0	0.00	676217	11.96

IS4 (PHN) = Phenanthrene-d10
IS5 (CRY) = Chrysene-d12
IS6 (PRY) = Perylene-d12

AREA UPPER LIMIT = +100% of internal satndard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

Figure 7: **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

Client : XYZ, INC.	Date Collected: 06/01/11
Project : CLEAN PROJECT	Date Received: 06/02/11
Batch No. : 11F017	Date Extracted: 06/06/11 14:50
Sample ID: IR9SB01-2	Date Analyzed: 06/07/11 14:22
Lab Samp ID: F017-02	Dilution Factor: 1
Lab File ID: RFH040	Matrix : SOIL
Ext Btch ID: SVF005S	% Moisture : 7.2
Calib. Ref.: REH072	Instrument ID : T-OE7

PARAMETERS	RESULTS (ug/kg)	RL (ug/kg)	MDL (ug/kg)
ACENAPHTHENE	ND	11	2.7
ACENAPHTHYLENE	ND	11	2.7
ANTHRACENE	ND	11	2.7
BENZO(A)ANTHRACENE	ND	11	2.7
BENZO(A)PYRENE	ND	11	2.7
BENZO(B)FLUORANTHENE	ND	11	2.7
BENZO(K)FLUORANTHENE	ND	11	2.7
BENZO(G,H,I)PERYLENE	ND	11	2.7
CHRYSENE	ND	11	2.7
DIBENZ(A,H)ANTHRACENE	ND	11	2.7
FLUORANTHENE	ND	11	2.7
FLUORENE	ND	11	2.7
INDENO(1,2,3-CD)PYRENE	ND	11	2.7
NAPHTHALENE	ND	11	2.7
PHENANTHRENE	ND	11	2.7
PYRENE	ND	11	2.7
1,6,7-TRIMETHYLNAPHTHALENE	ND	11	2.7
1-METHYLNAPHTHALENE	ND	11	2.7
1-METHYLPHENANTHRENE	ND	11	2.7
2,6-DIMETHYLNAPHTHALENE	ND	11	2.7
2-METHYLNAPHTHALENE	ND	11	2.7
BENZO(E)PYRENE	3.5J	11	2.7
BIPHENYL	ND	11	2.7
PERYLENE	3.5J	11	2.7

SURROGATE PARAMETERS	RESULTS	SPK_AMT	% RECOVERY	QC LIMIT
TERPHENYL-D14	596	718.4	83.0	30-125
2-FLUOROBIPHENYL	495	718.4	68.9	45-105
NITROBENZENE-D5	480	718.4	66.8	35-100

Figure 8: TYPICAL LCS/LCSD REPORT SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 11F017
METHOD: METHOD 3550B/8270C SIM

MATRIX:	SOIL			% MOISTURE:	NA
DILUTION FACTOR:	1	1	1		
SAMPLE ID:	MBLK1S				
LAB SAMP ID:	SVF005SB	SVF005SL	SVF005SC		
LAB FILE ID:	RFH031	RFH032	RFH033		
DATE EXTRACTED:	06/06/1114:50	06/06/1114:50	06/06/1114:50	DATE COLLECTED:	NA
DATE ANALYZED:	06/07/1111:28	06/07/1111:47	06/07/1112:06	DATE RECEIVED:	06/06/11
PREP. BATCH:	SVF005S	SVF005S	SVF005S		
CALIB. REF:	REH072	REH072	REH072		

ACCESSION:

PARAMETER	BLNK RSLT (ug/kg)	SPIKE AMT (ug/kg)	BS RSLT (ug/kg)	BS % REC	SPIKE AMT (ug/kg)	BSD RSLT (ug/kg)	BSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Acenaphthene	ND	1330	1110	83	1330	1100	82	1	45-110	30
Acenaphthylene	ND	1330	1180	88	1330	1160	87	2	45-105	30
Anthracene	ND	1330	1130	85	1330	1100	82	3	55-105	30
Benzo(a)anthracene	ND	1330	1220	92	1330	1200	90	2	50-110	30
Benzo(a)pyrene	ND	1330	1260	94	1330	1190	89	6	50-110	30
Benzo(b)fluoranthene	ND	1330	1280	96	1330	1240	93	3	45-115	30
Benzo(k)fluoranthene	ND	1330	1360	102	1330	1340	101	1	45-125	30
Benzo(g,h,i)perylene	ND	1330	1210	91	1330	1200	90	1	40-125	30
Chrysene	ND	1330	1160	87	1330	1140	86	2	55-110	20
Dibenz(a,h)anthracene	ND	1330	1220	92	1330	1210	91	1	40-125	30
Fluoranthene	ND	1330	1250	94	1330	1220	92	2	55-115	30
Fluorene	ND	1330	1190	89	1330	1170	88	1	50-110	30
Indeno(1,2,3-cd)pyrene	ND	1330	1220	91	1330	1210	91	1	40-120	30
Naphthalene	ND	1330	1020	76	1330	1010	76	1	40-105	30
Phenanthrene	ND	1330	1100	83	1330	1080	81	2	50-110	30
Pyrene	ND	1330	1210	91	1330	1180	89	2	45-125	30
1,6,7-Trimethylnaphthalene	ND	1330	1290	96	1330	1300	97	1	40-150	30
1-Methylnaphthalene	ND	1330	1060	79	1330	1040	78	2	40-150	30
1-Methylphenanthrene	ND	1330	1200	90	1330	1190	89	0	40-150	30
2,6-Dimethylnaphthalene	ND	1330	1140	86	1330	1160	87	1	40-150	30
2-Methylnaphthalene	ND	1330	1160	87	1330	1140	86	1	45-105	30
Benzo(e)pyrene	ND	1330	1290	96	1330	1290	97	1	40-150	30
Biphenyl	ND	1330	1130	85	1330	1130	85	0	40-150	30
Perylene	ND	1330	1210	90	1330	1210	91	1	40-150	30

SURROGATE PARAMETER	SPIKE AMT (ug/kg)	BS RSLT (ug/kg)	BS % REC	SPIKE AMT (ug/kg)	BSD RSLT (ug/kg)	BSD % REC	QC LIMIT (%)
Terphenyl-d14	667	618	93	667	651	98	30-125
2-Fluorobiphenyl	667	508	76	667	540	81	45-105
Nitrobenzene-d5	667	494	74	667	529	79	35-100

Figure 9: TYPICAL MS/MSD REPORT SUMMARY

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
BATCH NO.: 11F017
METHOD: METHOD 3550B/8270C SIM

MATRIX: SOIL % MOISTURE: 7.2

DILUTION FACTOR:	1	1	1
SAMPLE ID:	IR9SB01-2		
LAB SAMP ID:	F017-02	F017-02M	F017-02S
LAB FILE ID:	RFH040	RFH036	RFH037
DATE EXTRACTED:	06/06/1114:50	06/06/1114:50	06/06/1114:50
DATE ANALYZED:	06/07/1114:22	06/07/1113:03	06/07/1113:22
PREP. BATCH:	SVF005S	SVF005S	SVF005S
CALIB. REF:	REH072	REH072	REH072

DATE COLLECTED: 06/01/11
DATE RECEIVED: 06/02/11

ACCESSION:

PARAMETER	SMPL RSLT (ug/kg)	SPIKE AMT (ug/kg)	MS RSLT (ug/kg)	MS % REC	SPIKE AMT (ug/kg)	MSD RSLT (ug/kg)	MSD % REC	RPD (%)	QC LIMIT (%)	MAX RPD (%)
Acenaphthene	ND	1440	1210	84	1440	1010	70	18	45-110	30
Acenaphthylene	ND	1440	1270	89	1440	1060	74	18	45-105	30
Anthracene	ND	1440	1240	87	1440	1050	73	17	55-105	30
Benzo(a)anthracene	ND	1440	1350	94	1440	1140	79	17	50-110	30
Benzo(a)pyrene	ND	1440	1380	96	1440	1170	81	17	50-110	30
Benzo(b)fluoranthene	ND	1440	1460	102	1440	1210	84	18	45-115	30
Benzo(k)fluoranthene	ND	1440	1470	102	1440	1270	88	15	45-125	30
Benzo(g,h,i)perylene	ND	1440	1360	95	1440	1160	81	16	40-125	30
Chrysene	ND	1440	1280	89	1440	1080	75	17	55-110	30
Dibenz(a,h)anthracene	ND	1440	1380	96	1440	1180	82	16	40-125	30
Fluoranthene	ND	1440	1390	96	1440	1170	82	17	55-115	30
Fluorene	ND	1440	1320	92	1440	1110	77	17	50-110	30
Indeno(1,2,3-cd)pyrene	ND	1440	1380	96	1440	1180	82	16	40-120	30
Naphthalene	ND	1440	1010	70	1440	839	58	19	40-105	30
Phenanthrene	ND	1440	1240	86	1440	1040	72	17	50-110	30
Pyrene	ND	1440	1340	93	1440	1130	79	17	45-125	30
1,6,7-Trimethylnaphthalene	ND	1440	1340	93	1440	1160	81	14	40-150	30
1-Methylnaphthalene	ND	1440	1100	77	1440	912	63	19	40-150	30
1-Methylphenanthrene	ND	1440	1250	87	1440	1110	77	12	40-150	30
2,6-Dimethylnaphthalene	ND	1440	1160	81	1440	993	69	15	40-150	30
2-Methylnaphthalene	ND	1440	1190	83	1440	990	69	19	45-105	30
Benzo(e)pyrene	3.55J	1440	1350	94	1440	1190	83	12	40-150	30
Biphenyl	ND	1440	1200	83	1440	1010	71	17	40-150	30
Perylene	3.52J	1440	1260	88	1440	1110	77	12	40-150	30

SURROGATE PARAMETER	SPIKE AMT (ug/kg)	MS RSLT (ug/kg)	MS % REC	SPIKE AMT (ug/kg)	MSD RSLT (ug/kg)	MSD % REC	QC LIMIT (%)
Terphenyl-d14	718	749	104	718	648	90	30-125
2-Fluorobiphenyl	718	582	81	718	497	69	45-105
Nitrobenzene-d5	718	548	76	718	469	65	35-100

Figure 10: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 11F017

METHOD 3550B/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

A total of six (6) soil samples were received on 06/02/11 for PAH BY 8270C SIM analysis, Method 3550B/8270C SIM in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios were evaluated and results were within acceptance criteria. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for SVF005SL/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for F017-02M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameters.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1st Rvw	2nd Rvw
DFTPP Tune Check	Prior to calibration (ICAL, ICV or CCV)	Refer to criteria listed in the method description (Table 4)	Retune instrument and verify		
Breakdown Check	Prior to calibration (ICAL, ICV or CCV)	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Clean the injection port and repeat breakdown check. If problem persist cut or replace column.		
ICAL: Multi-point calibration for all analytes	Initially; as needed	Min. RF: Refer to Table 6 %RSD ≤ 20% 1) for analytes with RSD ≤ 20% use RRFm 2) for analytes with RSD > 20% and r ≥ 0.990 use either inverse weighting factor or linear least squares with minimum of 6 ICAL points	Rule out outlier(s)/ bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
ICV: Second-source calibration verification	After initial calibration	Min. RF: Refer to Table 6 All analytes within ± 30% of expected value	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
DCC: Calibration Check	Daily, before sample analysis and every 12 hours of analysis time	Min. RF: Refer to Table 6 All analytes ≤ 20% diff.	Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL		
Retention time window calculated for each analyte	Each sample	Relative retention time (RRT) of the analyte within ± 0.06 RRT units of the RRT	Correct the problem then reanalyze all samples analyzed since the last retention time check		
Internal Standard	Every sample, spiked sample, standard, and method blank	Retention time ± 30 seconds from retention time of the mid-point std. In the ICAL. EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		
Method blank	One per preparation batch (≤ 20 samples per matrix)	In the absence of PSR apply No analytes detected > ½ LOQ	Rule out instrument contamination by re-analyzing the MB. If problem persist refer to PSR. In the absence of PSR, report NDs and results > 10X of the MB concentration. Otherwise, cure contamination source, re-prep and re-analyze method blank and all associated samples.		
LCS	One LCS per preparation (≤ 20 samples per matrix)	In the absence of PSR default to EMAX QC Limits	Cure probable source of LCS failure, re-prep and reanalyze the LCS and all associated samples		
MS/MSD	One MS/MSD per every 20 project samples per matrix	In the absence of PSR default to EMAX QC Limits	Ensure that spike concentration and spike addition was accurate. If chromatogram exhibits matrix interference narrate observation in the case narrative.		
Surrogate spike	Every sample, spiked sample, standard, and method blank	In the absence of PSR default to EMAX QC Limits.	If non-compliant and no apparent matrix interference is observed, re-extract and analyze sample. Otherwise inform the client for further instruction.		
Comments: Project specific requirements (PSR) supersede EMAX QCP. In the absence of PSR, apply "J" flag to results between LOD and LOQ, "B" flag to results associated with MB contamination.			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 3550C / SW 8270SIM

Sample Prep SOP: EMAX-3550
Analytical SOP: EMAX-8270SIM
Conc Unit: µg/Kg
Sample Amt(gm): 30
Extract Volume (mL): 2

Instrument ID: E7
Extraction date: 6/6/11 & 6/9/11
Extracted by: J. Villena
Analysis date: 6/7/11 & 6/9/11
Analyzed by: D. Cheung

PARAMETER	RFH032	RFH033	RFH104	RFH105	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SVF005SL	SVF005SC	SVF012SL	SVF012SC							
Acenaphthene	1112	1100	1192	1126	1333	1132	85	41.0	4	40 - 130	PASSED
Acenaphthylene	1176	1156	1260	1184	1333	1194	90	45.5	4	50 - 130	PASSED
Anthracene	1135	1100	1208	1144	1333	1147	86	45.1	4	50 - 130	PASSED
Azobenzene	1200	1164	1324	1230	1333	1229	92	68.5	6	50 - 150	PASSED
Benzo(a)anthracene	1222	1200	1285	1369	1333	1269	95	75.8	6	50 - 130	PASSED
Benzo(a)pyrene	1258	1190	1356	1281	1333	1271	95	68.4	5	60 - 130	PASSED
Benzo(e)pyrene	1286	1294	1362	1309	1333	1313	98	34.5	3	60 - 130	PASSED
Benzo(b)fluoranthene	1275	1242	1437	1346	1333	1325	99	86.3	7	60 - 140	PASSED
Benzo(k)fluoranthene	1359	1344	1387	1270	1333	1340	100	49.9	4	60 - 140	PASSED
Benzo(g,h,i)perylene	1209	1197	1315	1279	1333	1250	94	56.5	5	60 - 130	PASSED
Bis(2-chloroethyl)ether	959	942	1024	971	1333	974	73	35.5	4	40 - 130	PASSED
Biphenyl	1129	1128	1207	1191	1333	1164	87	41.2	4	50 - 150	PASSED
Bis(2-Ethylhexyl)phthalate	1104	1083	1297	1347	1333	1208	91	133.8	11	50 - 150	PASSED
Butylbenzylphthalate	1084	1064	1283	1325	1333	1189	89	134.2	11	50 - 150	PASSED
Carbazole	1201	1179	1281	1268	1333	1232	92	49.8	4	70 - 130	PASSED
4-Chloro-3-methylphenol	1232	1220	1352	1267	1333	1268	95	59.7	5	40 - 130	PASSED
2-Chlorophenol	1036	1021	1100	1049	1333	1051	79	34.1	3	40 - 130	PASSED
Chrysene	1159	1141	1186	1265	1333	1188	89	54.5	5	50 - 140	PASSED
Dibenzo(a,h)anthracene	1221	1208	1364	1323	1333	1279	96	76.2	6	60 - 130	PASSED
2,4-Dichlorophenol	1156	1149	1235	1178	1333	1179	88	38.9	3	50 - 130	PASSED
Diethylphthalate	1252	1239	1363	1266	1333	1280	96	56.4	4	50 - 150	PASSED
2,6-Dimethylnaphthalene	1145	1159	1214	1181	1333	1175	88	30.1	3	50 - 130	PASSED
2,4-Dimethylphenol	1165	1146	1254	1194	1333	1190	89	47.2	4	50 - 130	PASSED
Dimethylphthalate	1202	1179	1294	1204	1333	1220	91	50.7	4	50 - 150	PASSED
Di-n-butylphthalate	1232	1204	1397	1363	1333	1299	97	95.2	7	50 - 150	PASSED
Di-n-octylphthalate	1098	1071	1401	1240	1333	1202	90	151.7	13	50 - 150	PASSED
Fluoranthene	1252	1223	1318	1314	1333	1277	96	46.8	4	60 - 140	PASSED
Fluorene	1186	1170	1270	1196	1333	1206	90	44.5	4	50 - 130	PASSED
Hexachlorobenzene	1219	1186	1288	1211	1333	1226	92	43.8	4	50 - 130	PASSED
Indeno(1,2,3-cd)pyrene	1220	1208	1368	1328	1333	1281	96	79.5	6	60 - 130	PASSED
1-Methylnaphthalene	1059	1042	1123	1066	1333	1072	80	34.9	3	50 - 130	PASSED
2-Methylnaphthalene	1158	1142	1229	1166	1333	1174	88	38.1	3	50 - 130	PASSED
1-Methylphenanthrene	1198	1193	1252	1242	1333	1221	92	30.1	2	70 - 130	PASSED
Naphthalene	1019	1009	1076	1024	1333	1032	77	30.2	3	50 - 130	PASSED
N-Nitrosodimethylamine	1054	1019	1103	1057	1333	1058	79	34.3	3	50 - 150	PASSED
N-Nitroso-di-n-propylamine	1113	1097	1228	1157	1333	1149	86	58.5	5	40 - 130	PASSED
Perylene	1206	1214	1155	1114	1333	1172	88	46.8	4	60 - 130	PASSED
Phenanthrene	1104	1080	1171	1112	1333	1117	84	38.3	3	50 - 130	PASSED
Pyrene	1207	1183	1261	1266	1333	1229	92	41.1	3	50 - 130	PASSED
Pentachlorophenol	1139	1131	1209	1184	1333	1166	87	37.2	3	50 - 150	PASSED
Phenol	1006	988	1077	1038	1333	1027	77	39.0	4	40 - 130	PASSED

Appendix 2 (cont.): DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
METHOD: SW 3550C / SW 8270SIM

Sample Prep SOP: EMAX-3550
Analytical SOP: EMAX-8270SIM
Conc Unit: µg/Kg
Sample Amt(gm): 30
Extract Volume (mL): 2

Instrument ID: E7
Extraction date: 6/6/11 & 6/9/11
Extracted by: J. Villena
Analysis date: 6/7/11 & 6/9/11
Analyzed by: D. Cheung

PARAMETER	RFH032	RFH033	RFH104	RFH105	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	SVF005SL	SVF005SC	SVF012SL	SVF012SC							
2,4,6-Trichlorophenol	1288	1278	1391	1309	1333	1317	99	51.4	4	50 - 130	PASSED
2,4,5-Trichlorophenol	1303	1289	1360	1288	1333	1315	99	43.8	3	50 - 130	PASSED
2,3,5-Trimethylnaphthalene	1287	1295	1373	1326	1333	1320	99	39.2	3	50 - 150	PASSED
2-Fluorophenol	1408	1483	1526	1514	2000	1483	74	53.3	4	30 - 130	PASSED
Phenol-d5	1459	1543	1606	1611	2000	1555	78	70.6	5	30 - 130	PASSED
Nitrobenzene-d5	494	529	545	541	667	527	79	23.2	4	40 - 130	PASSED
2-Fluorobiphenyl	508	540	547	542	667	534	80	17.5	3	40 - 130	PASSED
2,4,6-Tribromophenol	1832	1910	1988	1933	2000	1915	96	64.8	3	50 - 130	PASSED
Terphenyl-d14	619	651	657	694	667	655	98	30.8	5	50 - 130	PASSED

8270SIMFS: SAMPLE PREPARATION LOG

EMAX LABORATORIES, INC.

EXTRACTION LOG *for* SEMIVOLATILES

Page 1

SOP	Rev. #
☐ EMAX-3510	
☐ EMAX-3520	
☐ EMAX-3540	
☐ EMAX-3550	
☐ EMAX-3580	
☐ EMAX-CLP-SVOA	
☐ EMAX-	

Note: For samples and relevant QCs/Standards extracted, refer to attached extraction sequence.

Comments:

Lab Sample ID	Sonicator #	Concentrator # (35°C)

Book #: ESV-062

Preparation Batch:

Matrix:

Micropipette ID:

Micropipette ID:

Standards	ID	Amount Added (ml)
Surrogate		
LCS/MS		
LCS/MS		

Reagent	Lot# / ID
CH_2Cl_2	
Na_2SO_4	
H_2SO_4	
NaOH	
Silica Sand	
Silica Gel	

TUNING

Sonicator #	Reading

Concentrator	Water Bath Temperature Setting (°C)	Thermometer Reading (°C)
1		
2		
3		
4		
5		
6		

Thermometer ID = T_1

Prepared By: Witnessed By:

Standard Added By: Checked By:

Extract Received By: Location:

Disposed By: Disposed On:

8270SIMFA: **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

Page 1

ANALYSIS LOG FOR SEMIVOLATILES

SOP ☐ EMAX-8270 Rev. No. __ ☐ EMAX-8270SIM Rev. No. __ ☐ EMAX-CLPSVOA ☐ EMAX-M8270SIM Rev. No. __ ☐ EMAX-625 Rev. No. __ ☐ Book #AE7 -006

Method File: Tune File: Start Date/Time: End Date/Time:

ANALYTICAL BATCH : _____

Preparative Batch	Data File Name	Run ID	DF	Matrix		Notes
				S	W	

Instrument No:	E7
INITIAL CALIBRATION REFERENCE	
Date	
ICAL ID	

Standards		
Name	ID	Conc. (mg/L)
DFTPP		
INT. STD.		
ICV		
DCC		
BENZIDINE		
APP 9		
APP 9 ADD		

Solvent	ID	
CH_2Cl_2		

DATA FILE	

Electronic Data Archival	
Location	Date
HPCHEM_SVOA/TOE7	

Comments: _____

Analyzed By: _____

Date Disposed: _____

Disposed By: _____

This page is checked during data review.

8270SIMFM: INSTRUMENT MAINTENANCE LOG

EMAX LABORATORIES, INC.

Page 1

INSTRUMENT MAINTENANCE LOG

Instrument No: E7 Month: Year: 201_ Book #: ME7 -003

Date							
Column Head Pressure: 70 - 100 (KPa)							
Run Instrument Blank							
Column Temperature							
Autosampler							
Calibration curve updated							
Verify computer date & clock							
Check printer paper							
Change Septa							
Clean Linear							
Analyst Initial							
TroubleShooting							
Problems Encountered							
Return to Control (Analyst Initial)							

Code	Problems Encountered	Code	Corrective Action

SOP REVIEW FORM

EMAX-2340C	Rev. 3	HARDNESS, TOTAL
SOP No.	Revision Number	Title

Document the review process and comment. Check the "NA" box if it is not applicable to the SOP, check the "Yes" box if you have fully understood the section, check "No" if you have any questions or if there are discrepancies with the current practice. Discuss the issue with the mentor/supervisor. If you need more space use the allocated space below or attach additional page.

SECTION	Yes	No	NA	COMMENTS
Scope & Application	✓			
Summary of Method	✓			
Detection Limits	✓			
Dynamic Range	✓			
Sample Holding Time & Preservation	✓			
Associated SOPs	✓			
Safety	✓			I have read all MSDS listed in this SOP
Instruments, Chemicals & Reagents	✓			
Standards	✓			
Procedures	✓			
- Sample Preparation	✓			
- Instrument Parameters	✓			
- Standardization	✓			
- Analysis	✓			
- Calculations	✓			
- Data Reduction	✓			
- Report Generation	✓			
- Data Review	✓			
Quality Control	✓			
Corrective Action	✓			
Pollution Prevention	✓			
Waste Management	✓			
Supplementary Notes	✓			
References	✓			
Appendices	✓			

This is to acknowledge that I have read, understood and agree to perform the procedures set forth in this SOP. Print your name & affix your signature.

Reviewed By Mary Jane Mendoza [signature] Date: 6/12/14

STANDARD OPERATING PROCEDURE

HARDNESS, TOTAL

SOP No.:	EMAX-2340C	Revision No.	3	Effective Date:	23-Apr-12
Prepared By:	Mary Jane Mendoza			Date:	04.18.12
Approved By:	Kenette Pimentel QA Manager			Date:	04.18.12
Approved By:	Caspar Pang Laboratory Director			Date:	4/18/2012

Control Number: 2340C-03

1.0 SCOPE AND APPLICATION

1.1. This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes. It is suitable for all concentration ranges of hardness. This method is an adaptation of Method 2340C, Standard Methods for the Examination of Water and Wastewater, 18th Edition.

2.0 SUMMARY OF METHOD

2.1. Calcium and magnesium ions in the sample are sequestered upon the addition of disodium ethylenediamine tetraacetate (Na_2EDTA). The end point of the reaction is detected by means of Eriochrome Black T indicator, which has a red color in the presence of calcium and magnesium and a blue color when the cations are sequestered.

2.2. **Interferences**

2.2.1. Excessive amounts of heavy metals can interfere. This is usually overcome by complexing metal ions with cyanide.

2.2.1.1. Routine addition of sodium cyanide solution to prevent potential metallic interference is recommended.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD)**

3.1.1. DL and LOD are not applicable for this method.

3.2. **Limit of Quantitation (LOQ)**

3.2.1. Refer to EMAX-QA04 for generation, validation and verification of LOQ.

3.2.2. Established LOQ for this method is 10 mg/L.

4.0 DYNAMIC RANGE

4.1. 10 mg/L – 600 mg/L

4.2. The highest quantifiable range requiring no dilution is equal to the concentration of the sample titrated with < 15 ml of titrant within 5 minute of titration. All samples analyzed above this range are considered "over range" and requires a larger volume of sample for proper quantitation.

4.3. The lowest quantifiable range on a given sample amount is equal to a concentration above reporting limit. All samples analyzed lower than the standard sample amount (25 ml) whose concentration is ≤ LOQ are considered as "under range" and requires a higher sample amount for proper quantitation.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. Analyze samples within six months.

5.2. **Preservation**

5.2.1. Preserve the samples received with HNO_3 to pH < 2 to prevent degradation.

5.2.2. Store samples at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA04 Detection Limit (DL)

6.3. EMAX-QA05 Training

6.4. EMAX-QA08 Corrective Action

6.5. EMAX-QC01 Quality Control for Chemicals

6.6. EMAX-QC02 Analytical Standard Preparation

6.7. EMAX-QC07 Glassware Cleaning

6.8. EMAX-SM03 Waste Disposal

6.9. EMAX-SM04 Analytical and QC Labeling

7.0 SAFETY

7.1. Read all MSDS for chemicals listed in this SOP.

Caution: Sodium Cyanide (NaCN) is extremely poisonous.

7.2. Perform all reagent preparations under a properly operating fume hood.

7.3. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves, at all times when performing this procedure.

7.4. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. Titration apparatus ± 10 calibration

8.1.2. Magnetic stirrer

8.1.3. Micropipettes

8.1.4. Volumetric flasks

8.1.5. Erlenmeyer flasks

8.2. **Chemicals and Reagents**

8.2.1. All reagents are reagent grade or better.

8.2.2. Buffer Solution

8.2.2.1. Purchase commercially available "odorless buffers" or prepare buffer solutions as described below:

Magnesium EDTA	Dissolve 16.9 g NH_4Cl in 143 ml concentrated NH_4OH in a 250 ml volumetric flask, add 1.25 g of magnesium salt in EDTA and dilute to the mark with reagent water.
Disodium EDTA	Dissolve 1.179 g disodium EDTA (analytical reagent grade) and 780 mg $MgSO_4 \bullet 7\ H_2O$ in 50 ml reagent water. Add this solution to a 250 ml volumetric flask containing 16.9 g NH_4Cl and 143 ml concentrated NH_4OH with mixing and dilute to the mark with reagent water.

8.2.2.2. Store in a tightly stoppered plastic bottle. This solution is stable for one month. Discard when 1 or 2 ml added to sample fails to produce a pH of 10.0 ± 0.1 at end point of titration.

8.2.3. Inhibitors

8.2.3.1. For most waters inhibitors are not necessary. If interfering ions are present use one of the following:

Inhibitor I	NaCN powder. Basify solutions or sample containing this and place in CN waste container. Make sure no acids are present which might liberate HCN gas.
Inhibitor II	Dissolve 5.0 g $Na_2S \bullet 9H_2O$ or 3.7 g $Na_2S \bullet 5H_2O$ in 100 ml reagent water. Exclude air with tightly fitted rubber stopper. This gives sulfide precipitates, which may obscure the end point if large quantities of heavy metals are present. This deteriorates rapidly through air oxidation.
Inhibitor III	Dissolve 4.5 g hydroxylamine hydrochloride in 100 ml of 95% ethanol or isopropanol.

8.2.4. Indicator

8.2.4.1. Use a commercially available indicator or one of the formulations described below:

Eriochrome Black T	Mix 0.5 g Eriochrome Black T with 4.5 g hydroxylamine hydrochloride. Dissolve in 100 ml of 95% ethanol or isopropanol. Or Dissolve 0.5 to 1.0(g) Eriochrome Black T in an appropriate solvent such as triethanolamine or 2-methoxyethanol. This solution is stable approximately one week. Or Mix together 0.5 g Eriochrome Black T and 100 g NaCl.
Methyl red indicator	Dissolve 0.10 g methyl red in reagent water in 100 ml volumetric flask and dilute to mark.
Hydrochloric acid solution 1+1	Using a clean 500 ml flask, measure and transfer 100 ml of reagent water. Slowly add 100 ml of concentrated HCL while swirling the flask to obtain adequate mixing

8.2.5. Ammonium hydroxide solution, 3 N: Dilute 210 ml of concentrated NH_4OH to 1 L with reagent water.

8.2.6. Ammonium hydroxide solution, 1 N: Dilute 70 ml of concentrated NH_4OH to 1 L with reagent water.

9.0 STANDARDS

9.1. Purchase all standards/titrants as certified solutions as listed below:

STANDARD	SOURCE	CONCENTRATION
EDTA Solution	VWR or equivalent	0.02N (0.01M)
LCS	Wibby or equivalent	Based on Certified Concentration

9.2. Refer to EMAX-QC02 for proper preparation of analytical standards.

9.3. Store standards at room temperature.

9.4. Alternately, you may prepare the above solution as follows:

9.4.1. Standard EDTA titrant at 0.02N

9.4.1.1. Place 3.723 g analytical reagent grade disodium EDTA dehydrate ($Na_2H_2C_{10}H_{12}O_8N_2 \bullet 2H_2O$) in a 1000 ml volumetric flask and dilute to the mark with reagent water.

9.4.2. Standard Calcium Carbonate Solution at 0.02 N

9.4.2.1. Place 1.000 g anhydrous calcium carbonate (primary standard low in metals) in a 500 ml flask. Add droplets of 1+1 HCl until all of the $CaCO_3$ has dissolved.

9.4.2.2. Add 200 ml reagent water. Boil for a few minutes to expel CO_2. Allow solution to cool down.

9.4.2.3. Add a few drops of methyl red indicator and adjust to intermediate orange color by adding 3N NH_4OH or 1+1 HCl as required.

9.4.2.4. Quantitatively transfer to a 1000 ml volumetric flask and dilute to mark with reagent water.

10.0 PROCEDURES

10.1. Sample Preparation

10.1.1. Allow the samples to equilibrate with room temperature.

10.1.2. Prepare the analytical batch not to exceed 20 field samples with a sample duplicate, Method Blank (MB) and Lab Control Sample (LCS).

10.1.3. Measure 25 ml of sample in titration vessels. Use reagent water for MB and use LCS standard for LCS. Samples are now ready for titration.

10.1.4. For wastewater and highly polluted waters, the sample(s) must be digested. Refer to EMAX-3010 SOP for details.

10.2. Instrument Parameters

10.2.1. Burette used for titration should read a 0.10 graduation.

10.3. Standardization

10.3.1. When titrant is prepared in-house, perform three replicate standardization of standard titrant, 0.02N EDTA against 0.02 N $CaCO_3$ solution prior to sample analysis.

10.4. Analysis

10.4.1. Titration

10.4.1.1. Conduct titrations at or near normal room temperature. Note that the color change becomes impractically slow as the sample approaches freezing temperature. Indicator decomposition becomes a problem in hot water.

10.4.1.2. Neutralize the prepared sample with 1N ammonium hydroxide and dilute to about 50 ml with reagent water.

10.4.1.3. Set the timer to alarm after 5 minutes.

10.4.1.4. Add 1 to 2 ml buffer solution. This amount is usually sufficient to give a pH of 10.0 to 10.1.

10.4.1.5. Turn on the timer.

10.4.1.6. Add 1 to 2 drops indicator solution or one scoop of dry indicator. Expect the solution to turn to reddish pink.

10.4.1.7. Using EDTA titrant, titrate slowly with continuous stirring until the color changes to distinct blue. If color is not distinct blue, e.g. purple or reddish

violet, add inhibitor. If titration end point is reached the solution will turn to distinct blue. This color transition determines the end point.

10.4.1.8. If any of the conditions occur the sample is considered to be "over-ranged", lower the sample amount and repeat the process. [*Note that sample result is expected to be > LOQ, otherwise sample amount is insufficient.*]

- The color does not turn to distinct blue after addition of inhibitor.
- If titrant amount is more than the volume of EDTA used in the standardization.
- If titration is more than 5 minutes after addition of buffer.

Note: Sample result is expected to be > LOQ otherwise, sample amount is insufficient.

10.4.2. Sample Result Evaluation

10.4.2.1. Check the QC data as soon as available.

- ✓ Check the method blank and make sure that it meets the project requirement.
- ✓ Check the LCS and make sure it meets the recovery limit.
- ✓ Check the sample duplicate(s) that it meets the acceptance criteria or note possible matrix interference on the run log.
- ✓ Check that all samples are analyzed within the dynamic range.

10.5. **Calculations**

10.5.1. Standardization

$$E_c = \frac{(C_c)(C_v)}{E_v} \qquad \text{Eq.-10.5.1}$$

where:

E_c – molarity of EDTA titrant

E_v – volume of EDTA titrant

C_c – molarity of calcium carbonate

C_v – volume of calcium carbonate in ml

Calculate the average of the triplicate measurements

$$E = \frac{\sum E_c}{n} \qquad \text{Eq.-10.5.1a}$$

where:

E – average molarity of EDTA titrant

ΣE_c – summation of molarity of EDTA titrant

N – number of measurements

10.5.2. Calculate for Sample Result

$$H = \frac{(T)(E)50000}{S}$$ Eq.-10.5.2

where:

H – hardness as $CaCO_3$ (mg/L)

T – Titrant volume in ml

E – average EDTA concentration in N

S – sample amount (ml)

10.5.3. Percent Recovery

$$\%\,Recovery = \frac{C_f - C}{C_s} \times 100$$ Eq.-10.5.4

where:

C_f – Concentration Found

C – Concentration of sample (use 0 for LCS)

C_s – Concentration of spike

10.5.4. Calculate for Precision

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$ Eq.-10.5.3

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Print a copy of the run log.

10.6.2. Highlight reportable results for data processing.

10.7. **Report Generation**

10.7.1. Generate the method .txt file using WDBN.exe.

10.7.2. Generate the sample results using MSRB6.exe.

10.7.3. Generate the QC summary using JOQN.exe.

10.7.4. Generate the case narrative using CN2.exe.

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below:

10.8.1.1. Case Narrative

10.8.1.2. Sample Results

10.8.1.3. LCS/LCSD Summary

10.8.1.4. Sample Duplicate Result Summary

10.8.1.5. Raw Data

10.8.1.6. Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01and the PSR.

- Check that MB is compliant to PSR.
- Check LCS/LCSD recoveries against project specific criteria (PSR). In the absence of the PSR, default to in-house QC limits.
- Check concentration of sample results that all are written dynamic range.
- If any of the above check point is non-compliant, re-analysis is required.
- Check the generated reports against the run log. Check that the analytical data generated indicating positive results are qualitatively and quantitatively correct.
- Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analytical folder for secondary review.

11.0 QUALITY CONTROL

11.1. **Sample Preparation QC**

11.1.1. 20 is the maximum number of original field samples in an analytical batch unless otherwise specified by the project.

11.1.2. Properly treat all lab wares used in the sample preparation as specified in EMAX-QC07.

11.2. **Sample Analysis QC**

11.2.1. Prepare method blank and LCS in every analytical batch, unless otherwise specified by the project.

11.2.2. Prepare a sample duplicate at the frequency specified by the project.

11.2.3. Acceptance criteria, is summarized in Appendix 1.

11.3. **Method QC**

11.3.1. Method proficiency must be established before the analytical procedure can be used.

11.3.2. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05.

12.0 CORRECTIVE ACTION

12.1. Corrective action for each Quality Control Procedure is summarized in Appendix 1.

12.2. **Sample Preparation QC**

12.2.1. For insufficient amount of sample(s), inform the supervisor immediately.

12.2.2. When method blank is non-compliant, investigate the source of the problem and institute resolution to correct, minimize or eliminate the problem.

12.3. **Sample Analysis QC**

12.3.1. If LCS is non-compliant, investigate the source of the problem to institute resolution to correct the problem.

12.3.2. If sample duplicate is non-compliant, check PSR and discuss in case narrative.

12.4. A Non-Conformance Report (NCR) is required when the following circumstances occur.

- Anomalies other than specified in Appendix 1, is observed.
- Sample is out of technical holding time.

12.4.1. Refer to EMAX-QA08 for NCR details.

13.0 POLLUTION PREVENTION

13.1. NaCN is extremely poisonous. Observe all necessary precautions to avoid spillage of reagents that may go to the wastewater drains.

13.2. Prepare all standards in the fume hood.

14.0 WASTE MANAGEMENT

14.1. No samples maybe dumped on the laboratory sink.

14.2. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1. **Preparation Batch** - is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2. **Analytical batch** - is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Limit of Quantitation (LOQ) - is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.1.3. Material Safety Data Sheet (MSDS) – is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.4. Buffered solutions or buffers - Are solutions which resist a change in pH when small amounts of acid or base are added.

15.1.5. Total Hardness – is the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate, in milligrams per liter.

15.1.6. Indicators – A certain chemical has a special property that changes its color at different pH levels. When a few drops of indicator are added to a solution, the color of the solution serves as an indication of its pH.

15.1.7. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.8. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.9. Matrix – A component or form of a sample.

15.1.10. Method Blank (MB) – A target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.11. Reagent Water – Purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.12. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.13. Sample Duplicate – A replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.14. Sub-sample – An aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.15. Titration – A procedure for carrying out a chemical reaction between two solutions by the controlled addition of a solution of known concentration called titrant into an unknown.

Reaching a certain pH either measured by pH meter or a color change completes the reaction.

15.1.16. Reagent Water – Purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.3. **Application of EMAX QC Procedures**

15.3.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing Total Hardness. In instances where there is a project or program QAPP, the requirements given in the project takes precedence over this SOP.

15.4. **Department of Defense (DoD) Projects**

15.4.1. Samples from DoD sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, is applied.

15.5. **Department of Energy (DoE) Projects**

15.5.1. Samples from DoE sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, is applied.

16.0 REFERENCES

16.1. Standard Methods For the Examination Of Water and Wastewater, 18th Edition, 1992

16.2. EPA Test Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-20, March 1983

16.3. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. **Figures**

17.1.1. Figure 1 Typical Raw Data

17.1.2. Figure 2 Typical Sample Result

17.1.3. Figure 3 Typical LCS/LCSD Summary

17.1.4. Figure 4 Typical Sample Duplicate Result Summary

17.1.5. Figure 5 Typical Case Narrative

17.2. **Appendices**

17.2.1. Appendix 1 Summary of Quality Control Procedures

17.2.2. Appendix 2 Demonstration of Capability

17.3. **Forms**

17.3.1. 2340CFA Analytical Run Log

Figure 1: **TYPICAL RAW DATA**

EMAX LABORATORIES, INC.

11THF002.xls

ANALYSIS FOR HARDNESS

Page: 66
Book #: ATH-005
SOP: EMAX-130.2
Analytical Batch: THF002

Data File Name	Lab Sample ID	Sample, S (ml)	Titrant, T (ml)	Analysis Date mm:dd:yy	Analysis Time hh:mm:ss	HARDNESS	RESULT	UNIT	FLAG
THF002-01	THF002WB	25	0.05	06/22/11	16:13:57	1.94	ND	mg/L	
THF002-02	THF002WL	25	6.5	06/22/11	16:28:12	252.2	252	mg/L	
THF002-03	THF002WC	25	6.6	06/22/11	16:44:31	256.08	256	mg/L	
THF002-04	F169-01	10	5	06/22/11	17:02:00	485	485	mg/L	
THF002-05	F169-01D	10	5.1	06/22/11	17:11:47	494.7	495	mg/L	
THF002-06	F169-02	10	2.5	06/22/11	17:18:07	242.5	243	mg/L	
THF002-07	F169-03	10	2.4	06/22/11	17:24:41	232.8	233	mg/L	
THF002-08	F169-04	10	5.4	06/22/11	17:34:27	523.8	524	mg/L	
THF002-09	F169-06	10	6	06/22/11	17:44:10	582	582	mg/L	
THF002-10	F169-08	10	3.6	06/22/11	17:49:42	349.2	349	mg/L	
THF002-11	F169-09	10	6.4	06/22/11	17:58:38	620.8	621	mg/L	

MISCELLANEOUS INFORMATION		
Standard	Concentration	
Titrant, EDTA, E*	0.0097	*M*
LCS	264	*mg/L*
MDL	10	*mg/L*
RL	10	*mg/L*

QC REQUIREMENT	% Recovery/RPD
LCS	80 - 120
DUPLICATE	< 20

QC CHECK	Result	%R/RPD	Comments
THF002WB	1.94	19%	Passed
THF002WL	252.2	96%	Passed
F169-01	485	2%	Passed
F169-01D	494.7		

Hardness= (T)(E)(100,000)/(S)

Notes: *E is purchased as a certified standard solution.

Analyzed By: NM

Figure 2: TYPICAL SAMPLE RESULT SUMMARY

METHOD 2340C
HARDNESS

Client : XYZ, INC.
Project : CLEAN WATER PROJECT
Batch No. : 11F169

Matrix : WATER
Instrument ID : NA

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/L)	DLF	MOIST	RL (mg/L)	MDL (mg/L)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1W	THF002WB	ND	1	NA	10.0	10.0	06/22/1116:13	NA	THF00201	NA	THF002W	NA	NA
LCS1W	THF002WL	252	1	NA	10.0	10.0	06/22/1116:28	NA	THF00202	NA	THF002W	NA	NA
LCD1W	THF002WC	256	1	NA	10.0	10.0	06/22/1116:44	NA	THF00203	NA	THF002W	NA	NA
GW12A	F169-01	485	1	NA	10.0	10.0	06/22/1117:02	NA	THF00204	NA	THF002W	06/18/1110:26	06/18/11
GW26A	F169-02	243	1	NA	10.0	10.0	06/22/1117:18	NA	THF00206	NA	THF002W	06/18/1113:31	06/18/11
GW26A-D	F169-03	233	1	NA	10.0	10.0	06/22/1117:24	NA	THF00207	NA	THF002W	06/18/1113:31	06/18/11
GW1R	F169-04	524	1	NA	10.0	10.0	06/22/1117:34	NA	THF00208	NA	THF002W	06/18/1115:18	06/18/11
GW14A	F169-06	582	1	NA	10.0	10.0	06/22/1117:44	NA	THF00209	NA	THF002W	06/18/1113:50	06/18/11
GW17A	F169-08	349	1	NA	10.0	10.0	06/22/1117:49	NA	THF00210	NA	THF002W	06/18/1111:15	06/18/11
GW22A	F169-09	621	1	NA	10.0	10.0	06/22/1117:58	NA	THF00211	NA	THF002W	06/18/1114:50	06/18/11
GW12ADUP	F169-01D	495	1	NA	10.0	10.0	06/22/1117:11	NA	THF00205	NA	THF002W	06/18/1110:26	06/18/11

Figure 3: TYPICAL LCS/LCSD SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
METHOD: METHOD 2340C
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 11F169
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: THF002WL/C

DATE RECEIVED: NA
DATE EXTRACTED: NA
DATE ANALYZED: 06/22/11 16:28/16:44

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
Hardness	ND	264	252	95	264	256	97	2	80-120	20

Figure 4: TYPICAL SAMPLE DUPLICATE RESULT SUMMARY

EMAX QUALITY CONTROL DATA
DUPLICATE ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
METHOD: METHOD 2340C
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 10G387
SAMPLE ID: S5/8/9/17-MW48-0710DUP
CONTROL NO.: G387-01D

DATE RECEIVED: 07/29/10
DATE EXTRACTED: NA
DATE ANALYZED: 08/12/10 15:19

ACCESSION:

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)	RPD LIMIT (%)
Total Hardness	3060	3080	1	20

Figure 5: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER PROJECT

SDG : 11F169

METHOD 2340C
HARDNESS

A total of seven (7) water samples were received on 06/18/11 for Total Hardness analysis, Method 2340C in accordance with Standard Methods for the Examination of Water and Wastewater, 18th Edition.

Holding Time
Samples were analyzed within the prescribed holding time.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for THF002WL/C were all within QC limits.

Matrix QC Sample
Sample duplicate was analyzed with the samples. RPD was within project limit.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1ST Rvw	2ND Rvw
Method Blank	One blank per preparation batch	No analytes detected as required by the project.	Re-prepare and re-analyze method blank and all samples processed with the contaminated blank.		
LCS	One LCS per preparation batch	Recovery : 80-120%	Correct the problem and re-analyze LCS prior to sample analysis.		
Duplicate Sample	One Dup per preparation batch	RPD ≤ 20%	Check PSR and discuss in case narrative		
Comments: Refer to PSR for flagging criteria.			Reviewed By:		
18th Edition			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
TOTAL HARDNESS
SM 2340C

SOP: EMAX-2340C
Conc Unit: mg/L
Sample Amount(ml): 25

Analyzed date: 11/4/2010
Analyzed by: P. Phan

PARAMETER	THK001WL	THK001WC	THK001WX	THK001WY	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	THK001-02	THK001-03	THK001-04	THK001-05							
HARDNESS	212	208	216	220	222	214	96	5.16	2	80 - 120	PASSED

2340CFA: **ANALYSIS RUN LOG**

EMAX LABORATORIES, INC.

File ID: TH.xls

TOTAL HARDNESS ANALYSIS LOG

Prep Batch ID	Lab Sample ID	Aliquot (ml)	pH Adj	EDTA (ml)	Analysis Date Time	Found Conc.	Hardness	Unit	Notes

☐ EMAX-130.1 Rev. 4 Analyzed By:

☐ EMAX-2340C Rev. 2 Checked By:

Hardness=EDTA (N)xEDTA (ml)x100000/Aliquot (ml) Date:

Calibration of pH Meter		Instrument ID:	
Buffer ID	Value	Reading	Date Time
	4		
	7		
	10		
	Cal Ver 8		

STANDARDIZATION			
Vol. 0.02N CaCO3 (ml)	Vol. 0.02N EDTA (ml)	EDTA Titrant	DATE
		NA	
		Average EDTA (N)=	

☐ Titrant is certified standard

Standard/Reagent ID	Description	Concentration	Exp. Date
	EDTA (N)	0.02	
	LCS (mg/L)	264	
	NH_4OH		
	Eriochrome Black T		
	Methyl red indicator		
	HCl (v/v)	1+1	
	Inhibitor I		
	Inhibitor II		
	Inhibitor III		
	$CaCO_3$ (N)	0.02	

Micropipette ID:

QC Check	Result	Expected Val	QC Check
		0	

STANDARD OPERATING PROCEDURE

HARDNESS, TOTAL

SOP No.:	EMAX-2340C	Revision No.	3	Effective Date:	23-Apr-12
Prepared By:	Mary Jane Mendoza			Date:	04.18.12
Approved By:	Kenette Pimentel QA Manager			Date:	04.18.12
Approved By:	Caspar Pang Laboratory Director			Date:	4/18/2012

Control Number: 2340C-03

1.0 SCOPE AND APPLICATION

1.1. This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes. It is suitable for all concentration ranges of hardness. This method is an adaptation of Method 2340C, Standard Methods for the Examination of Water and Wastewater, 18th Edition.

2.0 SUMMARY OF METHOD

2.1. Calcium and magnesium ions in the sample are sequestered upon the addition of disodium ethylenediamine tetraacetate (Na_2EDTA). The end point of the reaction is detected by means of Eriochrome Black T indicator, which has a red color in the presence of calcium and magnesium and a blue color when the cations are sequestered.

2.2. **Interferences**

2.2.1. Excessive amounts of heavy metals can interfere. This is usually overcome by complexing metal ions with cyanide.

2.2.1.1. Routine addition of sodium cyanide solution to prevent potential metallic interference is recommended.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD)**

3.1.1. DL and LOD are not applicable for this method.

3.2. **Limit of Quantitation (LOQ)**

3.2.1. Refer to EMAX-QA04 for generation, validation and verification of LOQ.

3.2.2. Established LOQ for this method is 10 mg/L.

4.0 DYNAMIC RANGE

4.1. 10 mg/L – 600 mg/L

4.2. The highest quantifiable range requiring no dilution is equal to the concentration of the sample titrated with < 15 ml of titrant within 5 minute of titration. All samples analyzed above this range are considered "over range" and requires a larger volume of sample for proper quantitation.

4.3. The lowest quantifiable range on a given sample amount is equal to a concentration above reporting limit. All samples analyzed lower than the standard sample amount (25 ml) whose concentration is ≤ LOQ are considered as "under range" and requires a higher sample amount for proper quantitation.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Holding Time**

5.1.1. Analyze samples within six months.

5.2. **Preservation**

5.2.1. Preserve the samples received with HNO_3 to pH < 2 to prevent degradation.

5.2.2. Store samples at ≤ 6°C without freezing.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow and Review

6.2. EMAX-QA04 Detection Limit (DL)

6.3. EMAX-QA05 Training

6.4. EMAX-QA08 Corrective Action

6.5. EMAX-QC01 Quality Control for Chemicals

6.6. EMAX-QC02 Analytical Standard Preparation

6.7. EMAX-QC07 Glassware Cleaning

6.8. EMAX-SM03 Waste Disposal

6.9. EMAX-SM04 Analytical and QC Labeling

7.0 SAFETY

7.1. Read all MSDS for chemicals listed in this SOP.

Caution: Sodium Cyanide (NaCN) is extremely poisonous.

7.2. Perform all reagent preparations under a properly operating fume hood.

7.3. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves, at all times when performing this procedure.

7.4. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. Titration apparatus ± 10 calibration

8.1.2. Magnetic stirrer

8.1.3. Micropipettes

8.1.4. Volumetric flasks

8.1.5. Erlenmeyer flasks

8.2. **Chemicals and Reagents**

8.2.1. All reagents are reagent grade or better.

8.2.2. Buffer Solution

8.2.2.1. Purchase commercially available "odorless buffers" or prepare buffer solutions as described below:

Magnesium EDTA	Dissolve 16.9 g NH_4Cl in 143 ml concentrated NH_4OH in a 250 ml volumetric flask, add 1.25 g of magnesium salt in EDTA and dilute to the mark with reagent water.
Disodium EDTA	Dissolve 1.179 g disodium EDTA (analytical reagent grade) and 780 mg $MgSO_4 \bullet 7\ H_2O$ in 50 ml reagent water. Add this solution to a 250 ml volumetric flask containing 16.9 g NH_4Cl and 143 ml concentrated NH_4OH with mixing and dilute to the mark with reagent water.

8.2.2.2. Store in a tightly stoppered plastic bottle. This solution is stable for one month. Discard when 1 or 2 ml added to sample fails to produce a pH of 10.0 ± 0.1 at end point of titration.

8.2.3. Inhibitors

8.2.3.1. For most waters inhibitors are not necessary. If interfering ions are present use one of the following:

Inhibitor I	NaCN powder. Basify solutions or sample containing this and place in CN waste container. Make sure no acids are present which might liberate HCN gas.
Inhibitor II	Dissolve 5.0 g $Na_2S \bullet 9H_2O$ or 3.7 g $Na_2S \bullet 5H_2O$ in 100 ml reagent water. Exclude air with tightly fitted rubber stopper. This gives sulfide precipitates, which may obscure the end point if large quantities of heavy metals are present. This deteriorates rapidly through air oxidation.
Inhibitor III	Dissolve 4.5 g hydroxylamine hydrochloride in 100 ml of 95% ethanol or isopropanol.

8.2.4. Indicator

8.2.4.1. Use a commercially available indicator or one of the formulations described below:

Eriochrome Black T	Mix 0.5 g Eriochrome Black T with 4.5 g hydroxylamine hydrochloride. Dissolve in 100 ml of 95% ethanol or isopropanol. Or Dissolve 0.5 to 1.0(g) Eriochrome Black T in an appropriate solvent such as triethanolamine or 2-methoxyethanol. This solution is stable approximately one week. Or Mix together 0.5 g Eriochrome Black T and 100 g NaCl.
Methyl red indicator	Dissolve 0.10 g methyl red in reagent water in 100 ml volumetric flask and dilute to mark.
Hydrochloric acid solution 1+1	Using a clean 500 ml flask, measure and transfer 100 ml of reagent water. Slowly add 100 ml of concentrated HCL while swirling the flask to obtain adequate mixing

8.2.5. Ammonium hydroxide solution, 3 N: Dilute 210 ml of concentrated NH_4OH to 1 L with reagent water.

8.2.6. Ammonium hydroxide solution, 1 N: Dilute 70 ml of concentrated NH_4OH to 1 L with reagent water.

9.0 STANDARDS

9.1. Purchase all standards/titrants as certified solutions as listed below:

STANDARD	SOURCE	CONCENTRATION
EDTA Solution	VWR or equivalent	0.02N (0.01M)
LCS	Wibby or equivalent	Based on Certified Concentration

9.2. Refer to EMAX-QC02 for proper preparation of analytical standards.

9.3. Store standards at room temperature.

9.4. Alternately, you may prepare the above solution as follows:

9.4.1. Standard EDTA titrant at 0.02N

9.4.1.1. Place 3.723 g analytical reagent grade disodium EDTA dehydrate ($Na_2H_2C_{10}H_{12}O_8N_2 \bullet 2H_2O$) in a 1000 ml volumetric flask and dilute to the mark with reagent water.

9.4.2. Standard Calcium Carbonate Solution at 0.02 N

9.4.2.1. Place 1.000 g anhydrous calcium carbonate (primary standard low in metals) in a 500 ml flask. Add droplets of 1+1 HCl until all of the $CaCO_3$ has dissolved.

9.4.2.2. Add 200 ml reagent water. Boil for a few minutes to expel CO_2. Allow solution to cool down.

9.4.2.3. Add a few drops of methyl red indicator and adjust to intermediate orange color by adding 3N NH_4OH or 1+1 HCl as required.

9.4.2.4. Quantitatively transfer to a 1000 ml volumetric flask and dilute to mark with reagent water.

10.0 PROCEDURES

10.1. Sample Preparation

10.1.1. Allow the samples to equilibrate with room temperature.

10.1.2. Prepare the analytical batch not to exceed 20 field samples with a sample duplicate, Method Blank (MB) and Lab Control Sample (LCS).

10.1.3. Measure 25 ml of sample in titration vessels. Use reagent water for MB and use LCS standard for LCS. Samples are now ready for titration.

10.1.4. For wastewater and highly polluted waters, the sample(s) must be digested. Refer to EMAX-3010 SOP for details.

10.2. Instrument Parameters

10.2.1. Burette used for titration should read a 0.10 graduation.

10.3. Standardization

10.3.1. When titrant is prepared in-house, perform three replicate standardization of standard titrant, 0.02N EDTA against 0.02 N $CaCO_3$ solution prior to sample analysis.

10.4. Analysis

10.4.1. Titration

10.4.1.1. Conduct titrations at or near normal room temperature. Note that the color change becomes impractically slow as the sample approaches freezing temperature. Indicator decomposition becomes a problem in hot water.

10.4.1.2. Neutralize the prepared sample with 1N ammonium hydroxide and dilute to about 50 ml with reagent water.

10.4.1.3. Set the timer to alarm after 5 minutes.

10.4.1.4. Add 1 to 2 ml buffer solution. This amount is usually sufficient to give a pH of 10.0 to 10.1.

10.4.1.5. Turn on the timer.

10.4.1.6. Add 1 to 2 drops indicator solution or one scoop of dry indicator. Expect the solution to turn to reddish pink.

10.4.1.7. Using EDTA titrant, titrate slowly with continuous stirring until the color changes to distinct blue. If color is not distinct blue, e.g. purple or reddish

violet, add inhibitor. If titration end point is reached the solution will turn to distinct blue. This color transition determines the end point.

10.4.1.8. If any of the conditions occur the sample is considered to be "over-ranged", lower the sample amount and repeat the process. [*Note that sample result is expected to be > LOQ, otherwise sample amount is insufficient.*]

- The color does not turn to distinct blue after addition of inhibitor.
- If titrant amount is more than the volume of EDTA used in the standardization.
- If titration is more than 5 minutes after addition of buffer.

Note: Sample result is expected to be > LOQ otherwise, sample amount is insufficient.

10.4.2. Sample Result Evaluation

10.4.2.1. Check the QC data as soon as available.

- ✓ Check the method blank and make sure that it meets the project requirement.
- ✓ Check the LCS and make sure it meets the recovery limit.
- ✓ Check the sample duplicate(s) that it meets the acceptance criteria or note possible matrix interference on the run log.
- ✓ Check that all samples are analyzed within the dynamic range.

10.5. **Calculations**

10.5.1. Standardization

$$E_c = \frac{(C_c)(C_v)}{E_v} \qquad \text{Eq.-10.5.1}$$

where:

E_c – molarity of EDTA titrant

E_v – volume of EDTA titrant

C_c – molarity of calcium carbonate

C_v – volume of calcium carbonate in ml

Calculate the average of the triplicate measurements

$$E = \frac{\sum E_c}{n} \qquad \text{Eq.-10.5.1a}$$

where:

E – average molarity of EDTA titrant

ΣE_c – summation of molarity of EDTA titrant

N – number of measurements

10.5.2. Calculate for Sample Result

$$H = \frac{(T)(E)50000}{S}$$ Eq.-10.5.2

where:

H – hardness as $CaCO_3$ (mg/L)

T – Titrant volume in ml

E – average EDTA concentration in N

S – sample amount (ml)

10.5.3. Percent Recovery

$$\%\,Recovery = \frac{C_f - C}{C_s} \times 100$$ Eq.-10.5.4

where:

C_f – Concentration Found

C – Concentration of sample (use 0 for LCS)

C_s – Concentration of spike

10.5.4. Calculate for Precision

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$ Eq.-10.5.3

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Print a copy of the run log.

10.6.2. Highlight reportable results for data processing.

10.7. **Report Generation**

10.7.1. Generate the method .txt file using WDBN.exe.

10.7.2. Generate the sample results using MSRB6.exe.

10.7.3. Generate the QC summary using JOQN.exe.

10.7.4. Generate the case narrative using CN2.exe.

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below:

10.8.1.1. Case Narrative

10.8.1.2. Sample Results

10.8.1.3. LCS/LCSD Summary

10.8.1.4. Sample Duplicate Result Summary

10.8.1.5. Raw Data

10.8.1.6. Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01and the PSR.

- Check that MB is compliant to PSR.
- Check LCS/LCSD recoveries against project specific criteria (PSR). In the absence of the PSR, default to in-house QC limits.
- Check concentration of sample results that all are written dynamic range.
- If any of the above check point is non-compliant, re-analysis is required.
- Check the generated reports against the run log. Check that the analytical data generated indicating positive results are qualitatively and quantitatively correct.
- Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analytical folder for secondary review.

11.0 QUALITY CONTROL

11.1. **Sample Preparation QC**

11.1.1. 20 is the maximum number of original field samples in an analytical batch unless otherwise specified by the project.

11.1.2. Properly treat all lab wares used in the sample preparation as specified in EMAX-QC07.

11.2. **Sample Analysis QC**

11.2.1. Prepare method blank and LCS in every analytical batch, unless otherwise specified by the project.

11.2.2. Prepare a sample duplicate at the frequency specified by the project.

11.2.3. Acceptance criteria, is summarized in Appendix 1.

11.3. **Method QC**

11.3.1. Method proficiency must be established before the analytical procedure can be used.

11.3.2. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05.

12.0 CORRECTIVE ACTION

12.1. Corrective action for each Quality Control Procedure is summarized in Appendix 1.

12.2. **Sample Preparation QC**

12.2.1. For insufficient amount of sample(s), inform the supervisor immediately.

12.2.2. When method blank is non-compliant, investigate the source of the problem and institute resolution to correct, minimize or eliminate the problem.

12.3. **Sample Analysis QC**

12.3.1. If LCS is non-compliant, investigate the source of the problem to institute resolution to correct the problem.

12.3.2. If sample duplicate is non-compliant, check PSR and discuss in case narrative.

12.4. A Non-Conformance Report (NCR) is required when the following circumstances occur.

- Anomalies other than specified in Appendix 1, is observed.
- Sample is out of technical holding time.

12.4.1. Refer to EMAX-QA08 for NCR details.

13.0 POLLUTION PREVENTION

13.1. NaCN is extremely poisonous. Observe all necessary precautions to avoid spillage of reagents that may go to the wastewater drains.

13.2. Prepare all standards in the fume hood.

14.0 WASTE MANAGEMENT

14.1. No samples maybe dumped on the laboratory sink.

14.2. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1. **Preparation Batch** - is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2. **Analytical batch** - is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Limit of Quantitation (LOQ) - is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.1.3. Material Safety Data Sheet (MSDS) – is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.4. Buffered solutions or buffers - Are solutions which resist a change in pH when small amounts of acid or base are added.

15.1.5. Total Hardness – is the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate, in milligrams per liter.

15.1.6. Indicators – A certain chemical has a special property that changes its color at different pH levels. When a few drops of indicator are added to a solution, the color of the solution serves as an indication of its pH.

15.1.7. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.8. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.9. Matrix – A component or form of a sample.

15.1.10. Method Blank (MB) – A target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.11. Reagent Water – Purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.12. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.13. Sample Duplicate – A replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.14. Sub-sample – An aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.15. Titration – A procedure for carrying out a chemical reaction between two solutions by the controlled addition of a solution of known concentration called titrant into an unknown.

Reaching a certain pH either measured by pH meter or a color change completes the reaction.

15.1.16. Reagent Water – Purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.3. **Application of EMAX QC Procedures**

15.3.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing Total Hardness. In instances where there is a project or program QAPP, the requirements given in the project takes precedence over this SOP.

15.4. **Department of Defense (DoD) Projects**

15.4.1. Samples from DoD sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, is applied.

15.5. **Department of Energy (DoE) Projects**

15.5.1. Samples from DoE sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, is applied.

16.0 REFERENCES

16.1. Standard Methods For the Examination Of Water and Wastewater, 18th Edition, 1992

16.2. EPA Test Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-20, March 1983

16.3. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. **Figures**

17.1.1. Figure 1 Typical Raw Data

17.1.2. Figure 2 Typical Sample Result

17.1.3. Figure 3 Typical LCS/LCSD Summary

17.1.4. Figure 4 Typical Sample Duplicate Result Summary

17.1.5. Figure 5 Typical Case Narrative

17.2. **Appendices**

17.2.1. Appendix 1 Summary of Quality Control Procedures

17.2.2. Appendix 2 Demonstration of Capability

17.3. **Forms**

17.3.1. 2340CFA Analytical Run Log

Figure 1: **TYPICAL RAW DATA**

EMAX LABORATORIES, INC.

11THF002.xls

ANALYSIS FOR HARDNESS

Page: 66
Book #: ATH-005
SOP: EMAX-130.2
Analytical Batch: THF002

Data File Name	Lab Sample ID	Sample, S (ml)	Titrant, T (ml)	Analysis Date mm:dd:yy	Analysis Time hh:mm:ss	HARDNESS	RESULT	UNIT	FLAG
THF002-01	THF002WB	25	0.05	06/22/11	16:13:57	1.94	ND	mg/L	
THF002-02	THF002WL	25	6.5	06/22/11	16:28:12	252.2	252	mg/L	
THF002-03	THF002WC	25	6.6	06/22/11	16:44:31	256.08	256	mg/L	
THF002-04	F169-01	10	5	06/22/11	17:02:00	485	485	mg/L	
THF002-05	F169-01D	10	5.1	06/22/11	17:11:47	494.7	495	mg/L	
THF002-06	F169-02	10	2.5	06/22/11	17:18:07	242.5	243	mg/L	
THF002-07	F169-03	10	2.4	06/22/11	17:24:41	232.8	233	mg/L	
THF002-08	F169-04	10	5.4	06/22/11	17:34:27	523.8	524	mg/L	
THF002-09	F169-06	10	6	06/22/11	17:44:10	582	582	mg/L	
THF002-10	F169-08	10	3.6	06/22/11	17:49:42	349.2	349	mg/L	
THF002-11	F169-09	10	6.4	06/22/11	17:58:38	620.8	621	mg/L	

MISCELLANEOUS INFORMATION		
Standard	Concentration	
Titrant, EDTA, E*	0.0097	*M*
LCS	264	*mg/L*
MDL	10	*mg/L*
RL	10	*mg/L*

QC REQUIREMENT	% Recovery/RPD
LCS	80 - 120
DUPLICATE	< 20

QC CHECK	Result	%R/RPD	Comments
THF002WB	1.94	19%	Passed
THF002WL	252.2	96%	Passed
F169-01	485	2%	Passed
F169-01D	494.7		

Hardness= (T)(E)(100,000)/(S)

Notes: *E is purchased as a certified standard solution.

Analyzed By: NM

Figure 2: TYPICAL SAMPLE RESULT SUMMARY

METHOD 2340C
HARDNESS

Client : XYZ, INC.
Project : CLEAN WATER PROJECT
Batch No. : 11F169

Matrix : WATER
Instrument ID : NA

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/L)	DLF	MOIST	RL (mg/L)	MDL (mg/L)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1W	THF002WB	ND	1	NA	10.0	10.0	06/22/1116:13	NA	THF00201	NA	THF002W	NA	NA
LCS1W	THF002WL	252	1	NA	10.0	10.0	06/22/1116:28	NA	THF00202	NA	THF002W	NA	NA
LCD1W	THF002WC	256	1	NA	10.0	10.0	06/22/1116:44	NA	THF00203	NA	THF002W	NA	NA
GW12A	F169-01	485	1	NA	10.0	10.0	06/22/1117:02	NA	THF00204	NA	THF002W	06/18/1110:26	06/18/11
GW26A	F169-02	243	1	NA	10.0	10.0	06/22/1117:18	NA	THF00206	NA	THF002W	06/18/1113:31	06/18/11
GW26A-D	F169-03	233	1	NA	10.0	10.0	06/22/1117:24	NA	THF00207	NA	THF002W	06/18/1113:31	06/18/11
GW1R	F169-04	524	1	NA	10.0	10.0	06/22/1117:34	NA	THF00208	NA	THF002W	06/18/1115:18	06/18/11
GW14A	F169-06	582	1	NA	10.0	10.0	06/22/1117:44	NA	THF00209	NA	THF002W	06/18/1113:50	06/18/11
GW17A	F169-08	349	1	NA	10.0	10.0	06/22/1117:49	NA	THF00210	NA	THF002W	06/18/1111:15	06/18/11
GW22A	F169-09	621	1	NA	10.0	10.0	06/22/1117:58	NA	THF00211	NA	THF002W	06/18/1114:50	06/18/11
GW12ADUP	F169-01D	495	1	NA	10.0	10.0	06/22/1117:11	NA	THF00205	NA	THF002W	06/18/1110:26	06/18/11

Figure 3: TYPICAL LCS/LCSD SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
METHOD: METHOD 2340C
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 11F169
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: THF002WL/C

DATE RECEIVED: NA
DATE EXTRACTED: NA
DATE ANALYZED: 06/22/11 16:28/16:44

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
Hardness	ND	264	252	95	264	256	97	2	80-120	20

Figure 4: TYPICAL SAMPLE DUPLICATE RESULT SUMMARY

EMAX QUALITY CONTROL DATA
DUPLICATE ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
METHOD: METHOD 2340C
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 10G387
SAMPLE ID: S5/8/9/17-MW48-0710DUP
CONTROL NO.: G387-01D

DATE RECEIVED: 07/29/10
DATE EXTRACTED: NA
DATE ANALYZED: 08/12/10 15:19

ACCESSION:

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)	RPD LIMIT (%)
Total Hardness	3060	3080	1	20

Figure 5: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER PROJECT

SDG : 11F169

METHOD 2340C
HARDNESS

A total of seven (7) water samples were received on 06/18/11 for Total Hardness analysis, Method 2340C in accordance with Standard Methods for the Examination of Water and Wastewater, 18th Edition.

Holding Time
Samples were analyzed within the prescribed holding time.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for THF002WL/C were all within QC limits.

Matrix QC Sample
Sample duplicate was analyzed with the samples. RPD was within project limit.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1ST Rvw	2ND Rvw
Method Blank	One blank per preparation batch	No analytes detected as required by the project.	Re-prepare and re-analyze method blank and all samples processed with the contaminated blank.		
LCS	One LCS per preparation batch	Recovery : 80-120%	Correct the problem and re-analyze LCS prior to sample analysis.		
Duplicate Sample	One Dup per preparation batch	RPD ≤ 20%	Check PSR and discuss in case narrative		
Comments: Refer to PSR for flagging criteria.			Reviewed By:		
18th Edition			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
TOTAL HARDNESS
SM 2340C

SOP: EMAX-2340C
Conc Unit: mg/L
Sample Amount(ml): 25

Analyzed date: 11/4/2010
Analyzed by: P. Phan

PARAMETER	THK001WL	THK001WC	THK001WX	THK001WY	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	THK001-02	THK001-03	THK001-04	THK001-05							
HARDNESS	212	208	216	220	222	214	96	5.16	2	80 - 120	PASSED

2340CFA: **ANALYSIS RUN LOG**

EMAX LABORATORIES, INC.

File ID: TH.xls

TOTAL HARDNESS ANALYSIS LOG

PrepBatchID	LabSampleID	Aliquot (ml)	pH Adj	EDTA (ml)	AnalysisDateTime	Found Conc.	Hardness	Unit	Notes

Calibration of pH Meter		InstrumentID:	
BufferID	Value	Reading	DateTime
	4		
	7		
	10		
	CalVer 8		

STANDARDIZATION			
Vol. 0.02N CaCO3(ml)	Vol. 0.02N EDTA(ml)	EDTA Titrant	DATE
		NA	
		Average EDTA (N)=	

☐ Titrant is certified standard

Standard/Reagent ID	Description	Concentration	Exp.Date
	EDTA (N)	0.02	
	LCS (mg/L)	264	
	NH_4OH		
	Eriochrome Black T		
	Methyl red indicator		
	HCl (v/v)	1+1	
	Inhibitor I		
	Inhibitor II		
	Inhibitor III		
	$CaCO_3$(N)	0.02	

Micropipette ID:

QC Check	Result	ExpectedVal	QC Check
		0	

☐ EMAX-130.1 Rev. 4 Analyzed By:

☐ EMAX-2340C Rev. 2 Checked By:

Hardness=EDTA (N)xEDTA (ml)x100000/Aliquot (ml) Date:

SOP REVIEW FORM

EMAX-TOCWB	Rev. 2	TOTAL ORGANIC CARBON BY WALKLEY BLACK
SOP No.	Revision Number	Title

Document the review process and comment. Check the "NA" box if it is not applicable to the SOP, check the "Yes" box if you have fully understood the section, check "No" if you have any questions or if there are discrepancies with the current practice. Discuss the issue with the mentor/supervisor. If you need more space use the allocated space below or attach additional page.

SECTION	Yes	No	NA	COMMENTS
Scope & Application	✓			
Summary of Method	✓			
Detection Limits	✓			
Dynamic Range	✓			
Sample Holding Time & Preservation	✓			
Associated SOPs	✓			
Safety	✓			I have read all MSDS listed in this SOP.
Instruments, Chemicals & Reagents	✓			
Standards	✓			
Procedures	✓			
- Sample Preparation	✓			
- Instrument Parameters	✓			
- Standardization	✓			
- Analysis	✓			
- Calculations	✓			
- Data Reduction	✓			
- Report Generation	✓			
- Data Review	✓			
- Preventive Maintenance	✓			
Quality Control	✓			
Corrective Action				
Pollution Prevention	✓			
Waste Management	✓			
Supplementary Notes	✓			
References	✓			
Appendices	✓			

This is to acknowledge that I have read, understood and agree to perform the procedures set forth in this SOP. Print your name & affix your signature.

Reviewed By Mary Jane Mendoza [signature] Date: 6/6/14

STANDARD OPERATING PROCEDURE

TOTAL ORGANICS CARBON BY WALKLEY-BLACK METHOD

SOP No.:	EMAX-TOCWB	Revision No.	2	Date:	06-Feb-12
Prepared By:	Mary Jane Mendoza			Date:	02.01.12
Approved By:	Kenette Pimentel QA Manager			Date:	02.01.12
Approved By:	Caspar Pang Laboratory Director			Date:	2-01-12

Control Number: TOCWB-02-

1.0 SCOPE AND APPLICATION

1.1. This method describes the procedure to measure total organic carbons in soil matrices. This SOP is an adaptation of the Walkley-Black Method.

2.0 SUMMARY OF METHOD

2.1. A known amount of sample is subjected to rapid oxidation by adding potassium dichromate ($K_2Cr_2O_7$) and concentrated H_2SO_4. The excess Cr_2O_7 is titrated with Fe $(NH_4)_2(SO_4)\bullet 6H_2O$. The reduced Cr_2O_7 is assumed to be equivalent with the organic carbon present in the sample.

2.2. This method cannot be used to quantitatively recover carbonyl materials (charcoal, graphite, coal, and soot) from soil. Unreliable result for organic C will be found if dichromate method is applied to soil containing significant amount of carbonyl material.

2.3. **Interferences**

2.3.1. Chloride interferes with dichromate method through the formation of Chromyl Chloride. It can be corrected experimentally by the following equation:

2.3.1.1. Organic C in soil (%) = (Apparent % C in soil) – (% Cl/12)

2.3.1.2. This applies only to soil having Cl/C ratio of ≤ 5:1.

3.0 DETECTION LIMITS

3.1. **Detection Limit (DL) and Limit of Detection (LOD)**

3.1.1. DL and LOD are not applicable for this method.

3.2. **Limit of Quantitation (LOQ)**

3.2.1. Refer to EMAX-QA04 for generation, validation and verification of LOQ.

3.2.2. Established LOQ for this method is 600 mg/Kg.

4.0 DYNAMIC RANGE

4.1. Not applicable.

5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Preservation**

5.1.1. Soil samples are collected in 4 oz. glass jar or brass tubes and kept at ≤ 6°C without freezing until extraction.

5.2. **Holding Time**

5.2.1. Samples must be analyzed within 28 days from the time of collection.

6.0 ASSOCIATED SOPs

6.1. EMAX-DM01 Data Flow & Review

6.2. EMAX-QA04 Detection Limit (DL)

6.3. EMAX-QA05 Training

6.4. EMAX-QA08 Corrective Action

6.5. EMAX-QC02 Analytical Standard Preparation

6.6. EMAX-QC07 Glassware Cleaning

6.7. EMAX-SM01 Sample Management

6.8. EMAX-SM03 Waste Disposal

6.9. EMAX-SM04 Analytical Disposal

7.0 SAFETY

7.1. Read all MSDS for chemicals listed in this SOP.

7.2. All reagents, standards, and samples are treated as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves at all times when performing this procedure.

7.3. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of your body, rinse the affected body part thoroughly with tap water. If irritations persist inform your supervisor immediately so that proper action can be taken.

8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

8.1.1. Balance: Sartorius LC 620 or equivalent

8.1.2. Erlenmeyer flask: 500 ml

8.1.3. Titration apparatus ± 0.10 calibration

8.1.4. Micropipette

8.1.5. Magnetic Sirrer

8.2. **Chemicals and Reagents**

8.2.1. All reagents are reagent grade or better.

8.2.2. Potassium dichromate ($K_2Cr_2O_7$), 1N: Dissolve 49.04 g of reagent grade $K_2Cr_2O_7$ (dried at 105°C) in water, and dilute the solution to a volume of 1,000 ml.

8.2.3. Sulfuric acid (H_2SO_4), concentrated (not less than 96%) with 15 gm/l of Ag_2SO_4.

8.2.4. Phosphoric acid (H_3PO_4), concentrated.

8.2.5. O-Phenoanthroline-ferrous complex

8.2.6. Ferrous sulfate heptahydrate ($FeSO_4 \bullet 7\ H_2O$) solution, 0.5N: Dissolve the 140 gm of reagent grade $FeSO_4 \bullet 7\ H_2O$ in water, add 15 ml of conc. H_2SO_4. Cool the solution and dilute it to a volume of 1,000 ml.

9.0 STANDARDS

9.1. Refer to EMAX-QC02 for proper standard preparation.

9.2. **LCS Spike Standard Solution**

9.2.1. Purchase as certified solution:

STANDARD	SOURCE	CONCENTRATION
TOC	ERA or equivalent	0.1%

9.2.2. Alternately, you may prepare the above standard as follows:

9.2.2.1. Potassium biphthalate (HOCO C_6H_4COOK) solution: Dissolve 2.128 gm of potassium biphthalate in 1000 ml reagent water to make a 0.1% solution. (1 ml = 1 mg organic C)

10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Check project sub-sampling requirement. If multi incremental sub sampling (MIS) is required refer to EMAX-SM01 Section 5.13.4. Otherwise follow the steps described in EMAX-SM01 Section 5.13.2.

10.1.2. Line up the 500 ml Erlenmeyer flask in front of each sample and label them accordingly. Prepare at least one flask each for method blank [MB] and lab control sample(s)[LCS/LSD (optional)] . Prepare two flasks for the assigned matrix duplicate sample.

10.1.3. Weigh 2 gm of each sample into the assigned flask and bring the samples under a working fume hood. Add LCS standard into the LCS flask. Into each flask perform the following:

10.1.3.1. Add 10 ml of 1 N $K_2Cr_2O_7$ and swirl the flask gently to disperse the soil in solution.

10.1.3.2. Rapidly add 20 ml of concentrated H_2SO_4 with $AgSO_4$.

10.1.3.3. Immediately swirl the flask gently until soil and reagents are mixed subsequently increasing the intensity of swirling (from gentle to vigorous) for at least one minute. Write the time on the flask before proceeding to the next sample.

10.1.3.4. Allow reaction to complete for about 30 minutes.

10.1.3.5. Add 200 ml of water to the flask.

10.1.3.6. Spike 4 ml of potassium biphthalate (Section 9.2.1) in a blank to prepare a laboratory control sample (LCS). Follow the procedures from Sections 10.1.3.1 to 10.1.3.5.

10.2. **Instrument Parameters**

10.2.1. Burette used for titration reads a 0.10 graduation.

10.3. **Standardization**

10.3.1. $FeSO_4$ solution is standardized daily by titrating it against 10 ml of 1 N $K_2Cr_2O_7$.

10.4. **Analysis**

10.4.1. Add 3 to 4 drops of o-Phenanthroline indicator and titrate the solution with 0.5 N $FeSO_4$ until it reaches the end point of dark green. The solution takes on a greenish cast and then changes to dark green.

10.4.2. Continue to add $FeSO_4$ drop by drop until the color changes sharply from blue to red (i.e., maroon color in reflected light against a white background). Record the volume V_1 in ml.

10.4.3. In cases when the suspension will not allow easy determination of end point, allow it to pass through a fast filter paper on a Buchner funnel before titration.

10.4.4. A small amount of H_3PO_4 acid can enhance the end point in titration.

10.4.5. Make a blank determination to standardize the $Cr_2O_7^{2-}$(See 10.4.1 and 10.4.2). Record the volume V_2 in ml.

10.4.6. If 75% of dichromate is reduced, repeat the analysis with lesser amount of sample aliquot.

10.4.7. **Result Evaluation**

10.4.7.1. Check QC result as soon as available.

10.4.7.2. Check that the analytical results are generated by the prescribed calibration schedule of the method.

10.4.7.3. Check that LCS result is within QC limits.

10.4.7.4. Check that sample duplicate result agrees within the acceptance limit.

10.5. **Calculations**

10.5.1. Organic Carbon

$$OrganicC,\% = \frac{(meq.of\ Cr_2O_7^{2-}\ -\ meq.of\ FeSO_4\ )\ x\ .003\ x\ 100}{g\ of\ sample}\ x\ 1.3 \qquad \text{Eq.-10.5.1}$$

where:

$meq.\ of\ Cr_2O_72^-$ – 1.0 meq./ml x V_2 (from Section 10.4.5)

$meq.\ of\ FeSO_4$ – Normality from daily standardization x V_1 (from Section 10.4.2)

10.5.2. Calculate for Percent Recovery

$$\%Recovery = \frac{(C_f\ -\ C)}{C_s} \times 100 \qquad \text{Eq.-10.5.2}$$

where:

Cf – concentration found

C – concentration of sample (use 0 for LCS)

C_s – concentration of spike

10.5.3. Calculate for Precision

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C1 + C2}{2}\right)} \times 100$$ Eq.-10.5.3

where:

RPD – Relative Percent Difference

C_1 – Measured concentration of the first sample aliquot

C_2 – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Print a copy of the Raw Data.

10.6.2. Highlight reportable results for data processing.

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDBN.exe.

10.7.2. Generate the sample results using MSRB6.exe.

10.7.3. Generate the QC summary using JOQN.exe.

10.7.4. Generate the case narrative using CN2.exe.

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below.

10.8.1.1. Case Narrative

10.8.1.2. Sample Results

10.8.1.3. LCS/LCSD Summary

10.8.1.4. Sample Duplicate Result Summary

10.8.1.5. Non-Conformance Report (if any)

10.8.2. Perform 100% data review in accordance to EMAX-DM01 and the PSR.

10.8.2.1. Check that the Method Blank is compliant to the PSR.

10.8.2.2. Check the LCS/LCSD Recoveries against the PSR. In the absence of PSR, default to in-house QC limits.

10.8.2.3. Check the generated report against the raw data. Check that the analytical data generated indicating positive results are qualitatively and quantitatively correct.

10.8.2.4. Review the case narrative and edit as much as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.3. Submit the analytical folder for second review.

10.9. **Preventive Maintenance**

10.9.1. Not applicable.

11.0 QUALITY CONTROL

11.1. Burette used for titration must be class A.

11.2. Properly treat all lab wares used in the sample preparation as specified in EMAX-QC07.

11.3. At a minimum one MB, one LCS and a Sample Duplicate is analyzed in every preparation batch.

11.4. Acceptance criteria and corrective action is summarized in Appendix 1.

11.5. If project requires lower detection limit, this can be achieved by increasing the sample amount.

11.6. Method Detection Limit Study must be established before the analytical procedure can be used.

11.7. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05.

12.0 CORRECTIVE ACTION

12.1. Corrective action for each Quality Control procedure is summarized in Appendix 1.

12.2. When MB is non-compliant, perform the following suggestions to possibly correct the problem:

- If results are ND or >10X of the MB result, it is indicative that the MB is an isolated case and that the results are reportable. Refer the issue to the Supervisor and the PM if data is reportable, otherwise determine the source of the problem and repeat the process.
- If sample result(s) is/are detected at about the same level as the MB contamination, it is indicative that the probable source of contamination is the reagent water. Obtain fresh reagent water, prepare fresh titrant and repeat the process.

12.3. When LCS is non-compliant, perform the following suggestions to possibly correct the problem:

- Prepare a fresh titrant and re-analyze the LCS. If LCS passed, then it is indicative that results of the entire batch are affected by the titrant. Analyze all samples with the fresh titrant.
- If problem persist, prepare a fresh LCS standard and re-analyze. If LCS passed, it is indicative of LCS standard degradation. Discard the old LCS and proceed with the sample analysis.

12.4. Other anomalies encountered during the analytical process not listed in Appendix 1, requires a non-conformance report (NCR). Refer to EMAX-QA08.

13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to the wastewater drains.

13.2. Prepare all standards in fume hoods.

14.0 WASTE MANAGEMENT

14.1. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation batch** - is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical batch** - is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices; preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – is defined as the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type I error) is 1%.

15.1.4. Limit of Detection (LOD) – Is defined as the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%.

15.1.5. Limit of Quantitation (LOQ) – is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.1.6. Material Safety Data Sheet (MSDS) – Is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.7. Method Blank – Is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.8. Lab Control Sample (LCS) – Is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.9. Lab Control Sample Duplicate (LCSD) – Is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.10. Sample – Is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.11. Sample Duplicate – Is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.12. Sub-sample – Is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation batch.

15.1.13. Matrix – Is a component or form of a sample.

15.1.14. Matrix Spike – Is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.15. Matrix Spike Duplicate (MSD) – Is a replicate of MS analyzed to monitor precision or recovery.

15.1.16. Reagent Water – Is purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.17. Corrective Action – Action taken to eliminate the causes of an existing non-conformity, defect or other undesirable situation in order to prevent recurrence.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing Total Organic Carbon by Walkley-Black Method. In instances where there is a project or program QAPP, the requirement given in the project takes precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and or/ client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, is applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, is applied.

16.0 REFERENCES

16.1. Walkley-Black Procedure (Walkley, 1946; Peech et al., 1947; Greweling & Peech, 1960)

16.2. EMAX Quality Systems Manual, as updated

17.0 APPENDICES

17.1. **Figures**

17.1.1. Figure 1 Typical Sample Result Summary

17.1.2. Figure 2 Typical LCS/LCSD Summary

17.1.3. Figure 3 Typical Sample Duplicate Result Summary

17.1.4. Figure 4 Typical Case Narrative

17.2. **Appendices**

17.2.1. Appendix 1 Summary of Quality Control Procedures

17.2.2. Appendix 2 Demonstration of Capability

17.3. **Forms**

17.3.1. TOCWBFA Analytical Run Log

Figure 1: TYPICAL SAMPLE RESULT SUMMARY

METHOD WALKLEY BLACK
TOC

Client : XYZ, INC.
Project : CLEAN PROJECT
Batch No. : 11K219

Matrix : SOIL
Instrument ID : 70

SAMPLE ID	EMAX SAMPLE ID	RESULTS (mg/kg)	DLF	MOIST	RL (mg/kg)	MDL (mg/kg)	Analysis DATETIME	Extraction DATETIME	LFID	CAL REF	PREP BATCH	Collection DATETIME	Received DATETIME
MBLK1S	BCL001SB	ND	1	NA	600	600	12/05/1114:08	NA	BCL00101	NA	BCL001S	NA	NA
LCS1S	BCL001SL	2340	1	NA	600	600	12/05/1114:13	NA	BCL00102	NA	BCL001S	NA	NA
LCD1S	BCL001SC	2150	1	NA	600	600	12/05/1114:16	NA	BCL00103	NA	BCL001S	NA	NA
7-007	K219-01T	26100	1	42.2	1040	1040	12/05/1115:53	NA	BCL00111	NA	BCL001S	11/25/1115:30	11/28/11
7-007DUP	K219-01D	27500	1	42.2	1040	1040	12/05/1117:55	NA	BCL00112	NA	BCL001S	11/25/1115:30	11/28/11
7-008	K219-02	8790	1	20.9	759	759	12/05/1115:48	NA	BCL00106	NA	BCL001S	11/25/1116:20	11/28/11
7-009	K219-03	10900	1	23.8	787	787	12/05/1115:58	NA	BCL00107	NA	BCL001S	11/25/1116:05	11/28/11
7-010	K219-04	8540	1	22.0	769	769	12/05/1116:46	NA	BCL00108	NA	BCL001S	11/25/1116:05	11/28/11
7-011	K219-05	12600	1	27.3	825	825	12/05/1116:49	NA	BCL00109	NA	BCL001S	11/25/1115:55	11/28/11
7-012	K219-06	7720	1	18.8	739	739	12/05/1116:55	NA	BCL00110	NA	BCL001S	11/25/1115:40	11/28/11

Figure 2: TYPICAL LCS/LCSD SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
METHOD: WALKLEY BLACK
MATRIX: SOIL
% MOISTURE: NA

BATCH NO.: 11K219
SAMPLE ID: LCS1S/LCD1S
CONTROL NO.: BCL001SL/C

DATE RECEIVED: NA
DATE EXTRACTED: NA
DATE ANALYZED: 12/05/11 14:13/14:16

ACCESSION:

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TOC	ND	2000	2340	117	2000	2150	108	8	80-120	20

Figure 3: TYPICAL SAMPLE DUPLICATE RESULT SUMMARY

EMAX QUALITY CONTROL DATA
DUPLICATE ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN PROJECT
METHOD: WALKLEY BLACK
MATRIX: SOIL
% MOISTURE: 42.2

BATCH NO.: 11K219
SAMPLE ID: 7-007DUP
CONTROL NO.: K219-01D
DATE RECEIVED: 11/28/11
DATE EXTRACTED: NA
DATE ANALYZED: 12/05/11 17:55

ACCESSION:

PARAMETER	SAMPLE (mg/kg)	DUP. SAMPLE (mg/kg)	RPD (%)	RPD LIMIT (%)
TOC	26100	27500	5	25

Figure 4: TYPICAL CASE NARRATIVE

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN PROJECT

SDG : 11K219

METHOD WALKLEY BLACK
TOC

A total of six (6) soil samples were received on 11/28/11 for Total Organic Carbon analysis, Method WALKLEY BLACK in accordance with Methods of Soil Analysis by A.L. Page, R.H. Miller and D.R. Keeney, ASA, SSSA, 1992.

Holding Time
Samples were analyzed within the prescribed holding time.

Calibration
Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using a secondary source. Continuing calibration verifications were carried out at the frequency specified by the project. All calibration requirements were within acceptance criteria.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for BCL001SL/C were all within QC limits.

Matrix QC Sample
Sample duplicate was analyzed with the samples. RPD was within project limit.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

QC PROCEDURE	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	1ST Rvw	2ND Rvw
Standardization	Daily prior to sample analysis	Mean of replicate titration should be within 90-110% of expected value	Prepare a fresh standard and perform standardization.		
Method Blank	One MB per preparation batch	≤ ½ LOQ	If results are ND or result is > 10X of MB result, sample result may be reported, otherwise re-analyze all associated samples.		
LCS	One LCS per preparation batch	% Recovery: 80-120	Re-prep and re-analyze the LCS and all associated samples.		
Duplicate Sample	One sample duplicate per preparation batch	RPD ≤ 20%	If MB and LCS is under control, matrix interference is suspected, discuss in case narrative.		
Comments: For flagging criteria, refer to attached PSR.			Reviewed By:		
			Date:		

Appendix 2: DEMONSTRATION OF CAPABILITY

DEMONSTRATION OF CAPABILITY
TOTAL ORGANIC CARBON
TOC WALKLEY BLACK

SOP: EMAX-TOCWB
Conc Unit: mg/Kg
Sample Amount(g): 2

Analyzed date: 08/11/11 & 08/25/11
Analyzed by: C. Schwab

PARAMETER	BCH002SL	BCH002SC	BCH003SL	BCH003SC	TV	Ave. Conc.	Ave. %Rec	SD	RSD (%)	QC Criteria	COMMENTS
	BCH00202	BCH00203	BCH00302	BCH00303							
Total Organic Carbon	2110	2210	2190	2290	2000	2200	110	74	3.4	80 - 120	PASSED

TOCWBFA: **ANALYTICAL RUN LOG**

PrepBatchID	LabSampleID	Aliquot	Unit	DateTime	K_2CrO_7	$FeSO_4$	Moisture %	DateTime	TOC (WetBasis)	TOC (DryBasis)	Result(%)	Result (mg/Kg)	Notes

Standard/Reagent ID	Description	Concentration	Exp.Date
	K_2CrO_7 (N)	1	
	$FeSO_4$(N)	0.5	
	H_2SO_4	concentrated	
	Ag_2SO_4(g/L)	15	
	H_3PO_4	concentrated	
	O-Phenanthroline-ferrous complex		
	TOC LCS(%)	0.2	

STANDARDIZATION			
K_2CrO_7(ml)	$FeSO_4$(ml)	Conc.(N)	DATE
Average Normality of $FeSO_4$=			

Balance ID: 10304418. Calibration check was verified prior to use.

Micropipette ID:

QC Check	Result	ExpectedValue	Comment

Comment:

☐ EMAX-TOCWB Rev.

Analyzed By:

Checked By:

Date:

This SOP was effective 02/01/2014 as indicated
on the signatures on page 2 of this document
RP 10/8/2014

ALS Standard Operating Procedure

Uncontrolled Document

DOCUMENT TITLE: *ANALYSIS OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)*

REFERENCED METHOD: *EPA 1613B / EPA 8290A / M23 / TO-9A*
SOP ID: *HE-HMS001*
REV. NUMBER: *0.1*
EFFECTIVE DATE: *02/01/2013*

ANALYSIS OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)

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Approved By: _____ Date: 01-21-14

Technical Director – Lan Le

Approved By: _____ Date: 1-21-14

QA Manager – Rebecca Pierrot

Approved By: _____ Date: 01-21-14

Laboratory Director – Jim Piassard

Archival Date:		Doc Control ID#:		Editor:	

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Uncontrolled Document

ANALYSIS OF POLYCHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)

1) SCOPE AND APPLICATION

1.1 This procedure provides the analytical conditions and procedures for the detection and quantitative measurement of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in extracts by isotope dilution High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS).

1.2 The procedure incorporates the analysis of PCDDs/PCDFs via the following referenced methods:

- 1.2.1 US EPA Office of Water, Method 1613B
- 1.2.2 US EPA Office of Solid Waste, SW846 Method 8290A
- 1.2.3 US EPA Office of Research and Development Method TO-9A
- 1.2.4 US EPA Office of Air Quality Planning & Standards Method 23

1.3 The following compounds can be determined by this method:

Analyte	CAS Registry No
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)	1746-01-6
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin (PeCDD)	40321-76-4
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)	39227-28-6
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin (HxCDD)	57653-85-7
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin (HxCDD)	19408-74-3
1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin (HpCDD)	35822-46-9
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin (OCDD)	3268-87-9
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0
Total Tetrachlorodibenzo-*p*-dioxin (TCDD)	41902-57-5
Total Pentachlorodibenzo-*p*-dioxin (PeCDD)	36088-22-9
Total Hexachlorodibenzo-*p*-dioxin (HxCDD)	34465-46-8
Total Heptachlorodibenzo-*p*-dioxin (HpCDD)	37871-00-4
Total Tetrachlorodibenzofuran (TCDF)	55722-27-5
Total Pentachlorodibenzofuran (PeCDF)	30402-15-4
Total Hexachlorodibenzofuran (HxCDF)	55684-94-1
Total Heptachlorodibenzofuran (HpCDF)	38998-75-3

1.4 The calibration range of this procedure is 0.25 to 200 ng/mL for TCDD/TCDF and

PeCDD/PeCDF. This equates to 5 to 4,000 ppq for a 1L water samples, 0.5 to 400 ppt for a 10g soil, sediment, ash, or tissue samples, and 5 to 4000 pg/sample for air samples (TABLE 1).

1.5 A calculation for reporting the analytical results using a 2,3,7,8-TCDD toxicity equivalency factor (TEF) to obtain a total toxicity equivalence quotient (Total TEQ) is described. Refer to the current revision of HE-HMS003 for further discussion of Total TEQ.

1.6 This procedure is designated for use by, or under the supervision of analysts experienced with residue analysis and skilled in HRGC/HRMS.

1.7 This procedure details the operating conditions and requirements for PCDD/PCDF analysis by HRMS. For specific details regarding the instrument operations and troubleshooting, refer to the User Manual for each component of the system (Section 19)).

2) METHOD SUMMARY

2.1 Samples are prepared for analysis using matrix specific extraction techniques, analyte specific clean up, and HRGC/HRMS analysis techniques. The SOPs for these procedures are listed in TABLE 1.

2.2 The preparation of the final extract for HRGC/HRMS analysis is accomplished by adding 20µL of a nonane solution, containing 100 pg/µL of the recovery standards ^{13}C-1,2,3,4-TCDD and ^{13}C-1,2,3,7,8,9-HxCDD, to the extract. These compounds are used to determine the percent recoveries of the isotopically (^{13}C) labeled standards. TABLE 2 outlines the relationships between recovery standards and labeled internal standards

2.3 A 1-µL aliquot of the concentrated extract is injected into a HRGC/HRMS system capable of performing selected ion monitoring at resolving powers of at least 10,000 (10 percent valley definition).

2.4 The congeners associated directly with ^{13}C labeled standards are identified based on the elution of the congeners at the same retention times as their respective labeled standards. The remaining congeners for which ^{13}C labeled standards are not present are identified when their retention times fall within the windows established during routine calibration. All congeners are also identified based on the simultaneous detection of the two most abundant ions as well as the comparison of the ratio of these two ions with theoretical ion abundance ratios.

2.5 Quantitation of the individual congeners, total PCDDs, and total PCDFs is achieved in conjunction with the establishment of a multipoint calibration curve for each homologue. For details on processing data obtained through this procedure, refer to the current revision of the SOP for HRMS Data Review and Reporting (***HE-HMS003***).

3) DEFINITIONS

3.1 Abbreviations

PCDD	=	Polychlorinated dibenzo-*p*-dioxin
PCDF	=	Polychlorinated dibenzofurans
TCDD	=	Tetrachlorodibenzo-*p*-dioxin
PeCDD	=	Pentachlorodibenzo-*p*-dioxin

HxCDD	=	Hexachlorodibenzo-*p*-dioxin
HpCDD	=	Heptachlorodibenzo-*p*-dioxin
OCDD	=	Octachlorodibenzo-*p*-dioxin
TCDF	=	Tetrachlorodibenzofuran
PeCDF	=	Pentachlorodibenzofuran
HxCDF	=	Hexachlorodibenzofuran
HpCDF	=	Heptachlorodibenzofuran
OCDF	=	Octachlorodibenzofuran
PFK	=	Perfluorokerosene
CS	=	Clean up standard
IS	=	Internal standard
RS	=	Recovery standard
HRGC	=	High-resolution gas chromatography
HRMS	=	High-resolution mass spectrometry
TEF	=	Toxicity equivalence factor
TEQ	=	Toxicity equivalent

3.2 **Polychlorinated dibenzo-p-dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs)** - compounds that contain from 1 to 8 chlorine atoms, resulting in a total of 75 PCDDs and 135 PCDFs. The structures are shown in Figure 1.

3.3 **Isomer** - compounds having the same number and type of chlorine atoms, but substituted in different positions.

3.4 **Internal Standard Solution**- a solution containing the isotopically labeled analogs that is added to all samples, including method blanks and quality control samples, before extraction. The labeled standards are used along with response factors to measure the concentrations of the analytes. (Table 2).

3.5 **Calibration Solutions** - solutions containing known amounts of unlabeled PCDDs/PCDFs and labeled standards (Table 4). These solutions are used to determine the instrument response of the unlabeled analytes relative to the C^{13} labeled standards.

3.6 **Recovery Standard Solution** - a solution containing the recovery standards that are added to the extract after final concentration for HRGC/HRMS analysis to determine the recovery efficiencies achieved for the C13 labeled standards (Table 3).

3.7 **Clean Up Standard Solution** - a solution containing one Cl37 labeled standard that is to be spiked to the sample extract prior to performing any clean up procedures (Table 3)

3.8 **Matrix Spike Solution** - a solution of native (unlabeled) PCDDs and PCDFs that are spiked into the laboratory control samples or matrix spike samples prior to extraction (Table 3).

3.9 **Method Blank (MB)** - represents the background contributions from glassware, extraction and clean up solvents. An MB is spiked with a solution of C13 labeled

internal standards, extracted, cleaned up, and analyzed by HRGC/HRMS in exactly the same manner as the test samples.

3.10 **Laboratory Control Sample** - A known matrix spiked with analytes representative of the target analytes. This sample is used to document laboratory performance.

3.11 **Allowable Marginal Exceedance** - random outliers to acceptance criteria, which are not occurring repeatedly, and a systematic way. The number of allowable marginal exceedances for any LCS/DLCS is 1, based on the 17 analytes reported for this procedure.

4) INTERFERENCES

4.1 Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts or elevated baselines that may cause misinterpretation of the chromatographic data. All materials used during the extraction procedure must be demonstrated to be free from interferences under the conditions of analysis by performing laboratory method blanks. Analysts should avoid using polyvinylchloride gloves.

4.2 The use of high purity reagents and solvents helps minimize interference problems. Solvent lots are tested for the absence of PCDDs and PCDFs prior to use by the laboratory.

4.3 Interferences co-extracted from the sample will vary considerably from matrix to matrix. PCDDs and PCDFs are often associated with other interfering chlorinated substances such as polychlorinated biphenyls (PCBs), polychlorinated diphenyl ethers (PCDPEs), polychlorinated naphthalenes, and polychlorinated alkyldibenzofurans that may be found at concentrations several orders of magnitude higher than the analytes of interest. Retention times of target analytes are verified using reference standards. These values must correspond to the established retention time windows. Refer to HE-EXT003 for cleanup options available to reduce interferences, and to achieve lower detection limits.

4.4 Interference with 2,3,7,8-TCDF is well documented on the DB-5 chromatographic column. As such, all positive 2,3,7,8-TCDF detections are confirmed on a DB-225 (Section 12.6.3) chromatographic column which is capable of resolving 2,3,7,8-TCDF from other TCDF isomers.

5) SAFETY

5.1 The 2,3,7,8-TCDD isomer has been found to be acnegenic, carcinogenic, and teratogenic in laboratory animal studies. Other PCDDs and PCDFs containing chlorine atoms in positions 2,3,7,8 are known to have toxicities similar to that of 2,3,7,8-TCDD. As such, 2,3,7,8-chlorine substituted isomers can pose health hazards if handled improperly. Only highly trained individuals who are thoroughly versed in appropriate laboratory procedures and familiar with the hazards of dioxins should handle these substances.

5.2 The laboratory will ensure that all analysts receive adequate safety training prior to working with the chemicals and compounds associated with this method.

5.3 The solvents and acids in use in the laboratory may be hazardous and should be treated as such. Exposure to these chemicals must be kept to a minimum. See the

Environmental Health and Safety Manual, ***CHP*** (Chemical Hygiene Plan), Section 5, for more information. Additionally, material safety data sheets (MSDS) are available in the laboratory for review prior to handling solvents and reagents.

5.4 Finely divided dry soils contaminated with PCDDs and PCDFs are particularly hazardous due to the potential for inhalation and ingestion. Samples of this nature should be processed under a fume hood. Additionally, fitted masks, with charcoal filters should be worn to prevent the inhalation of dust. Any activity that may generate airborne contamination must be performed with good ventilation.

5.5 The toxicity or carcinogenicity of each reagent used in this method is not precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be kept to a minimum.

5.6 A useful method for determining cleanliness of work surfaces and tools is to wipe the surface with a piece of filter paper, extract the filter paper and analyze the extract.

5.7 Materials known, or suspected to contain 2,3,7,8-Substituted PCDD/PCDFs, including environmental samples submitted for analysis must be confined to designated work areas. This includes, but is not limited to samples, standards, reagents, and glassware.

5.8 Personal Protective Equipment (PPE) - Disposable gloves, lab coats, safety glasses, and fume hoods adequate for work with these materials must be used. Cut resistant liners may be worn to protect against injury caused by broken glass. At the option of the analyst, protective shoe covers and pants may be worn. See the Environmental Health and Safety Manual, ***CHP*** (Chemical Hygiene Plan), for more information.

5.9 Thorough washing of hands and forearms after each handling of samples or extracts and before breaks (coffee, lunch, and shift) is recommended. Workers must be trained in the proper method of removing contaminated gloves and clothing without contacting the exterior surfaces. Gloves must be one time use only and must be changed frequently to minimize exposure.

5.10 Care must be taken when handling compressed gas tanks in the laboratory. All cylinders must be properly secured at all times. See Section 6 of the ***CHP*** for more information.

5.11 Low-level contamination is always a possibility for HRGC/HRMS analysis due to the chemical properties of dioxins/furans and the low detection limits of the instruments.

6) SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1 Refer to the appropriate preparatory SOP (TABLE 1) for sample collection, containers, preservation and storage requirements.

6.2 Sample extracts are stored in the dark at room temperature. Sample extracts must be analyzed within 45 days of extraction. Extract of tissue samples submitted for analysis by method 8290A must be analyzed within 45 days of *collection*. If analysis occurs after this holding time, the results are considered minimum concentrations, and must be noted as such in the case narrative.

6.3 Unused portions of sample extracts are stored for one year after analysis.

7) APPARATUS AND EQUIPMENT

7.1.1 **High-Resolution Gas Chromatograph/High-Resolution Mass Spectrometer/Data System (HRGC/HRMS/DS)** - The laboratory utilizes HRGC/HRMS/Data Systems designed to meet the requirements for the analysis of PCDD/PCDFs.

7.1.2 Specifically, the laboratory employs the following systems:

7.1.2.1 An Agilent 6890N Gas Chromatograph with a CTC A200S Autosampler interfaced to a Micromass Autospec Ultima High Resolution Mass Spectrometer.

7.1.2.2 An Agilent 6890N GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Ultima HRMS.

7.1.2.3 An Agilent 7890A GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Premier HRMS.

7.1.2.4 An Agilent 7890A GC with a CTC A200S Autosampler interfaced to a Micromass Autospec Premier HRMS.

7.1.3 Micromass MassLynx (Version 4.1) is used to obtain all data from the HRMS system.

7.1.4 Chromatographic data is processed using OpusQuan version 3.6. Detailed procedures for data reduction are discussed in the current revision of ***HE-HMS003***.

7.2 GC Columns

7.2.1 The laboratory employs the following chromatographic columns capable of meeting method performance criteria outlined in Section 13.2.

7.2.1.1 60m DB-5 fused silica capillary column (J&W Scientific, Agilent 122-5062 or equivalent) - This column is used for the initial determination of PCDDs/PCDFs (TABLE 2).

7.2.1.2 30m DB-225 fused silica capillary column (J&W Scientific, Agilent 122-2232, or equivalent) - This column is used to confirm the presence of 2,3,7,8-TCDF in samples when the congener is detected on the DB-5 column. This column is also available for samples requiring 2,3,7,8-TCDD reporting only.

7.3 **Miscellaneous Equipment and Materials** - The following list of items does not necessarily constitute an exhaustive compendium of the equipment needed for this analytical method (laboratory specific equipment in parentheses).

7.3.1 20mL scintillation vials (VWR, 66022-004)
7.3.2 Laboratory fume hoods
7.3.3 Pipet tips, 2-200uL and 10-1000uL (Eppendorf, 022492039 and 022492055, respectively)
7.3.4 GC Gooseneck Splitless Liners, 2mm inner diameter (Restek, 20797)
7.3.5 Thermogreen™ LB-2 11mm Septa (Supelco, 20654)
7.3.6 Autosampler Vial Caps, Seal with PTFE Liner, 11mm (Supelco, 27102-U)
7.3.7 Carrier Gas, Ultra High Purity Helium (Airgas)
7.3.8 Perfluorokerosene (PFK) (SynQuest, SpectraSynQ PKF-H, PN 1200-2-20)
7.3.9 Ultrasonicator (Bransonic Ultrasonic Cleaner, 5510R-MT)
7.3.10 Supeltex™ M-2A Ferrules 0.4mm ID (Supelco, 22474)

8) STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

8.1 All standards, reagents, and consumable materials must be logged in and labeled with a unique standard ID upon receipt. Refer to the current revision of the SOP for Standard Receipt and Preparation, ***HE-EXT006***, for details of standard handling and

traceability. Store standards in the dark at room temperature.

8.2 Solvents

8.2.1 Methanol - 99.9% minimum Assay (HPLC Grade, JT Baker, UN1230, or equivalent)

8.2.2 Nonane - 99.9% minimum Assay (HPLC Grade, Sigma, N29406-500mL, or equivalent)

8.2.3 Toluene - 99.9% minimum Assay (HPLC Grade, JT Baker, UN1294, or equivalent)

8.3 **High-Resolution Concentration Calibration Solutions** - A series of nonane solutions containing unlabeled and carbon-labeled PCDDs and PCDFs at known concentrations are used to calibrate the instrument. The concentration ranges of these series are homolog dependent. Refer to TABLE 4 for specific homolog concentrations at each calibration level. These standards are purchased prepared and are assigned the manufacturer's expiration dates. Store at room temperature in the dark.

8.4 **Window Defining/GC Column Performance Mix Solution (WDM)** - This solution contains the first and last eluting isomers for each homologous series from tetra- through heptachlorinated congeners. The solution also contains a series of other TCDD isomers for the purpose of documenting the chromatographic resolution. The labeled 2,3,7,8-TCDD and TCDF are also present (TABLE 5). This is purchased prepared at 200ng/mL and is assigned the manufacturer's expiration date. Store at room temperature in the dark.

8.5 **Recovery Standard Solution** - Individual labeled analytes are combined to make a recovery standard stock solution. Perform an additional dilution on the stock solution to make a recovery standard working solution. Store at room temperature in the dark.

8.6 **Initial Calibration Verification Standard (Reference Standard)** - This standard is a CS-3 mix purchased from a supplier other than the primary standard supplier, and serves as the second source verification of the initial calibration. This CS-3 mix is not used as the daily calibration verification standard. This standard is purchased pre-made and assigned the manufacturer's expiration date. Store at room temperature, in the dark.

8.7 **Research standards must be adequately labeled as such.** All labels for standards designated for research must also state specifically the intended research to be done, along with an appropriate qualifier, such as "For research purposes only."

9) PREVENTIVE MAINTENANCE

9.1 For details on performing preventive and routine maintenance, refer to the user manual for the specific component being maintained.

9.2 Record all maintenance activities in the designated instrument maintenance logbook.

9.3 Carrier gas - Inline purifiers or scrubbers must be in place for all sources of carrier gas. These remove water, oxygen, and hydrocarbons. Purifiers are changed as recommended by the supplier.

9.4 Gas Chromatograph

9.4.1 Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum,

column ferrule, and auto sampler syringe as needed. Liners are replaced, at a minimum, before every 12-hour shift. Seals changed when recent sample analyses predict a problem with chromatographic performance. Liners may be cleaned and re-used.

9.4.2 Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column-cutting tool.

9.4.3 The performance of the column will deteriorate over time. The rate of deterioration is also dependant on the nature of the samples analyzed. A new column is required when, despite preventive maintenance, acceptable routine and/or initial calibrations cannot be achieved.

9.5 Mass Spectrometer

9.5.1 Tune the MS as needed to result in consistent and acceptable performance.

9.5.2 The outer source should be cleaned, as needed, depending on the performance of the instrument.

9.6 Preventive maintenance is performed annually by the service engineer for instruments under a service contract.

10) RESPONSIBILITIES

10.1 It is the responsibility of the analyst to perform the analysis according to the instructions in this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are only to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data. Problems that require corrective action are to be documented by the analyst, and brought to the attention of the Operations Manager.

11) PROCEDURE FOR SAMPLE PREPARATION

11.1 Refer to the appropriate preparatory SOP as outlined in TABLE 1, for details regarding the preparation, extraction concentration and clean-up of samples.

12) PROCEDURE FOR HRGC/HRMS ANALYSIS AND CALIBRATION

12.1 Typical Chromatographic/Mass Spectrometric Conditions and Data Acquisition Parameters, actual parameters may vary based on instrument optimization.

Gas Chromatograph - Operating Conditions
Column coating: DB-5
Film thickness: 0.25µm
Column dimension: 60 m x 0.25mm
Injector temperature: 300°C
Splitless valve time: 1 min
Interface temperature: 300°C
Temperature program:

DB-5	INITIAL	INITIAL HOLD TIME,	TEMPERATURE RAMP,	FINAL TEMP	FINAL HOLD TIME,

STAGE	TEMP °C	MIN	°C/MIN	°C	MIN
1	150	5	35	215	5
2			1.5	230	6
3			7	315	5

Column coating: DB-225
Film thickness: 0.25µm
Column dimension: 30 m x 0.25mm
Injector temperature: 240°C
Splitless valve time: 1 min
Interface temperature: 320°C
Temperature program:

DB-225 STAGE	INITIAL TEMP °C	INITIAL HOLD TIME, MIN	TEMPERATURE RAMP, °C/MIN	FINAL TEMP °C	FINAL HOLD TIME, MIN
1	130	2.5	40	170	0
2			5	210	1
3			3	230	13

12.1.1 Mass Spectrometer (MS) Resolution

12.1.1.1 The mass spectrometer is operated in electron ionization mode, utilizing select ion monitoring (SIM) to monitor the ions listed in TABLE 10 for each of the five SIM descriptors. The total cycle time (including the voltage-reset time) is < 1 second. The set of ions monitored for the initial calibration is monitored during sample analysis. The lock-mass ion for each descriptor is defined in TABLE 10.

12.1.1.2 Details for tuning the instrument are outlined in the user manual for each instrument. The mass spectrometer tuning conditions are based on the groups of monitored ions shown in TABLE 10. By using a PFK molecular leak, tune the instrument to meet the minimum required static resolving power of 10,000 (10% valley) at m/z 304.9824 (PFK).

12.1.1.3 Using peak matching conditions and the aforementioned PFK reference peak, verify that the exact mass of m/z 380.9760 (PFK) is within 5 ppm of the required value. Note that the selection of the low mass and high mass ions must be such that they provide the largest voltage jump performed in any of the five mass descriptors.

12.1.1.4 Additionally, for all methods except EPA 8290A, 3-5 masses from each descriptor must be monitored to verify 10,000 resolution is met. EPA 8290A requires that only m/z 304.9824 and 380.9760 meet the 10,000 resolution.

12.1.1.5 The chromatography time for PCDDs/PCDFs exceeds the long-term mass stability of the mass spectrometer. Because the instrument is operated in high-resolution mode, mass drifts of a few ppm (e.g., 5 ppm in mass) can have serious adverse effects on instrument performance. Therefore, mass drift correction is required. This is why a lock-mass ion from the PFK reference compound is used to tune the instrument.

12.1.1.6 During tuning the level of PFK metered into the ion chamber during analysis, should be adjusted so that the amplitude of the most intense selected lock-mass ion signal does not exceed 10% of the full scale deflection for a given set of detector parameters. Under those conditions, sensitivity changes that might occur during the analysis can be more effectively monitored.

Note: Excessive PFK may cause noise problems and contamination of the ion source resulting in an increase in downtime for source cleaning.

12.1.1.7 Document each mass resolution check by printing the MassLynx "Experiment Calibration Report," which provides a peak profile includes the result of the peak width measurement (performed at 5% of the maximum, which corresponds to the 10% valley definition. This report also allows for the determination of the resolution.

12.2 Data Acquisition

12.2.1 The total cycle time for data acquisition must be <1 second. The total cycle time includes the sum of all the dwell times and voltage reset times.

12.2.2 Acquire SIM data for all the ions listed in the five descriptors (TABLE 10).

12.3 Window Define / GC Column Performance- Window Define / GC Column Performance must be demonstrated (and documented) to be acceptable before further analysis can be performed, including initial calibrations.

12.3.1 Inject 1 µL of the Window Define Mixture (WDM; Section 8.4) and acquire selected ion monitoring (SIM) data as described above (Section 12.2).

12.3.2 The chromatographic separation between 2,3,7,8-TCDD and the peaks representing any other unlabeled TCDD isomers must be resolved with a valley of at least 25%. This is verified using the following equation:

$$\text{Valley Percent} = \frac{X}{Y} \times 100$$

Where:

X = Trough height measured between 2,3,7,8-TCDD and its closest eluting isomer

Y = Peak height of 2,3,7,8-TCDD

12.3.3 The WDM also contains the known first and last PCDD/PCDF eluters under the conditions described in Section 12.1. The retention times of these isomers are used to determine the five homologue retention time windows that are used for qualitative (Section 13.5.1) and quantitative purposes (Section 14.2.1). All peaks, including $^{13}C_{12}$-2,3,7,8-TCDD, are labeled and identified on the chromatograms. Individual selected ion current profiles (SICPs) are presented for each homologous series, as well as labeled compounds

12.3.4 Retention times for the switching of SIM ions characteristic of one homologous series to the next higher homologous is indicated in the SICP. Accurate switching at the appropriate times is necessary for accurate monitoring PCDDs/PCDFs. Particular care must be exercised for the switching time between the last tetrachlorinated congener (1,2,8,9-TCDD) and the first pentachlorinated congener (1,3,4,6,8-PeCDF), which elute within 15 seconds of each other on the 60-m DB-5 column. Corrective action is required if these congeners cannot be resolved.

12.4 Initial Calibration - Initial calibration (ICAL) is required before any samples may be analyzed for PCDDs and PCDFs. Initial calibrations are performed annually and after significant instrument maintenance such that an acceptable continuing calibration

cannot be obtained following stabilization. .

12.4.1 Tune the instrument according to section 12.1.1.2.

12.4.2 Inject 1µL of the GC Window Define solution and acquire SIM mass spectral data. Verify that the criteria for this column performance check (Section 13.2.2) is met before proceeding.

12.4.3 Using the same GC and MS conditions, analyze a 1µL portion of each calibration solution in order of lowest to highest concentration. Each point in the calibration must meet the conditions for ion abundance ratio and signal-to-noise ratio outlined in section 12.4.7. If these criteria are not met, identify the cause of the error, perform appropriate corrective action and reanalyze the entire ICAL.

12.4.4 Calculate the 17 relative response factors (RF) for the target analytes [RF_n; n = 1-17, TABLE 4]. The response factors are relative to the target analytes and the RFs for the internal standards [RF_{is}; is = 18 to 32]. The response factors for the cleanup standard [RF_{cs}, cs = 33] is also related to the recovery standard using the following equations:

$$RF_n = \frac{(A_n^1 + A_n^2) \times Q_{is}}{(A_{is}^1 + A_{is}^2) \times Q_n} \qquad RF_n = \frac{(A_{is}^1 + A_{is}^2) \times Q_{rs}}{(A_{rs}^1 + A_{rs}^2) \times Q_{is}}$$

$$RF_n = \frac{(A_{cs}) \times Q_{rs}}{(A_{rs}^1 + A_{rs}^2) \times Q_{cs}}$$

Where:

A_n^1 and A_n^2 = sum of the integrated ion abundances of the quantitation ions for unlabeled PCDDs/PCDFs.

A_{is}^1 and A_{is}^2 = sum of the integrated ion abundances of the quantitation ions for the internal standard PCDDs/PCDFs.

A_{rs}^1 and A_{rs}^2 = sum of the integrated ion abundances of the quantitation ions for the labeled recovery standards.

A_{cs} = integrated ion abundance of the quantitation ion for the labeled cleanup standard.

Q_{is} = quantity of the internal standard injected (pg).

Q_{rs} = quantity of the recovery standard injected (pg).

Q_{cs} = quantity of the clean up standard injected (pg).

Q_n = quantity of the unlabeled PCDD/PCDF analyte injected (pg).

12.4.5 Calculate the mean response factors for the five calibration solutions:

$$\overline{RF_n} = \frac{\sum_{j=1}^{x} RF_{n(j)}}{x} \qquad \overline{RF_m} = \frac{\sum_{j=1}^{x} RF_{m(j)}}{x}$$

Where

n = The particular native congener (n = 1 to 17)

m = The particular labeled congener (m = 18 to 26)

x = The number of calibration injections, or solutions

j = The injection number (or calibration solution number)

RF_n = Relative response factor of a particular native compound (n) relative to an appropriate internal standard, as determined from each injection

$\overline{RF_n}$ = Calculated mean relative response factor of a particular native compound (n) relative to an appropriate internal standard, as determined from the initial calibration injections (j)

RF_m = Relative response factor of a particular internal standard (m) relative to an appropriate recovery standard, as determined from each injection

$\overline{RF_m}$ = Calculated mean relative response factor of a particular labeled standard (m) relative to an appropriate recovery standard, as determined from the initial calibration injections (j)

12.4.6 The relative response factors to be used for the determination of the concentration of total isomers in a homologous series are calculated as follows:

12.4.6.1 For congeners that belong to a homologous series with only one isomer (e.g., OCDD and OCDF) or only one 2,3,7,8-substituted isomer (TCDD, PeCDD, HpCDD, and TCDF), the mean RF used will be the same as the mean RF for that single isomer.

12.4.6.2 For congeners that belong to a homologous series containing more than one 2,3,7,8-substituted isomer, the mean RF used for those homologous series is the mean of the RFs calculated for all individual 2,3,7,8-substituted congeners using the equation below:

$$\overline{RF_k} = \frac{1}{t}\sum_{n=1}^{t} RF_n$$

Where:

k = 34 to 37; with 34=PeCDF; 35=HxCDF; 36=HxCDD; and 37=HpCDF (TABLE 4)

t = total number of 2,3,7,8-substituted isomers present in the calibration solutions for each homologous series (e.g., two for PeCDF, four for HxCDF, three for HxCDD, two for HpCDF).

12.4.7 Criteria for Acceptable Calibration – The criteria listed below for acceptable calibration must be met before sample analyses are performed.

12.4.7.1 The percent relative standard deviations for the mean response factors [$\overline{RF_n}$ and $\overline{RF_m}$] for each native and labeled isomer must meet the criteria outlined in TABLE 6, for the appropriate method.

12.4.7.2 The Ion Abundance Ratio for all native and labeled isomers must be the criteria outlined in TABLE 9.

12.4.7.3 For each selected ion current profile (SICP) and for each GC signal corresponding to the elution of a target analyte and of its labeled standards, the signal-to-noise ratio (S/N) must be better than or equal to 10.0.

12.4.8 Secondary Source Verification – Immediately following the analysis of the five calibration solutions, analyze the *Initial Calibration Verification Standard* (Section 8.6) to verify the accuracy of the calibration. The quantified values of this analysis must be within the criteria listed in TABLE 6.

12.4.9 Initial Calibrations are required annually, or under the following circumstances:

12.4.9.1 When a CCAL does not yield acceptable results after appropriate corrective actions;

12.4.9.2 Following significant instrument maintenance where subsequent column performance/continuing calibration verifications do not meet criteria once stabilized.

12.5 Instrument Sequence:

12.5.1 Once an acceptable initial calibration has been performed and verified through the analysis of the second source verification standard, sample analysis may commence. The following is an example of a typical continuous analytical sequence:

1A Window Define Mix/Column Performance Check
2A CS3
3A Method or Solvent Blank
4A Batch QC/Samples
1B Window Define Mix/Column Performance Check
2B CS3
3B Method or Solvent Blank
4B Batch QC/Samples
1C .....

12.5.2 In the sequence above items 1A through 4A represent the first 12-hour run sequence immediately followed by the next. The key requirements for each sequence are as follows:

12.5.2.1 A Mass Resolution Check is required before and after each 12 hour sequence, and must meet criteria outlined in Section 13.2.1.

12.5.2.2 The time of injection of the last sample must not be greater than 12 hours after the injection of the Window Define Mix/Column Performance Check.

12.5.2.3 Instrument conditions must remain constant during the 12-hour sequence, and no injections may occur between the last injection of the 12 hour period and the ending mass resolution check.

12.5.2.4 For Method 8290A, and some specified contract requirements, a CS3 is required to be analyzed successfully at the end of the 12-hour sequence. In this case, the time of injection of the CS3 must not be greater than 12 hours after the injection of the Window Define Mix/Column Performance Check. This verification check must meet the criteria outlined in TABLE 6.

12.5.2.5 When an ending CS3 meets the criteria for an opening CS3, it can serve as the opening CS3 for the following sequence (1B). In this case, the start of the 12-hour shift is the injection time of the CS3.

12.5.2.6 A System Blank *or* Method Blank is at the beginning of the sequence.

12.6 Extract Analysis:

Allow the extract to reach near dryness, add 20µL of recovery standard (Table 3) to the final dry extract. Mix the extract well using the vortex

12.6.1 Inject a 1µL aliquot of the extract into the GC, and analyze via the DB-5 column.

12.6.2 <u>Acquire SIM data</u> - Use the same acquisition and mass spectrometer operating

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conditions previously used to determine the relative response factors.

12.6.3 Additional option for 2,3,7,8-TCDD only samples:

12.6.3.1 Samples that only require the analysis of 2,3,7,8-TCDD may also be analyzed on the DB-225. This column provides demonstrated equivalent sensitivity, precision and accuracy for 2,3,7,8-TCDD. The selectivity of this column for 2,3,7,8-TCDD has not been demonstrated by the laboratory. As such, any positive detection for 2,3,7,8-TCDD must be confirmed on the DB-5 column.

12.6.4 Confirmations for 2,3,7,8-TCDF

12.6.4.1 Samples that exhibit a positive identification must be confirmed using the parameters below

The concentration of the 2,3,7,8-TCDF is obtained from the analysis of the sample extract on the 30m DB-225 fused silica capillary column. The chromatographic separation between the 2,3,7,8-TCDF and its close eluters (2,3,4,7-TCDF and 1,2,3,9-TCDF) must be equal or less than 25 percent valley.

12.6.5 Sample Dilutions: If the concentration in the final extract of any of the 2,3,7,8-substituted PCDD/PCDF compounds exceeds the upper method calibration limits (MCL), the linear range of response versus amount has been exceeded. The extract can be diluted, using the procedures below, to bring the analyte within the linear range. If dilution would not bring the analyte into the linear range, the sample should be re-extracted using a smaller sample volume.

12.6.5.1 To prepare a dilution of 1:50 or less:

Combine a portion of the extract equal to the dilution factor (i.e. 1/10th of the extract for a 1:10 dilution) with an amount of internal and recovery standards equal to the amount added prior to extraction and analysis, respectively. For extracts that may have partially evaporated between the analysis and the dilution, the volume must be brought back up to the extract volume following the most recent analysis prior to removing the portion to be combined with the internal and recovery standards. Additional solvent may be added to allow for the accurate retrieval of the portion removed for combination.

12.6.5.2 For dilutions higher than 1:50: Serial dilutions are necessary due to the limited size of the auto sampler vials and the high volume required for the accurate retrieval of the portion removed for combination. For example, to perform a 1:100 dilution, bring the extract volume up to the volume following the previous injection. Transfer 1/10th of the extract to a new auto sampler vial, and bring this volume up to a suitable amount. Transfer 1/10th of this new volume to a final vial, where 2000-4000 pg of the internal and 2000pg of the recovery standards are added. The successive 1:10 dilutions result in a 1:100 dilution.

12.6.5.3 Reanalyze the diluted sample using the labeled standard recoveries calculated from the initial analysis to correct the diluted results for

losses during the original extraction and clean up.

13) QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

13.1 Initial Precision and Recovery (IPR) – Demonstrates that the laboratory can meet method performance criteria through the processing of four laboratory control samples according to this procedure. Refer to the appropriate extraction and clean-up SOPs for specific sample preparation techniques.

13.1.1 Frequency: Prior to evaluating field samples for the first time, or following any major procedural changes.

13.1.2 Acceptance Criteria: Refer to TABLE 7 for Acceptance criteria.

13.1.3 Corrective Action: Identify and correct the source of the problem, perform the IPR again.

13.2 Method Performance Criteria – The following criteria must be met during initial method development, and verified thereafter.

13.2.1 Mass Spectrometer Performance: Verifies the resolving power of the mass spectrometer.

13.2.1.1 Frequency: At the beginning and end of each 12-hour instrument sequence. Specifically, prior to the GC column performance check, and immediately following the closing CCAL or last sample injection.

13.2.1.2 Acceptance Criteria: The static resolving power must be at least 10,000 (10 percent valley definition) at m/z 304.9824. The exact mass of m/z 380.9760 must be verified to be within 5 ppm of the required value.

13.2.1.3 Corrective Action: Identify and correct the source of the problem, re-tune the instrument. If the resolution check fails at the end of the sequence, then the data from the sequence must be evaluated to rule out chemical interference or deterioration of instrument sensitivity. If, upon review, it is determined that the samples exhibit diminished quality, then re-injection of the affected sample under acceptable instrument conditions is required. If data quality of the samples does not appear to be compromised, then the data may be reported with appropriate comment in the case narrative.

13.2.2 GC Column Performance (Window Define): Demonstrates adequate GC resolution and sensitivity, response factor reproducibility, and mass range calibration. Also establishes the PCDD/PCDF retention time windows.

13.2.2.1 Frequency: Prior to performing ICAL, and before each daily opening CCAL. Refer to Section 12.5.

13.2.2.2 Acceptance Criteria: Chromatographic separation of 2,3,7,8-TCDD and the closest unlabeled TCDD isomer must be ≤25%

NOTE: The analyst is required to verify the presence of 1,2,8,9-TCDD and 1,3,4,6,8-PeCDF in the SICPs in the window defining mix. Should either one compound be missing, the analyst is required to take corrective action as it may indicate a potential problem with the ability to detect all the PCDDs/PCDFs.

13.2.2.3 Corrective Action: Identify and correct the source of the problem and repeat the analysis of the GC Column Performance.

13.2.3 Continuing Calibration (CCAL) Criteria

13.2.3.1 Frequency: At the beginning and end of each 12-hour shift.

13.2.3.2 Acceptance Criteria: Refer to TABLE 6 for acceptance criteria for each referenced method.

13.2.3.3 Corrective Action:

Opening CCAL: Identify and correct the source of the failure. Re-analyze all affected samples.

Closing CCAL: If less than 2 hours has passed since the injection of the unacceptable CCAL, re-injection is appropriate. If this second injection does not meet acceptance criteria, or cannot be analyzed within 2 hours of the end of the sequence, then all samples with positive detections for the unacceptable analyte must be rerun. Samples that are non-detect may be reported with appropriate comments in the case narrative. Further investigation and documented corrective action is required to restore the instrument to acceptable control. If all corrective action efforts fail to bring the instrument into control, a new initial calibration is required.

13.3 Batch Performance: The following criteria must be met with each preparation batch of not more than 20 analytical samples.

13.3.1 Method Blank - Demonstrates that the analytical system is free from contamination.

13.3.1.1 Frequency: A MB is prepared with each preparation batch of 20, or less samples. A MB *or* System Blank is analyzed after the CCAL, prior to analyzing samples. The same blank extract may be analyzed more than once if the samples in a preparation batch are analyzed over more than on analytical sequence.

13.3.1.2 Acceptance Criteria: Tetra through Hepta congeners <MRL, Octa congeners < 3X MRL. Samples submitted under the DoD QSM: <1/2 MRL, or < 1/10 amount in any sample. Labeled standard recoveries meet criteria outlined in TABLE 8.

13.3.1.3 Corrective Action: Identify and correct the source of error. Re-analyze the blank to confirm contamination. If contamination is confirmed, re-extract all affected samples. If re-extraction is not possible, qualify each detection for that compound that is less than 10 times the concentration in the MB with a "B" flag, and provide a comment in the case narrative.

NOTE: A low or high percent recovery for a blank does not require discarding the analytical data but it may indicate a potential problem with future analytical data.

13.3.2 Laboratory Control Sample/Duplicate Laboratory Control Sample (LCS/DLCS)

13.3.2.1 Frequency: An LCS is prepared with each batch of 20, or less, samples. A DLCS is prepared when insufficient sample is provided to prepare a matrix spike/matrix spike duplicate.

13.3.2.2 Acceptance Criteria: Default acceptance criteria (OPR) are listed in TABLE 7 for Methods 1613 and 8290. Acceptance criteria for Methods 23 and TO-9A is 70% - 130%. Acceptance criteria for

labeled standards are listed in TABLE 8.

13.3.2.3 Corrective Action: Identify and correct the source of error. Review associated samples for potential diminished data quality. Unacceptable LCS results may indicate a compromise to one or more of the standards or to the extraction/clean-up process. If significant affects on data quality are observed for one or more samples in the batch, then the affect samples should be re-extracted and/or re-injected. If re-extraction is not possible due to limited sample, then report the data, with appropriate qualifiers and case narratives.

13.3.3 Matrix Spike and Matrix Spike Duplicate (MS/DMS)

13.3.3.1 Frequency: An MS/DMS combination is performed only at the request of the client. For Department of Defense (DoD), Texas Risk Reduction Program (TRRP), or MDH samples, an MS/DMS is required with each batch of samples. When an MS/DMS is prepared a DLCS is not required.

13.3.3.2 Acceptance Criteria: Default acceptance criteria are listed in TABLE 7. Acceptance criteria for Methods 23 and TO-9A is 70% - 130%. Acceptance criteria for labeled standards are listed in TABLE 8. If an analyte is present in the parent sample > 4 times the spiking level, these criteria are not applicable.

13.3.3.3 Corrective Action: If the LCS meets acceptance criteria, the batch is demonstrated to be in control. Evaluate the data for possible calculation or analytical error. Qualify the data and provide an explanation in the case narrative.

13.3.4 Sample Duplicate (DUP)

13.3.4.1 Frequency: A field sample duplicate is performed at the request of the client.

13.3.4.2 Acceptance Criteria: The %RPD between the two analyses must be ≤ 25%.

13.3.4.3 Corrective Action: Evaluate the sample for homogeneity. Evaluate the data for calculation or analytical errors. If, despite laboratory efforts to homogenize the sample, in inhomogeneity persists, report the data with appropriate qualifiers and comments in the case narrative. It may be necessary to re-extract and/or re-inject the sample and duplicate.

13.4 Isotopically Labeled Standards: Isotopically labeled standards utilized in this procedure serve a variety of purposes. They are generally added to each sample to monitor performance and/or for purposes of quantitation. Refer to TABLE 2 for an outline of appropriate associations for each of the referenced methods applicable to this procedure. TABLE 8 also provides acceptance criteria for each. Appropriate corrective actions for unacceptable recoveries are outlined below:

13.4.1 Labeled Internal Standards - Evaluate the source of error. Potential actions may include re-extraction, re-injection, additional clean-up, or qualifying the data. Unless there is clear evidence of matrix bias, ever effort should be made to resolve a labeled internal standard failure. In general, labeled internal standard recoveries above 20%, but below the lower acceptance criteria, may be reported with appropriate qualification and comments in the case narrative. Labeled internal standard recoveries less than 20% require re-extraction if possible.

13.4.2 Clean-up Standard – Evaluate the source of error, and potential affect on data quality. Report the data with appropriate qualifiers and comment in the case narrative.

13.4.3 Recovery Standard – A low recovery standard response indicates a failed injection. The most common corrective action is to re-inject the sample. A high recovery standard response indicates that the extract has concentration. Confirm the final volume of the extract. Otherwise a low or high response on the recovery standard indicates a potential problem with extract handling or interference. Unless there is a clearly identifiable cause of the failure, re-extraction and re-analysis is necessary.

13.4.4 Surrogate Standards - For air samples, if surrogate standards are unacceptable, re-inject the sample to confirm the failure. If possible re-extract the archived portion of the sample.

13.5 Identification Criteria – For a gas chromatographic peak to be identified as a PCDD or PCDF, it must meet all of the following criteria:

13.5.1 Retention Times.

13.5.2 The retention time (RT) of the peak maximum of all 2,3,7,8-substituted native isomers must be within -1 to +3 seconds of the RT of the corresponding $^{13}C_{12}$-labeled isomer. For native analytes that do not have a corresponding labeled isomer, the relative retention time (RRT) must be within 0.005 of the relative retention time observed in the daily CS3.

13.5.2.1 Identification of peaks associated with non-2,3,7,8-substituted isomers requires that the retention time be within the corresponding homologous retention time windows established by analyzing the GC Window Define solution.

13.5.3 Peak Matching for Quantification Ions.

13.5.3.1 The retention time (RT) of the peaks for each pair of quantification ions for each 2,3,7,8-native and labeled isomer must reach maximum simultaneously (± 2 seconds, or scans).

13.5.4 Ion Abundance Ratio Criteria.

13.5.4.1 For all compounds (labeled and native), with the exception of 2,3,7,8-TCDD-$^{37}Cl_{12}$, the specific ^{37}Cl:^{35}Cl isotopic ratio must be within the upper and lower limits in TABLE 9, or within 10% of those values observe on the most recent CS3 (Methods 1613B and DLM 2.2 only).

13.5.5 Signal-to-Noise Ratio.

13.5.5.1 All ion current intensities must be ≥2.5 times noise level for positive identification of a PCDD/PCDF compound or a group of coeluting isomers.

13.5.6 Polychlorinated Diphenyl Ether Interferences. In addition to the above criteria, the identification of a GC peak as a PCDF can only be made if no signal having a S/N≥2.5 is detected at the same retention time (±2 seconds) in the corresponding polychlorinated diphenyl ether channel. Compounds associated with a corresponding ether peak are assigned data qualifier flags to indicate the possible interference.

13.5.7 When samples are to be reported under Method 1613B for compliance purposes, all of the above criteria must be met. Otherwise the target analyte has not been identified, and results cannot be reported for compliance purposes. EMPC may be reported for samples analyzed under all other methods, and for non-compliance samples analyzed under Method 1613b.

13.6 Additional Requirements for Drinking Water Samples:

13.6.1 When performing drinking water analysis on samples originating in Arizona or Minnesota, a low-level LCS is required, in addition to routine sample QC. This sample must be spiked at the reporting limit and must have a recovery between 70% - 130%.

14) DATA REDUCTION AND REPORTING

14.1 Data reduction and reporting steps are outlined in detail in the most recent revision of the Data Review and Reporting SOP (HE-HMS003). Calculations are provided here for reference.

14.2 Calculations

14.2.1 For gas chromatographic peaks that have met the criteria, calculate the concentration of the PCDD or PCDF compounds using the formula:

$$C_x = \frac{A_x \times Q_{is}}{A_{is} \times wv \times \overline{RF_n}}$$

Where:

C_x = Amount of unlabeled PCDD/PCDF congeners (or group of isomers within a homologous series) in pg.

A_x = Sum of the integrated ion abundances of the quantitation ions for unlabeled PCDDs/PCDFs.

wv = Weight or volume, in g or L, of the sample (solid or liquid).

A_{is} = Sum of the integrated ion abundances of the quantitation ions for the internal standards.

Q_{is} = Quantity, in pg, of the internal standards added to the sample before extraction.

$\overline{RF_n}$ = Calculated mean relative response factor for the analyte RF_n [n = 1 to 17]

14.2.2 For internal standards and the clean up standard, calculate the recovery based on the recovery standards. Calculate the percent recovery measured in the sample extract, using the formula (TABLE 8):

$$\%Recovery = \frac{A_{is} \times Q_{rs}}{Q_{is} \times A_{rs} \times \overline{RF_m}} \times 100 \qquad \%Recovery = \frac{A_{cs} \times Q_{rs}}{Q_{cs} \times A_{rs} \times \overline{RF_m}} \times 100$$

Where:

A_{is}, A_{cs}, A_{rs} = sum of the integrated ion abundances of the quantitation ions for the internal, clean up (one ion), and recovery standards.

Q_{is}, Q_{cs}, Q_{rs} = quantity, in pg, of the internal, clean up, and recovery standards added to the sample prior to extraction.

$\overline{RF_m}$ = calculated mean relative response factor for the labeled internal (or clean up) standard relative to the appropriate recovery standard.

14.2.3 When a dilution is performed, calculate the results as below:

$$C_x = \frac{A_x \times Q_{is} \times DL}{A_{is} \times \overline{RF_n} \times \%Rec}$$

Where:

C_x = Amount of unlabeled PCDD/PCDF congeners (or group of coeluting isomers within a homologous series) in pg.

A_{is}, A_{cs}, A_{rs} = Sum of the integrated ion abundances of the quantitation ions for the internal, clean up (one ion), and recovery standards.

Q_{is}, Q_{cs}, Q_{rs} = Quantity, in pg, of the internal, clean up, and recovery standards added to the sample prior to extraction.

$\overline{RF_m}$ = Calculated mean relative response factor for the labeled internal (or clean up) standard relative to the appropriate recovery standard.

DL = Dilution factor of the reanalyzed extract

%REC = Percent recovery of the labeled internal standard in the original analysis of the extract as calculated above.

14.2.3.1 If there is significant interference present or if internal standard recoveries are below the acceptance criteria (Section 13.4), a re-extraction with a smaller sample size may be necessary. The analyst must take precautions to ensure a representative aliquot is taken (weights <2g are not recommended).

14.2.3.2 The total concentration for each homologous series of PCDD and PCDF is calculated by summing up the concentrations of all positively identified isomers of each homologous series. Therefore, the total will also include the 2,3,7,8-substituted congeners.

14.2.4 Sample Specific Estimated Detection Limit - An EDL is calculated for each 2,3,7,8-substituted congener that is not identified. This value represents the concentration at which the analytical system could detect the analyte, if present.

14.2.4.1 The background level is determined by measuring the noise (peak to peak) for the two quantitation ions of a particular 2,3,7,8-substituted isomer within an homologous series, in the window of the SICP trace corresponding to the elution of the labeled standard. Where the isomer does not have a corresponding labeled standard, the noise is measured in the window of the SICP where the congener is expected to elute by comparison with the routine calibration data. The EDL is determined by multiplying that noise height by 2.5, and relating the product to an estimated concentration that would produce that peak height. Use the formula:

$$EDL = \frac{2.5 \times H_x \times Q_{is}}{H_{is} \times \overline{RF_n}}$$

Where:

EDL = Estimated detection limit for homologous 2,3,7,8-substituted PCDDs/PCDFs.

H_x = Sum of the height of the noise level for each quantitation ion for the unlabeled PCDDs/PCDFs.

Q_{is} = Quantity, in pg, of the internal standard added to the sample

H_{is} = Sum of the height of the signal level for each quantitation ion for the internal standard.

$\overline{RF_n}$ = Calculated mean relative response factor for the analyte [n=1 to 17]

14.2.5 Estimated Maximum Possible Concentration: This value represents the worst-case estimation of the concentration of an analyte analyzed under chemical interference, and is applied to any analyte detected a 2.5 S/N, but not meeting the additional qualitative criteria outlined in Section 13.5.

14.3 The relative percent difference (*RPD*) of any duplicate sample results are calculated as follows:

$$RPD = \frac{|S_1 - S_2|}{\frac{S_1 + S_2}{2}} \times 100$$

where: S_1, S_2 = sample and duplicate sample results.

14.3.1 Toxicity Equivalency Quotient

14.3.1.1 The 2,3,7,8-TCDD toxicity equivalents (TEQ/TEF) of PCDDs and PCDFs present in the sample are calculated according to the method recommended by the Chlorinated Dioxins Workgroup (CDWG) of the EPA and the Center for Disease Control (CDC). This method assigns a 2,3,7,8-TCDD toxicity equivalency factor (TEF) to each of the 2,3,7,8-substituted PCDDs and PCDFs. The 2,3,7,8-TCDD equivalent of the PCDDs and PCDFs present in the sample is calculated by summing the TEF times their concentration for each of the compounds or groups of compounds. The exclusion of other homologous series such as mono-, di-, and tri- chlorinated dibenzo-p-dioxins and dibenzofurans does not mean that they are non-toxic.

14.3.1.2 The concentration of the 2,3,7,8-TCDF is obtained from the analysis of the sample extract on the 30m DB-225 fused silica capillary column. The chromatographic separation between the 2,3,7,8-TCDF and its close eluters (2,3,4,7-TCDF and 1,2,3,9-TCDF) must be equal or less than 25 percent valley.

14.4 Data review

14.4.1 Refer to the SOP for ***HRMS Data Review and Reporting, HE-HMS003,*** for general instructions for data review.

15) METHOD PERFORMANCE

15.1 While the EDL is used for reporting purpose, the annual analysis of MDL studies is performed according to the SOP for Detection Limits (***CE-QA011***), in accordance with 40CFR Part 136, Appendix B.

15.2 Limits of Detection (LOD) and Limits of Quantitation (LOQ) are generated and verified according to the requirements in the Department of Defense Quality Systems Manual (Reference **Error! Reference source not found.**).

15.3 Method capabilities can be found in appropriate reference method. Training documentation and demonstrations of capability are controlled by the Quality Assurance Program Manager.

16) POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes

consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat from solvent and reagents used in this method can be minimized when recycled or disposed of properly. All disposable glassware should be recycled as per the laboratory procedures. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS-Columbia Environmental Health and Safety (EH&S) Manual. Also, see the SOP for *Waste Disposal, **HE-SAF001***.

17) CORRECTIVE ACTIONS FOR OUT OF CONTROL DATA

17.1 Corrective action measures applicable to specific analysis steps are discussed in the applicable section of this SOP. Also, refer to the SOP for *Corrective Action, **CE-QA008***, for correct procedures for identifying and documenting such data. Procedures for applying data qualifiers are described in the SOP for *HRMS Data Review and Reporting, **HE-HMS003***. See TABLE 11 for additional example corrective actions and required documentation.

17.2 In general, LCS/DLCS recoveries for 8290A are evaluated against the method defined OPR criteria in Method 1613B. Should recoveries for 8290A fall outside of the criteria outlined in Table 7, the recoveries shall be evaluated against recent laboratory process control limits. If those recoveries fall within the laboratory's control limits, the results may be reported with qualification.

17.3 Contamination problems, if they arise, should be investigated systematically.

- 17.3.1 Analyze a solvent blank.
  - 17.3.1.1 If the solvent blank has positive detections, clean the system to remove contamination due to carry over. Re-analyze the method blank.
  - 17.3.1.2 If this solvent blank is non-detect, the contamination may be attributed to the extraction process. If possible, re-extract the blank and all samples with positive detections.
- 17.3.2 Contaminated chemicals (including solvents) should be discarded immediately. If one or more additional containers of the chemical with the same lot number are present in the laboratory, submit an aliquot for analysis to ensure that the entire lot is not contaminated.
- 17.3.3 The reuse of glassware is minimized. However, if glassware demonstrates contamination, it must be discarded immediately.

17.4 Problems associated with low standard recoveries are usually attributed to one of the following:

- 17.4.1 Low recoveries of internal standard (for samples where the clean up standard recoveries are normal) indicate that extraction is inefficient. The analysis should be repeated. If the low recoveries of internal standards are still a problem, then the cause may be a matrix effect. Low recoveries of internal standard are frequently a problem if the sample is a charcoal filter or a fly ash.
- 17.4.2 Low recoveries of both internal standards and clean up standards indicate that losses are taking place during the clean up process. Such losses may simply be due to inefficient transfers, or losses may be taking place during column clean up. Contaminants in the sample extract may interact with the stationary and alter the retention times of analytes on the column.

17.4.3 If any of the standards are completely absent from the selected ion profile, the possibility should be considered that addition of that standard to the sample or extract has not taken place.

17.4.4 If the chromatographic peak area for a standard is approximately double the anticipated area, the possibility should be considered that two aliquots of that standard have been added to the sample or extract.

17.5 Low sensitivity (poor signal-to-noise ratio) may be attributed to a number of causes.

17.5.1 A leaking septum might result in losses of sample during injection. Another consequence of a leaking septum (or any leak in the inlet system of the gas chromatograph) is reduced flow of carrier gas, resulting in increased retention times.

17.5.2 Accumulation of particles of septum or ferrule material in the injection port can lead to adsorptive losses. Similar losses are encountered when the injection port or the injection port liner are contaminated by the residues of 'dirty' samples.

17.5.3 A degraded column can cause peak distortion, and may also lead to adsorptive losses. Excessive bleed of stationary phase from the column may result in high background levels and, consequently, elevated noise levels (thus decreasing the signal-to-noise ratio). The problem is commonly restricted to the first few centimeters of the column, and can be corrected by cutting off 10 to 20 cm of the column.

17.5.4 High background levels can also be attributed to bleed from an inappropriate septum. This is a particular problem with the PeCDF channels.

17.5.5 Re-tuning of the mass spectrometer might improve the sensitivity, or the problem may be due to a contaminated ion source. If, over a period of time, continual increases in the electron multiplier voltage are needed to obtain adequate sensitivity, then the photo multiplier may have to be replaced.

18) CONTINGENCIES FOR HANDLING OUT OF CONTROL OR UNACCEPTABLE DATA

18.1 Where samples and related QC do not meet acceptance criteria outlined in this procedure, proper corrective actions are warranted. Every effort must be made to determine the cause of the exceedance and to correct the issue.

18.2 There are times when we extraction and re-analysis are not possible. In such cases, report the data with appropriate data qualifiers, and provide an explanation in the case narrative.

19) DATA RECORDS MANAGEMENT

19.1 All data is stored both electronically and hard copy for 5 years, or longer as required by specific clients or regulatory agencies.

19.2 All sample and standard preparation information must be recorded on the bench sheet. Hardcopy computer printouts of analytical sequences and raw data must be retained and initialed by the analyst (electronic initials are acceptable). To simplify standard tracking, analyst must attempt to use one lot of reagents and standards with each batch.

19.3 Complete all pertinent sections in the respective logbooks. If not-applicable then line out the section. "Z" out or "X" out all large sections of the worksheet that are not used. Make all corrections with single line through, date and initial. Make NO obliterations

when manually recording data.

19.4 Logbooks are controlled. Never remove a page from a logbook. Completed logbooks are returned to the QA department when filled and no longer needed in the work area.

19.5 The effective date this SOP is the date in the header or last signature date, whichever is most recent.

20) METHOD MODIFICATIONS

20.1 The following modifications have been made to the published method (referenced parenthetically).

20.1.1 The calibration scheme applied in this procedure follows that of EPA Method 1613B, with the addition of the CS0.5 which extends the calibration range lower to meet the reporting limits of each referenced method. The association of labeled standards relative to each of the methods is listed in TABLE 2. The choice of a larger list of labeled internal standards is consistent with method 1613B and offered as an option in 7.9 of Method 8290A, and ultimately enhances the method and data quality. Such performance based modifications within the scope of SW-846 8000 series methods.

20.1.1.1 With respect to Methods TO-9A and M23 Calibration spiking levels have been modified to model the Method 1613 calibration scheme, which encompasses the calibration range of both methods. Surrogate and Labeled Internal spikes follow that of each respective method.

20.1.2 Spiking levels vary among the various methods referenced in this procedure. In order to maintain consistency efficiency with in the laboratory the concentration levels of labeled and native spiking solutions are prepared at the levels outlined in TABLE 4. Due to variations in spiking protocols among each referenced method the laboratory has adopted spiking protocols consistent with Method 8290A to provide consistency and efficiency in laboratory operations. Soxhlet extractions (including ambient sorbents/filters) are spiked directly in the soxhlet using a nonane solution. Aqueous samples are spiked using an acetone diluted standard, directly into the sample bottle prior to filtration.

20.1.3 Certain modifications to extract cleanup procedures have been made to improve efficiency within the extraction process. Every effort is made, however to provide clean extracts for instrumental analysis. As such the laboratory reserves the option to subject extracts to additional cleanup techniques as discussed in HE-EXT003.

21) INSTRUMENT SPECIFIC ADDENDUM

None.

22) CHANGES FROM PREVIOUS REVISION

Revision Number	Effective Date	Document Editor	Description of Changes
0.1	02/01/2013	R. Pierrot	Included further discussion of Method Blank/System Blank handling.
			Re-arranged various sections
			Added section for Document Control and Record Keeping

			Clarified language regarding requirements for the Mass Resolution Check following the end of a 12-hour sequence.

23) REFERENCES

23.1 "Method 8290A: Analytical Procedures and Quality Assurance for Multimedia Analysis of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry". Y. .US Environmental Protection Agency, Office of Solid Waste, Washington DC, 2007.

23.2 "Method 1613B: Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS" US Environmental Protection Agency, Office of Water, Engineering and Analysis Division, Washington DC, 1994.

23.3 "Statement of Work for Analysis of Chlorinated Dibenzo-*p*-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs)", DLM02.2, US Environmental Protection Agency, Analytical Services Branch, Washington DC, 2009.

23.4 "Method 0023: Sampling Method for Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans From Stationary Sources," US Environmental Protection Agency, Office of Solid Waste, Washington DC, 1996.

23.5 "Method TO-9A: Determination of Polychlorinated and Brominated/Chlorinated Dibenzo-*p*-Dioxins and Dibenzofurans in Ambient Air." Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, US EPA, Center for Environmental Research, Office of Research and Development, Cincinnati, OH, 1999.

23.6 DoD *Quality Systems Manual*, Final Version 4.2, U.S. Department of Defense Environmental Data Quality Work Group,

23.7 2009 TNI Quality Systems Standard, The NELAC Institute, Weatherford, TX, 2010.

23.8 USEPA, 2005-09-01; USEPA AOC National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (Sept 2005)

23.9 "Method 8000C: Determinative Chromatographic Separations", USEPA

23.10 "Laboratory Procedure Manual: PCDDs, PCDFs, cPCBs, and ortho-substituted PCBs." National Center for Environmental Health, CDC, October 2006.

24) ATTACHMENTS

24.1 Tables - See Appendix 1.

24.2 Figures - See Appendix 2.

APPENDIX 1

TABLE 1

MATRICES, SAMPLE SIZES, AND METHOD CALIBRATION LIMITS (PARTS PER TRILLION)

	Water	Soil, Sediment, Paper Pulp[b]	Fly ash	Tissue[c]	Sludges Fuel Oil	Air Sampling Media
Prep SOP	HMS-LIQ	HMS-SOX	HMS-SOX	HMS-SOX	HMS-SOX	HMS-SOX
Unit	pg/L	ng/Kg	ng/kg	ng/Kg	ng/Kg	pg
Lower MCL[a]	5	0.5	0.5	0.5	0.5	5
Upper MCL[a]	4000	400	400	400	400	4000
Weight/Volume (g/mL)	1000	10	10	10	1	1
IS Spiking Levels (pg)	2000	2000	2000	2000	2000	2000
Final Extract Volume (µL)	20	20	20	20	20	20

[a] For other congeners, multiply the values by 1 for TCDF/TCDD, by 2.5 for PeCDD/PeCDF, HxCDD/HxCDF/HpCDD/HpCDF, and by 5 for OCDD/OCDF.
[b] Sample dewatered prior to analysis.

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TABLE 2
RETENTION TIME REFERENCES, QUANTITATION REFERENCES, RELATIVE RETENTION TIMES, FOR CDDS AND CDFS

CDDs/CDFs	TO9-A / M23 Retention Time and Quantitation Reference	Method 1613 RT Reference Retention time and quatitation reference	Relative retention time
	Compounds using $^{13}C_{12}$-1,2,3,4-TCDD as the injection internal standard.		
2,3,7,8-TCDF	$^{13}C_{12}$-2,3,7,8-TCDF	$^{13}C_{12}$-2,3,7,8-TCDF	0.999-1.003
2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDD	0.999-1.002
1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF	0.999-1.002
2,3,4,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF	$^{13}C_{12}$-2,3,4,7,8-PeCDF	0.999-1.002
1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,7,8-PeCDD	0.999-1.002
$^{13}C_{12}$-2,3,7,8-TCDF	$^{13}C_{12}$-1,2,3,4-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD	0.923-1.103
$^{13}C_{12}$-2,3,7,8-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD	0.976-1.043
$^{37}Cl_4$-2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDF	$^{13}C_{12}$-1,2,3,4-TCDD	0.989-1.052
$^{13}C_{12}$-1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,4-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD	1.000-1.425
$^{13}C_{12}$-2,3,4,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,4-TCDD	1.011-1.526
$^{13}C_{12}$-1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,4-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD	1.000-1.567
	Compounds using $^{13}C_{12}$-1,2,3,7,8,9-HxCDD as the injection internal standard.		
1,2,3,4,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	0.999-1.001
1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	0.997-1.005
1,2,3,7,8,9-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	0.999-1.001
2,3,4,6,7,8-HxCDF	$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	0.999-1.001
1,2,3,4,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	0.999-1.001
1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	0.998-1.004
1,2,3,7,8,9-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	—[1]	1.000-1.019
1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	0.999-1.001
1,2,3,4,7,8,9-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	0.999-1.001
1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	0.999-1.001
OCDF	$^{13}C_{12}$-OCDD	$^{13}C_{12}$-OCDD	0.999-1.008
OCDD	$^{13}C_{12}$-OCDD	$^{13}C_{12}$-OCDD	0.999-1.001
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	0.944-0.970
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	0.949-0.975
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	0.977-1.047
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	0.959-1.021
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	0.977-1.000
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	0.981-1.003
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	1.043-1.085
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	1.057-1.151
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	1.086-1.110
$^{13}C_{12}$-OCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	$^{13}C_{12}$ -1,2,3,7,8,9-HxCDD	1.032-1.311

[1] For solids/waters via 1613B, 1,2,3,7,8,9-HxCDD is quantified against the average response of $^{13}C_{12}$-1,2,3,4,7,8-HxCDD and $^{13}C_{12}$-1,2,3,6,7,8-HxCDD. $^{13}C_{12}$-1,2,3,6,7,8-HxCDD is the RT Reference.

TABLE 3
CONCENTRATION OF STOCK AND SPIKING SOLUTIONS CONTAINING PCDDS/PCDFS AND LABELED COMPOUNDS

	Labeled Compound		Matrix Standard		LCS Standard
CDD/CDF	Stock Solution (ng/mL)	Working Solution (ng/mL)	Stock Solution (ng/mL)	Working Solution (ng/mL)	Working Solution (ng/mL)
2,3,7,8-TCDD	-	-	40	2.0	0.5
2,3,7,8-TCDF	-	-	40	2.0	0.5
1,2,3,7,8-PeCDD	-	-	200	10	2.5
1,2,3,7,8-PeCDF	-	-	200	10	2.5
2,3,4,7,8-PeCDF	-	-	200	10	2.5
1,2,3,4,7,8-HxCDD	-	-	200	10	2.5
1,2,3,6,7,8-HxCDD	-	-	200	10	2.5
1,2,3,7,8,9-HxCDD	-	-	200	10	2.5
1,2,3,4,7,8-HxCDF	-	-	200	10	2.5
1,2,3,6,7,8-HxCDF	-	-	200	10	2.5
1,2,3,7,8,9-HxCDF	-	-	200	10	2.5
2,3,4,6,7,8-HxCDF	-	-	200	10	2.5
1,2,3,4,6,7,8-HpCDD	-	-	200	10	2.5
1,2,3,4,6,7,8-HpCDF	-	-	200	10	2.5
1,2,3,4,7,8,9-HpCDF	-	-	200	10	2.5
OCDD	-	-	400	20	5.0
OCDF	-	-	400	20	5.0
Labeled Standards					
$^{13}C_{12}$-2,3,7,8-TCDD	100	2	-	-	-
$^{13}C_{12}$-2,3,7,8-TCDF	100	2	-	-	-
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	2	-	-	-
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100	2	-	-	-
$^{13}C_{12}$-2,3,4,7,8-PeCDF*	100	2	-	-	-
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD*	100	2	-	-	-
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	2	-	-	-
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF*	100	2	-	-	-
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	2	-	-	-
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF[1]	100	2	-	-	-
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100	2	-	-	-
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	2	-	-	-
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	2	-	-	-
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF*	100	2	-	-	-
$^{13}C_{12}$-OCDD	200	4	-	-	-
Clean Up Standard					
$^{37}Cl_4$-2,3,7,8-TCDD*	5000	8	-	-	-
Recovery Standards					
$^{13}C_{12}$-1,2,3,4-TCDD	-	100	-	-	-
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	-	100	-	-	-

* Noted compounds serve as surrogate compounds for methods M23 and TO-9A, and are prepared as a separate spiking solution applied to the sampling media prior to sampling.

[1] $^{13}C_{12}$-1,2,3,7,8,9-HxCDF serves as the clean up standard for M23 and TO-9A, and is prepared as a separate spiking solution applied to the extract prior to clean up.

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TABLE 4
CONCENTRATION OF STOCK AND SPIKING SOLUTIONS CONTAINING PCDDS/PCDFS AND LABELED COMPOUNDS

RRF Reference (n)	CDD/CDF	CS0.5 (ng/mL)	CS1 (ng/mL)	CS2 (ng/mL)	CS3 (ng/mL)	CS4 (ng/mL)	CS5 (ng/mL)
1	2,3,7,8-TCDD[1]	0.25	0.5	2.0	10	40	200
2	2,3,7,8-TCDF[2]	0.25	0.5	2.0	10	40	200
3	1,2,3,7,8-PeCDD[3]	1.25	2.5	10	50	200	1000
4	1,2,3,7,8-PeCDF	1.25	2.5	10	50	200	1000
5	2,3,4,7,8-PeCDF	1.25	2.5	10	50	200	1000
6	1,2,3,4,7,8-HxCDD	1.25	2.5	10	50	200	1000
7	1,2,3,6,7,8-HxCDD	1.25	2.5	10	50	200	1000
8	1,2,3,7,8,9-HxCDD	1.25	2.5	10	50	200	1000
9	1,2,3,4,7,8-HxCDF	1.25	2.5	10	50	200	1000
10	1,2,3,6,7,8-HxCDF	1.25	2.5	10	50	200	1000
11	1,2,3,7,8,9-HxCDF	1.25	2.5	10	50	200	1000
12	2,3,4,6,7,8-HxCDF	1.25	2.5	10	50	200	1000
13	1,2,3,4,6,7,8-HpCDD[4]	1.25	2.5	10	50	200	1000
14	1,2,3,4,6,7,8-HpCDF	1.25	2.5	10	50	200	1000
15	1,2,3,4,7,8,9-HpCDF	1.25	2.5	10	50	200	1000
16	OCDD	2.50	5.0	20	100	400	2000
17	OCDF	2.50	5.0	20	100	400	2000
18	$^{13}C_{12}$-2,3,7,8-TCDD	100	100	100	100	100	100
19	$^{13}C_{12}$-2,3,7,8-TCDF	100	100	100	100	100	100
20	$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	100	100	100	100	100
21	$^{13}C_{12}$-1,2,3,7,8-PeCDF	100	100	100	100	100	100
22	$^{13}C_{12}$-2,3,4,7,8-PeCDF	100	100	100	100	100	100
23	$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100	100	100	100	100	100
24	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	100	100	100	100	100
25	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100	100	100	100	100	100
26	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	100	100	100	100	100
27	$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100	100	100	100	100	100
28	$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100	100	100	100	100	100
29	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	100	100	100	100	100
30	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	100	100	100	100	100
31	$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100	100	100	100	100	100
32	$^{13}C_{12}$-OCDD	200	200	200	200	200	200
33	$^{37}Cl_4$-2,3,7,8-TCDD	0.25	0.5	2.0	10	40	200
34	Total PeCDFs	--	--	--	--	--	--
35	Total HxCDFs	--	--	--	--	--	--
36	Total HxCDFs	--	--	--	--	--	--
37	Total HpCDFs	--	--	--	--	--	--

[1] RF is also used for Total TCDDs
[2] RF is also used for Total TCDFs
[3] RF is also used for Total PeCDDs
[4] RF is also used for Total HpCDFs

TABLE 5
GC RETENTION TIME WINDOW DEFINING
SOLUTION AND ISOMER SPECIFICITY STANDARD

DB 5 Column GC Retention Time Window Defining Solution		
CDD/CDF	**First Eluted**	**Last Eluted**
TCDF	1,3,6,8-	1,2,8,9-
TCDD	1,3,6,8-	1,2,8,9-
PeCDF	1,3,4,6,8-	1,2,3,8,9-
PeCDD	1,2,4,7,9-	1,2,3,8,9-
HxCDF	1,2,3,4,6,8-	1,2,3,4,8,9-
HxCDD	1,2,4,6,7,9-	1,2,3,4,6,7-
HpCDF	1,2,3,4,6,7,8-	1,2,3,4,7,8,9-
HpCDD	1,2,3,4,6,7,9-	1,2,3,4,6,7,8-

DB-5 Column TCDD Specificity Test Standard

1,2,3,7+1,2,3,8-TCDD
2,3,7,8-TCDD
1,2,3,9-TCDD

DB-225 Column TCDF Isomer Specificity Test Standard

2,3,4,7-TCDF
2,3,7,8-TCDF
1,2,3,9-TCDF

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TABLE 6
Calibration Control Limits

CDD/CDF	1613B iCAL %RSD	1613B CCAL ng/mL	M23 & TO-9A iCAL %RSD	M23 & TO-9A CCAL ng/mL	8290A iCAL %RSD	8290A CCAL ng/mL
2,3,7,8-TCDD	20	7.8 - 12.9	25	25	20	20*
2,3,7,8-TCDF	20	8.4 - 12	25	25	20	20*
1,2,3,7,8-PeCDD	20	39 - 65	25	25	20	20*
1,2,3,7,8-PeCDF	20	41 - 60	25	25	20	20*
2,3,4,7,8-PeCDF	20	41 - 61	25	25	20	20*
1,2,3,4,7,8-HxCDD	20	39 - 64	25	25	20	20*
1,2,3,6,7,8-HxCDD	20	39 - 64	25	25	20	20*
1,2,3,7,8,9-HxCDD	20	41 - 61	25	25	20	20*
1,2,3,4,7,8-HxCDF	20	45 - 56	25	25	20	20*
1,2,3,6,7,8-HxCDF	20	44 - 57	25	25	20	20*
1,2,3,7,8,9-HxCDF	20	45 - 56	25	25	20	20*
2,3,4,6,7,8-HxCDF	20	44 - 57	25	25	20	20*
1,2,3,4,6,7,8-HpCDD	20	43 - 58	25	25	20	20*
1,2,3,4,6,7,8-HpCDF	20	45 - 55	25	25	20	20*
1,2,3,4,7,8,9-HpCDF	20	43 - 58	25	25	20	20*
OCDD	20	79 - 126	25	25	20	20*
OCDF	35	63 - 159	30	30	20	20*
Labeled Standards						
$^{13}C_{12}$-2,3,7,8-TCDD	35	82 - 121	25	25	30	30**
$^{13}C_{12}$-2,3,7,8-TCDF	35	71 - 140	30	30	30	30**
$^{13}C_{12}$-1,2,3,7,8-PeCDD	35	62 - 160	30	30	30	30**
$^{13}C_{12}$-1,2,3,7,8-PeCDF	35	76 - 130	30	30	30	30**
$^{13}C_{12}$-2,3,4,7,8-PeCDF	35	77 - 130	25	25	30	30**
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	35	85 - 117	25	25	30	30**
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	35	85 - 118	25	25	30	30**
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	35	76 - 131	25	25	30	30**
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	35	70 - 143	30	30	30	30**
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	35	74 - 135	-	-	30	30**
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	38	73 - 137	30	30	30	30**
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	35	72 - 138	30	30	30	30**
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	35	78 - 129	30	30	30	30**
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	35	77 - 129	25	25	30	30**
$^{13}C_{12}$-OCDD	35	96 - 415	30	30	30	30**
$^{37}Cl_4$-2,3,7,8-TCDD	35	7.9 - 12.7	25	25	30	30**

*25% is allowed for a post-run verification but when the value is above 20%, analyte quantitation is achieved per 8290A, Section 8.3.2.4 and corrective action is required before the next sequence may commence.
**35% is allowed for a post-run verification but when the value is above 20%, analyte quantitation is achieved per 8290A, Section 8.3.2.4 and corrective action is required before the next sequence may commence.

TABLE 7
ACCEPTANCE CRITERIA FOR IPR AND OPR[1]

CDD/CDF	Test Conc. (ng/mL)	IPR[2,3] s (ng/mL)	IPR[2,3] X (ng/mL)	OPR[4] Conc. (ng/mL)	OPR[4] %Rec (%)
2,3,7,8-TCDD	10	2.8	8.3 - 13	6.7 - 16	*67 - 158*
2,3,7,8-TCDF	10	2.0	8.7 - 14	7.5 - 16	*75 - 158*
1,2,3,7,8-PeCDD	50	7.5	38 - 66	35 - 71	*70 - 142*
1,2,3,7,8-PeCDF	50	7.5	43 - 62	40 - 67	*80 - 134*
2,3,4,7,8-PeCDF	50	8.6	36 - 75	34 - 80	*68 - 160*
1,2,3,4,7,8-HxCDD	50	9.4	39 - 76	35 - 82	*70 - 164*
1,2,3,6,7,8-HxCDD	50	7.7	42 - 66	38 - 67	*76 - 134*
1,2,3,7,8,9-HxCDD	50	11.1	37 - 71	32 - 81	*64 - 162*
1,2,3,4,7,8-HxCDF	50	8.7	41 - 59	36 - 67	*72 - 134*
1,2,3,6,7,8-HxCDF	50	6.7	46 - 60	42 - 65	*84 - 130*
1,2,3,7,8,9-HxCDF	50	6.4	42 - 61	39 - 65	*78 - 130*
2,3,4,6,7,8-HxCDF	50	7.4	37 - 74	35 - 78	*70 - 156*
1,2,3,4,6,7,8-HpCDD	50	7.7	38 - 65	35 - 70	*70 - 140*
1,2,3,4,6,7,8-HpCDF	50	6.3	45 - 56	41 - 61	*82 - 122*
1,2,3,4,7,8,9-HpCDF	50	8.1	43 - 63	39 - 69	*78 - 138*
OCDD	100	19.0	89 - 127	78 - 144	*78 - 144*
OCDF	100	27.0	74 - 146	63 - 170	*63 - 170*
$^{13}C_{12}$-2,3,7,8-TCDD	100	37	28 - 134	20 - 175	*20 - 175*
$^{13}C_{12}$-2,3,7,8-TCDF	100	35	31 - 113	22 - 152	*22 - 152*
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	39	27 - 184	21 - 227	*21 - 227*
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100	34	27 - 156	21 - 192	*21 - 192*
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100	38	16 - 279	13 - 328	*13 - 328*
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100	41	29 - 147	21 - 193	*21 - 193*
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	38	34 - 122	25 - 163	*25 - 163*
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100	43	27 - 152	19 - 202	*19 - 202*
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	35	30 - 122	21 - 159	*21 - 159*
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100	40	24 - 157	17 - 205	*17 - 205*
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100	37	29 - 136	22 - 176	*22 - 176*
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	35	34 - 129	26 - 166	*26 - 166*
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	41	32 - 110	21 - 158	*21 - 158*
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100	40	28 - 141	20 - 186	*20 - 186*
$^{13}C_{12}$-OCDD	200	95	41 - 276	26 - 397	*13 - 199*
$^{37}Cl_4$-2,3,7,8-TCDD (VER Only)[5]	10				
$^{37}Cl_4$-2,3,7,8-TCDD	40	14.4	15.6 - 61.6	12 - 76	*31 - 191*

1. All specifications are given as concentration in the final extract, assuming a 20µL volume.
2. s = standard deviation of the concentration.
3. X = average concentration.
4. OPR control limits are applicable to Methods 1613 and 8290. LCS/DLCS acceptance criteria for Methods M23 and TO-9A are 70%-130% for all native analytes.
5. CAS/Houston adds 40ng/mL of $^{37}Cl_4$-2,3,7,8-TCDD to sample extracts. Therefore, s=14.4ng/mL, X=15.6-61.6ng/mL, and OPR=12.4-76.4ng/mL. VER remains at 10ng/mL.

TABLE 8
Labeled Standard Recovery Control Limits

CDD/CDF	Test Conc. (ng/mL)	1613B / 8290A (%Rec)			Ref.		M23 (%Rec)			Ref.		TO-9A (%Rec)			Ref.
Extraction Standards															
$^{13}C_{12}$-2,3,7,8-TCDD	100	25	-	164	a		40	-	130	b		50	-	120	c
$^{13}C_{12}$-2,3,7,8-TCDF	100	24	-	169	a		40	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	25	-	181	a		40	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100	24	-	185	a		40	-	130	b		50	-	120	c
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100	21	-	178	a		N/A		N/A			N/A		N/A	
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100	32	-	141	a		N/A		N/A			N/A		N/A	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	28	-	130	a		40	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100	26	-	152	a		N/A		N/A			N/A		N/A	
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	26	-	123	a		40	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100	29	-	147	a		N/A		N/A			N/A		N/A	
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100	28	-	136	a		40	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	23	-	140	a		25	-	130	b		40	-	120	c
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	28	-	143	a		25	-	130	b		40	-	120	c
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100	26	-	138	a		N/A		N/A			N/A		N/A	
$^{13}C_{12}$-OCDD	200	17	-	157	a		25	-	130	b		40	-	120	c
Cleanup Standards															
$^{37}Cl_4$-2,3,7,8-TCDD	40	35	-	197	a		N/A		N/A			N/A		N/A	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100	N/A		N/A			40	-	130	b		50	-	120	c
Sampling Standards															
$^{37}Cl_4$-2,3,7,8-TCDD	100	N/A		N/A			70	-	130	b		50	-	120	c
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100	N/A		N/A			70	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100	N/A		N/A			70	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100	N/A		N/A			70	-	130	b		50	-	120	c
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100	N/A		N/A			70	-	130	b		40	-	120	c

TABLE 9
THEORETICAL ION ABUNDANCE RATIOS AND QC LIMITS

Number of Chlorine Atoms	M/Z's Forming Ratio	Theoretical Ratio	QC Limit[1]	
			Lower	Upper
4[2]	M / (M+2)	0.77	0.65	0.89
5	(M+2) / (M+4)	1.55	1.32	1.78
6	(M+2) / (M+4)	1.24	1.05	1.43
6[3]	M / (M+2)	0.51	0.43	0.59
7	(M+2) / (M+4)	1.05	0.88	1.2
7[4]	M / (M+2)	0.44	0.37	0.51
8	(M+2) / (M+4)	0.89	0.76	1.02

[1] QC Limits represent ±15% windows around the theoretical ion abundance ratios.
[2] Does not apply to ^{37}Cl-2,3,7,8-TCDD (clean up standard).
[3] Used for $^{13}C_{12}$-HxCDF only.

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TABLE 10
DESCRIPTORS, EXACT M/Z TYPES, AND ELEMENTAL COMPOSITIONS OF THE PCDDS AND PCDFS

Descriptor	Exact M/Z[1]	M/Z Type	Elemental composition	Substance[2]
1	292.9825	Lock	C_7F_{11}	PFK
	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF
	315.9419	M	$^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF[3]
	317.9389	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF[3]
	319.8965	M	$C_{12}H_4{}^{35}Cl_4O_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	327.8847	M	$C_{12}H_4{}^{37}Cl_4O_2$	TCDD[3]
	330.9792	QC	C_7F_{11}	PFK
	331.9368	M	$^{13}C_{12}H_4{}^{35}Cl_4O_2$	TCDD[3]
	333.9339	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD[3]
	375.8364	M+2	$C_{12}H_4{}^{35}Cl_5{}^{37}ClO$	HxCDPE
2	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF
	341.8567	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF
	351.9000	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF
	353.8970	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF[3]
	354.9792	Lock	C_7F_{11}	PFK
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD
	357.8516	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD
	367.8949	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD[3]
	369.8919	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD[3]
	409.7974	M+2	$C_{12}H_3{}^{35}Cl_5{}^{37}ClO$	HpCDPE
3	373.8208	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF
	375.8178	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDF
	383.8639	M	$^{13}C_{12}H_2{}^{35}Cl_6O$	HxCDF[3]
	385.8610	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF[3]
	389.8157	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD
	392.9760	Lock	C_8F_{13}	PFK
	401.8559	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD[3]
	403.8529	M+4	$^{13}C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD[3]
	430.9729	QC	C_8F_{13}	PFK
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_5{}^{37}Cl_2O$	OCDPE
4	407.7818	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF
	409.7789	M+4	$C_{12}H^{35}Cl_6{}^{37}Cl_2O$	HpCDF

TABLE 10(Cont.)
DESCRIPTORS, EXACT M/Z TYPES, AND ELEMENTAL COMPOSITIONS OF THE PCDDS AND PCDFS

Descriptor	Exact M/Z[1]	M/Z Type	Elemental composition	Substance[2]
	417.8253	M	$^{13}C_{12}H^{35}Cl_6O$	HpCDF[3]
	419.8220	M+2	$^{13}C_{12}H^{35}Cl_5{}^{37}ClO$	HpCDF[3]
	423.7766	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD
	425.7737	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD
	430.9729	Lock	C_6F_{12}	PFK
	435.8169	M+2	$^{13}C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD[3]
	437.8140	M+4	$^{13}C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD[3]
	479.7165	M+4	$C_{12}H^{35}Cl_9{}^{37}Cl_2O$	NCDPE
5	441.7428	M+2	$C_{12}H^{35}Cl_7O$	OCDF
	442.9728	Lock	C_6F_{12}	PFK
	443.7399	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD
	459.7348	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7779	M+2	$^{13}C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD[3]
	471.7750	M+4	$^{13}C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD[3]
	513.9775	M+4	$C_{12}{}^{35}Cl_9{}^{37}Cl_2O$	DCDPE

[1] Nuclidic masses used

H = 1.007825	C = 12.00000	^{13}C = 13.003355	F = 18.9984
O = 15.994915	^{35}Cl = 34.968853	^{37}Cl = 36.965903	

[2]

TCDD	=	Tetrachlorodibenzo-*p*-dioxin	TCDF	=	Tetrachlorodibenzofuran
PeCDD	=	Pentachlorodibenzo-*p*-dioxin	PeCDF	=	Pentachlorodibenzofuran
HxCDD	=	Hexachlorodibenzo-*p*-dioxin	HxCDF	=	Hexachlorodibenzofuran
HpCDD	=	Heptachlorodibenzo-*p*-dioxin	HpCDF	=	Heptachlorodibenzofuran
OCDD	=	Octachlorodibenzo-*p*-dioxin	OCDF	=	Octachlorodibenzofuran
HxCDPE	=	Hexachlorodiphenyl ether	HpCDPE	=	Heptachlorodiphenyl ether
OCDPE	=	Octachlorodiphenyl ether	NCDPE	=	Nonachlorodiphenyl ether
DCDPE	=	Decachlorodiphenyl ether	PFK	=	Perfluorokerosene

[3] Labeled compound.

[4] There is only one m/z for ^{37}Cl-2,3,7,8-TCDD (clean up standard).

TABLE 11
CORRECTIVE ACTION SUMMARY TABLE

QC Activity	Unacceptable Criteria	Recommended Corrective Action	Documentation
Method Blank	Tetra through Hepta>MRL or Octa>3xMRL	Analyze an instrument blank to demonstrate instrument is free of possible contamination. Evaluate whether entire sample batch must be re-extracted.	Compounds associated with a value in the method blank are flagged with 'B' on Form 1s.
Instrument Blank	>MRL	Determine cause of contamination. Analyze an acceptable instrument blank prior to analyzing analytical sequence.	Resolve blank issue before proceeding.
Initial Calibration Standards	See Table 6	Evaluate and correct the cause of the issue, Re-analyze the ICAL	Resolve ICAL standards issue before proceeding.
Calibration Verification Standard (CS3/VER)	>Table 6 requirements	Reanalyze standard. If still unacceptable, recalibrate and reanalyze samples from last acceptable CS3/VER.	Comment in case narrative.
Laboratory Control Sample (LCS) & Laboratory Control Sample Duplicate (DLCS)	Value outside acceptance criteria; >50% RPD	If LCS or DLCS out, evaluate the labeled standard(s) associated with the compound(s). If out, evaluate the associated labeled standard(s) in the sample(s). If out, re-extract the samples. If labeled standard(s) meet the acceptance criteria, release the test results.	Comment in case narrative.
Matrix Spike (MS) & Duplicate Matrix Spike (DMS)	Value outside acceptance criteria; >50% RPD	Evaluate parent sample. If necessary, re-extract sample and MS/DMS pair.	Comment in case narrative.
Duplicate (DUP)	>50% RSD	Evaluate parent samples. If necessary, re-extract sample and DUP.	Comment in case narrative
Labeled Standard Recovery(ies)	Outside acceptance criteria for all labeled standards or if any labeled standard recovery is <10%	Complete an NCAR form and re-extract the sample using a smaller sample size.	Add an 'RE' suffix to the end of the Lab Sample ID, indicating 'Re-extraction'
Recovery of labeled standard for cmpds	Outside acceptance criteria	Report values and flag results.	Flag associated results with 'Y' on Form 1s.
2378-TCDF result	Quantitated value on DB-5 column, above the MRL	Reanalyze 2378-TCDF on DB-225 column. Report value obtained from DB-225 column.	2378-TCDF result associated with a value from the DB-5 column flagged with 'C' on Form 1s.
Sample Results	Quantitated value >upper end of linear calibration range. (OCDD/OCDF are exceptions to this rule)	Report values; dilute sample and report both undiluted and diluted test results. If only OCDD and/or OCDF are over-range, do not dilute extract - report OCDD and/or OCDF as over-range.	Flag associated results with 'E' on Form 1s.

QC Activity	Unacceptable Criteria	Recommended Corrective Action	Documentation
Sample Results	Quantitated value < MRL and >EDL.	Report values and flag results.	Flag associated results with 'J' on Form 1s.
Sample Results	Compound not detected.	Report and flag results.	Flag associated compounds with 'U' on Form 1s.
Native ions	Outside ion abundance ratio QC limit	Report as EMPC	Flag associated results with 'K' on Form 1s.
AZ DHS Requirement - Analyze LFB	Native Compounds outside acceptance criteria (70-130%)	Re-extract affected samples.	Resolve issues before proceeding.

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APPENDIX 2

FIGURE 1
GENERAL STRUCTURES OF DIBENZO-*p*-DIOXINS (TOP) AND DIBENZOFURANS (BOTTOM)

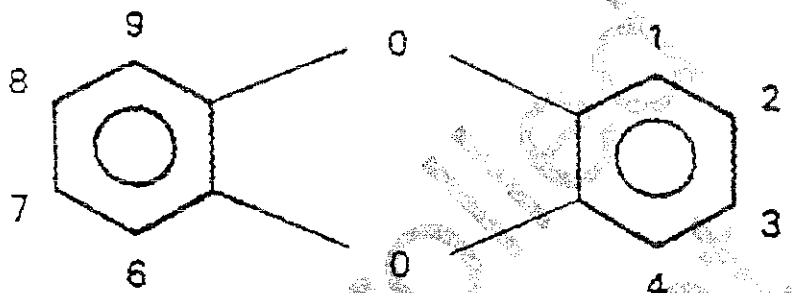

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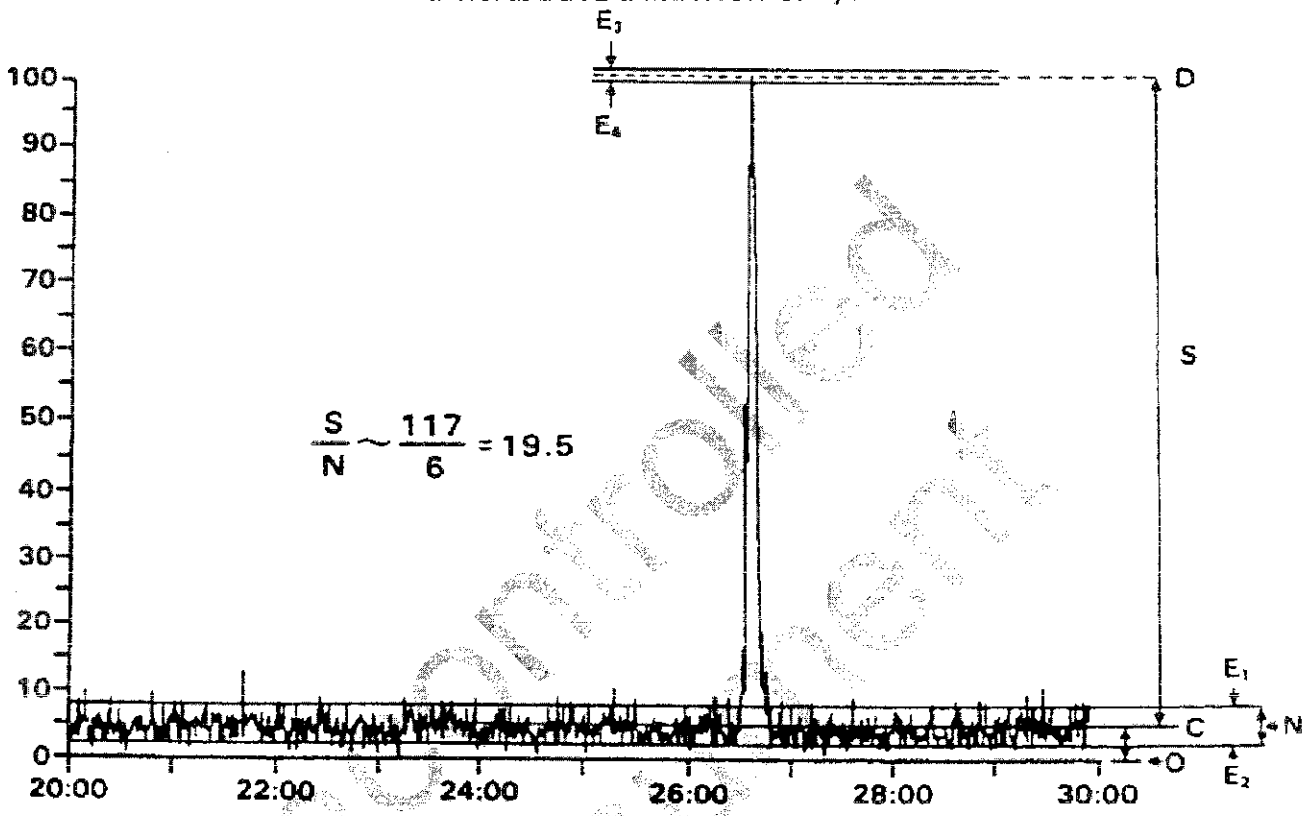
FIGURE 2
MANUAL DETERMINATION OF S/N



The peak height (S) is measured between the mean noise (lines C and D.) These mean signal values are obtained by tracing the line between the baseline average noise extremes, E1 and E2, and between the apex average noise extremes, E3 and E4, at the apex of the signal.

NOTE: It is imperative that the instrument interface amplifier electronic zero offset be set high enough so that negative going baseline noise is recorded.

FIGURE 3
MASS RESOLUTION CHECK

Experiment Calibration Report **MassLynx 4.1** Page 1 of

File: Experiment Reference: Pfk.ref Function: 1 @ 200 (ppm)

Printed: Friday, April 04, 2008 05:18:13 Central Standard Time

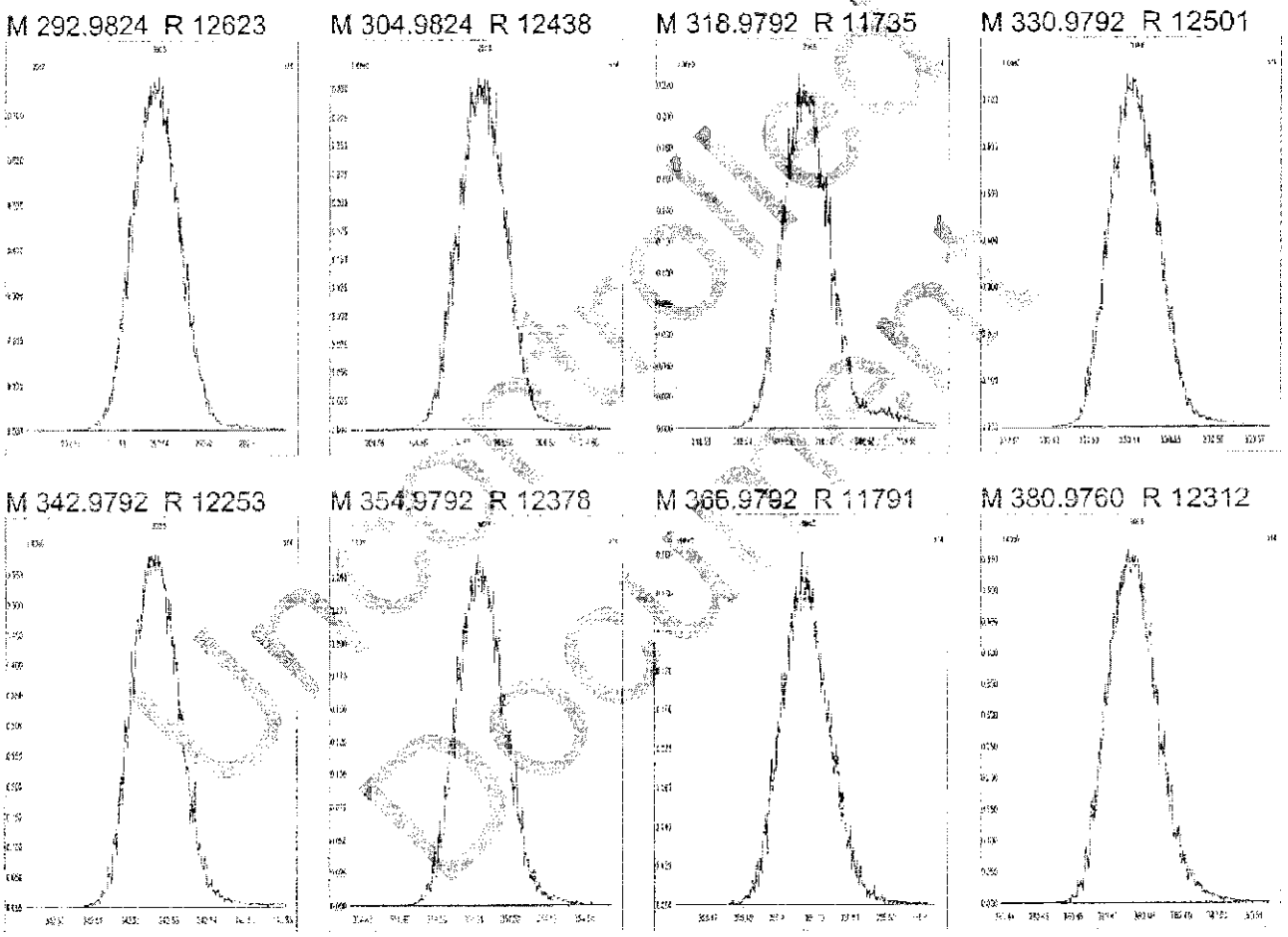
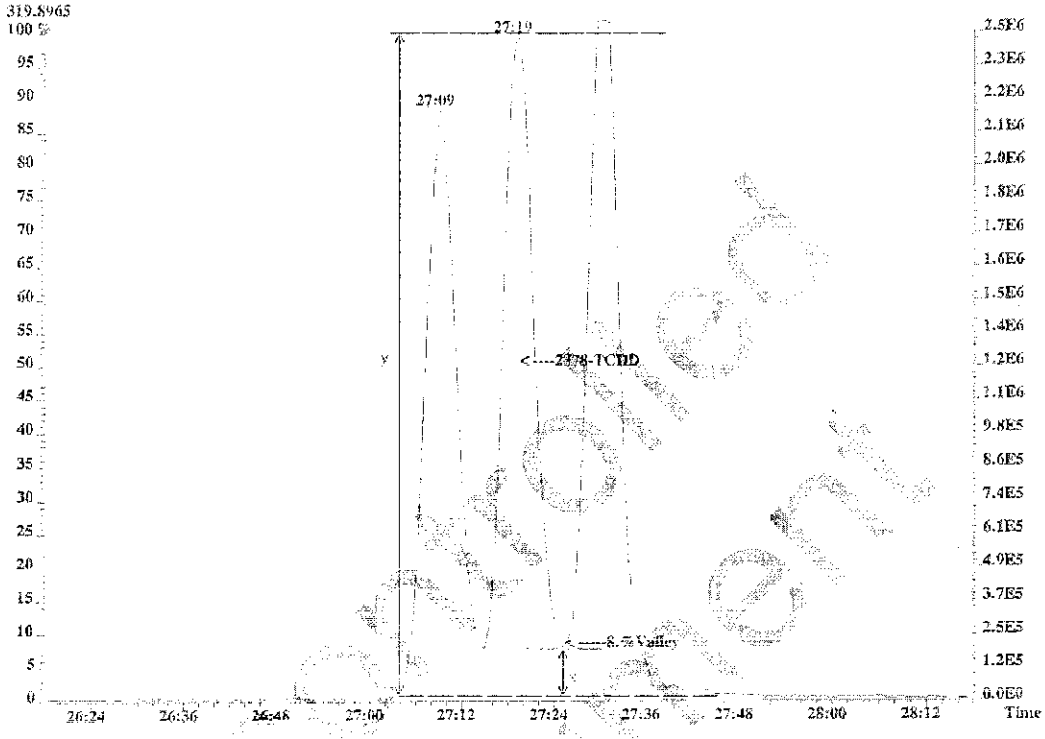
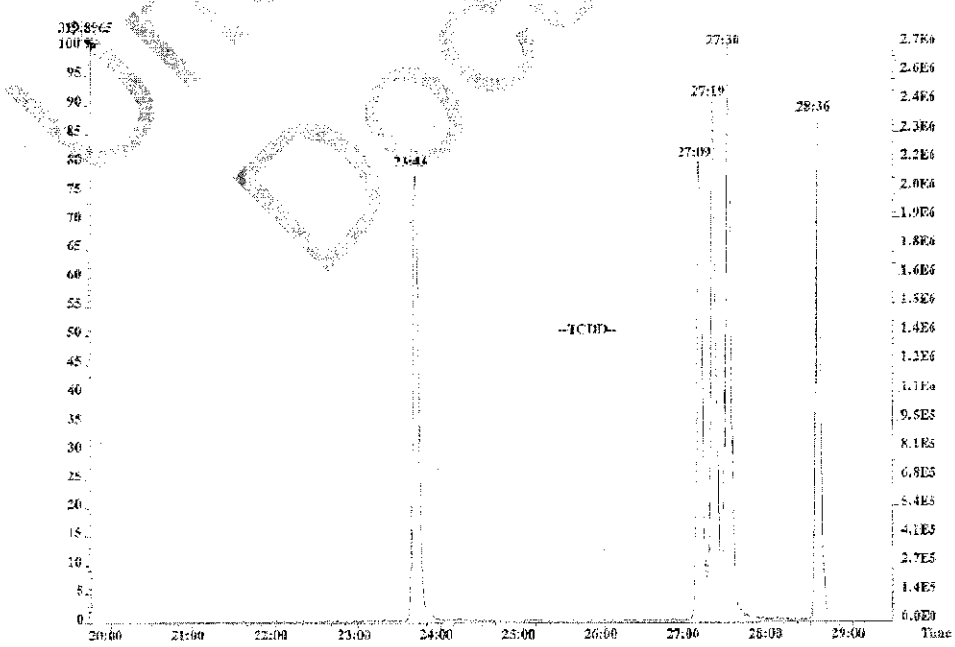


FIGURE 4
DB-5 GC COLUMN PERFORMANCE AND WINDOW DEFINITION





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Attachment 3: Analytical Laboratory ELAP Certifications

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CALIFORNIA DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

EMAX Laboratories, Inc.
1835 West 205th Street
Torrance, CA 90501
Phone: (310) 618-8889

Certificate No.: **2672**
Renew Date: **6/30/2015**

Field of Testing: 102 - Inorganic Chemistry of Drinking Water

102.020	001	Turbidity	EPA 180.1
102.022	001	Turbidity	SM2130B
102.030	001	Bromide	EPA 300.0
102.030	003	Chloride	EPA 300.0
102.030	005	Fluoride	EPA 300.0
102.030	006	Nitrate	EPA 300.0
102.030	007	Nitrite	EPA 300.0
102.030	008	Phosphate, Ortho	EPA 300.0
102.030	010	Sulfate	EPA 300.0
102.045	001	Perchlorate	EPA 314.0
102.100	001	Alkalinity	SM2320B
102.120	001	Hardness	SM2340B
102.121	001	Hardness	SM2340C
102.130	001	Conductivity	SM2510B
102.140	001	Total Dissolved Solids	SM2540C
102.145	001	Total Dissolved Solids	EPA 160.1
102.150	001	Chloride	SM4110B
102.150	002	Fluoride	SM4110B
102.150	003	Nitrate	SM4110B
102.150	004	Nitrite	SM4110B
102.150	005	Phosphate, Ortho	SM4110B
102.150	006	Sulfate	SM4110B
102.170	001	Chloride	SM4500-Cl- B
102.190	001	Cyanide, Total	SM4500-CN E
102.200	001	Fluoride	SM4500-F C
102.210	001	Hydrogen Ion (pH)	SM4500-H+ B
102.212	001	Hydrogen Ion (pH)	EPA 150.1
102.220	001	Nitrite	SM4500-NO2 B
102.232	002	Nitrate	SM4500-NO3 E
102.240	001	Phosphate, Ortho	SM4500-P E
102.260	001	Total Organic Carbon	SM5310B
102.520	001	Calcium	EPA 200.7
102.520	002	Magnesium	EPA 200.7
102.520	003	Potassium	EPA 200.7
102.520	005	Sodium	EPA 200.7
102.520	006	Hardness (calculation)	EPA 200.7

102.564	001	Cyanide	Quickchem 10-204-00-1-X

Field of Testing: 103 - Toxic Chemical Elements of Drinking Water

103.130	001	Aluminum	EPA 200.7
103.130	003	Barium	EPA 200.7
103.130	004	Beryllium	EPA 200.7
103.130	005	Cadmium	EPA 200.7
103.130	007	Chromium	EPA 200.7
103.130	008	Copper	EPA 200.7
103.130	009	Iron	EPA 200.7
103.130	011	Manganese	EPA 200.7
103.130	012	Nickel	EPA 200.7
103.130	015	Silver	EPA 200.7
103.130	017	Zinc	EPA 200.7
103.140	001	Aluminum	EPA 200.8
103.140	002	Antimony	EPA 200.8
103.140	003	Arsenic	EPA 200.8
103.140	004	Barium	EPA 200.8
103.140	005	Beryllium	EPA 200.8
103.140	006	Cadmium	EPA 200.8
103.140	007	Chromium	EPA 200.8
103.140	008	Copper	EPA 200.8
103.140	009	Lead	EPA 200.8
103.140	010	Manganese	EPA 200.8
103.140	012	Nickel	EPA 200.8
103.140	013	Selenium	EPA 200.8
103.140	014	Silver	EPA 200.8
103.140	015	Thallium	EPA 200.8
103.140	016	Zinc	EPA 200.8
103.160	001	Mercury	EPA 245.1
103.310	001	Chromium (VI)	EPA 218.6

Field of Testing: 104 - Volatile Organic Chemistry of Drinking Water

104.030	001	1,2-Dibromoethane	EPA 504.1
104.030	002	1,2-Dibromo-3-chloropropane	EPA 504.1
104.030	004	EDB and DBCP	EPA 504.1
104.040	000	Volatile Organic Compounds	EPA 524.2
104.040	001	Benzene	EPA 524.2
104.040	002	Bromobenzene	EPA 524.2
104.040	003	Bromochloromethane	EPA 524.2
104.040	006	Bromomethane	EPA 524.2
104.040	007	n-Butylbenzene	EPA 524.2
104.040	008	sec-Butylbenzene	EPA 524.2
104.040	009	tert-Butylbenzene	EPA 524.2
104.040	010	Carbon Tetrachloride	EPA 524.2

104.040	011	Chlorobenzene	EPA 524.2
104.040	012	Chloroethane	EPA 524.2
104.040	014	Chloromethane	EPA 524.2
104.040	015	2-Chlorotoluene	EPA 524.2
104.040	016	4-Chlorotoluene	EPA 524.2
104.040	018	Dibromomethane	EPA 524.2
104.040	019	1,3-Dichlorobenzene	EPA 524.2
104.040	020	1,2-Dichlorobenzene	EPA 524.2
104.040	021	1,4-Dichlorobenzene	EPA 524.2
104.040	022	Dichlorodifluoromethane	EPA 524.2
104.040	023	1,1-Dichloroethane	EPA 524.2
104.040	024	1,2-Dichloroethane	EPA 524.2
104.040	025	1,1-Dichloroethene	EPA 524.2
104.040	026	cis-1,2-Dichloroethene	EPA 524.2
104.040	027	trans-1,2-Dichloroethene	EPA 524.2
104.040	028	Dichloromethane	EPA 524.2
104.040	029	1,2-Dichloropropane	EPA 524.2
104.040	030	1,3-Dichloropropane	EPA 524.2
104.040	031	2,2-Dichloropropane	EPA 524.2
104.040	032	1,1-Dichloropropene	EPA 524.2
104.040	033	cis-1,3-Dichloropropene	EPA 524.2
104.040	034	trans-1,3-Dichloropropene	EPA 524.2
104.040	035	Ethylbenzene	EPA 524.2
104.040	036	Hexachlorobutadiene	EPA 524.2
104.040	037	Isopropylbenzene	EPA 524.2
104.040	038	4-Isopropyltoluene	EPA 524.2
104.040	039	Naphthalene	EPA 524.2
104.040	040	Nitrobenzene	EPA 524.2
104.040	041	N-propylbenzene	EPA 524.2
104.040	042	Styrene	EPA 524.2
104.040	043	1,1,1,2-Tetrachloroethane	EPA 524.2
104.040	044	1,1,2,2-Tetrachloroethane	EPA 524.2
104.040	045	Tetrachloroethene	EPA 524.2
104.040	046	Toluene	EPA 524.2
104.040	047	1,2,3-Trichlorobenzene	EPA 524.2
104.040	048	1,2,4-Trichlorobenzene	EPA 524.2
104.040	049	1,1,1-Trichloroethane	EPA 524.2
104.040	050	1,1,2-Trichloroethane	EPA 524.2
104.040	051	Trichloroethene	EPA 524.2
104.040	052	Trichlorofluoromethane	EPA 524.2
104.040	053	1,2,3-Trichloropropane	EPA 524.2
104.040	054	1,2,4-Trimethylbenzene	EPA 524.2
104.040	055	1,3,5-Trimethylbenzene	EPA 524.2

104.040	056	Vinyl Chloride	EPA 524.2
104.040	057	Xylenes, Total	EPA 524.2
104.040	059	Federal regulated VOCs, excluding vinyl chloride	EPA 524.2
104.040	060	Federal unregulated VOCs	EPA 524.2
104.045	001	Bromodichloromethane	EPA 524.2
104.045	002	Bromoform	EPA 524.2
104.045	003	Chloroform	EPA 524.2
104.045	004	Dibromochloromethane	EPA 524.2
104.045	005	Trihalomethanes	EPA 524.2
104.050	011	Oxygenates	EPA 524.2

Field of Testing: 108 - Inorganic Chemistry of Wastewater

108.020	001	Conductivity	EPA 120.1
108.110	001	Turbidity	EPA 180.1
108.112	001	Boron	EPA 200.7
108.112	002	Calcium	EPA 200.7
108.112	003	Hardness (calculation)	EPA 200.7
108.112	004	Magnesium	EPA 200.7
108.112	005	Potassium	EPA 200.7
108.112	007	Sodium	EPA 200.7
108.113	001	Boron	EPA 200.8
108.113	002	Calcium	EPA 200.8
108.113	003	Magnesium	EPA 200.8
108.113	004	Potassium	EPA 200.8
108.113	006	Sodium	EPA 200.8
108.120	001	Bromide	EPA 300.0
108.120	002	Chloride	EPA 300.0
108.120	003	Fluoride	EPA 300.0
108.120	004	Nitrate	EPA 300.0
108.120	005	Nitrite	EPA 300.0
108.120	006	Nitrate-nitrite, Total	EPA 300.0
108.120	007	Phosphate, Ortho	EPA 300.0
108.120	008	Sulfate	EPA 300.0
108.323	001	Chemical Oxygen Demand	EPA 410.4
108.360	001	Phenols, Total	EPA 420.1
108.381	002	Oil & Grease Total	EPA 1664 Rev. B
108.385	001	Color	SM2120B-2001
108.390	001	Turbidity	SM2130B-2001
108.400	001	Acidity	SM2310B-1997
108.410	001	Alkalinity	SM2320B-1997
108.420	001	Hardness (calculation)	SM2340B-1997
108.421	001	Hardness	SM2340C-1997
108.430	001	Conductivity	SM2510B-1997
108.440	001	Residue, Total	SM2540B-1997

108.441	001	Residue, Filterable TDS	SM2540C-1997
108.442	001	Residue, Non-filterable TSS	SM2540D-1997
108.443	001	Residue, Settleable	SM2540F-1997
108.448	001	Bromide	SM4110B or C-2000
108.448	002	Chloride	SM4110B or C-2000
108.448	003	Fluoride	SM4110B or C-2000
108.448	004	Nitrate	SM4110B or C-2000
108.448	005	Nitrite	SM4110B or C-2000
108.448	006	Nitrate-nitrite	SM4110B or C-2000
108.448	007	Phosphate, Ortho	SM4110B or C-2000
108.448	008	Sulfate	SM4110B or C-2000
108.450	001	Chloride	SM4500-ChlorideB-1997
108.460	001	Chlorine, Total	SM4500-Cl B-2000
108.472	001	Cyanide, Total	SM4500-CN E-1999
108.473	001	Cyanide, amenable	SM4500-CN G-1999
108.480	001	Fluoride	SM4500-F B,C-1997
108.490	001	Hydrogen Ion (pH)	SM4500-H+ B-2000
108.504	002	Ammonia (as N)	SM4500-NH3 F-1997
108.505	002	Kjeldahl Nitrogen, Total (as N)	SM4500-NH3 F-1997
108.512	001	Kjeldahl Nitrogen, Total (as N)	SM4500-Norg C-1997
108.514	001	Nitrite as N	SM4500-NO2- B-2000
108.528	001	Nitrate-Nitrite (as N)	SM4500-NO3- E-2000
108.528	002	Nitrite as N	SM4500-NO3- E-2000
108.528	003	Nitrate (as N)	SM4500-NO3- E-2000
108.540	001	Phosphate, Ortho	SM4500-P E-1999
108.541	001	Phosphorus, Total	SM4500-P E-1999
108.552	001	Silica, Dissolved	SM4500-SiO2 C-1997
108.580	001	Sulfide	SM4500-S= D
108.584	001	Sulfide (as S)	SM4500-S= D-2000
108.585	001	Sulfide (as S)	SM4500-S= F-2000
108.592	001	Biochemical Oxygen Demand	SM5210B-2001
108.595	001	Chemical Oxygen Demand	SM5220D-1997
108.596	001	Organic Carbon-Total (TOC)	SM5310B-2000
108.603	001	Oil & Grease Total	SM5520B-2001
108.605	001	Surfactants	SM5540C-2000
108.926	001	Cyanide	Quickchem 10-204-00-1-X

Field of Testing: 109 - Toxic Chemical Elements of Wastewater

109.010	001	Aluminum	EPA 200.7
109.010	002	Antimony	EPA 200.7
109.010	003	Arsenic	EPA 200.7
109.010	004	Barium	EPA 200.7
109.010	005	Beryllium	EPA 200.7
109.010	007	Cadmium	EPA 200.7

109.010	009	Chromium	EPA 200.7
109.010	010	Cobalt	EPA 200.7
109.010	011	Copper	EPA 200.7
109.010	012	Iron	EPA 200.7
109.010	013	Lead	EPA 200.7
109.010	015	Manganese	EPA 200.7
109.010	016	Molybdenum	EPA 200.7
109.010	017	Nickel	EPA 200.7
109.010	019	Selenium	EPA 200.7
109.010	021	Silver	EPA 200.7
109.010	023	Thallium	EPA 200.7
109.010	024	Tin	EPA 200.7
109.010	026	Vanadium	EPA 200.7
109.010	027	Zinc	EPA 200.7
109.020	001	Aluminum	EPA 200.8
109.020	002	Antimony	EPA 200.8
109.020	003	Arsenic	EPA 200.8
109.020	004	Barium	EPA 200.8
109.020	005	Beryllium	EPA 200.8
109.020	006	Cadmium	EPA 200.8
109.020	007	Chromium	EPA 200.8
109.020	008	Cobalt	EPA 200.8
109.020	009	Copper	EPA 200.8
109.020	010	Lead	EPA 200.8
109.020	011	Manganese	EPA 200.8
109.020	012	Molybdenum	EPA 200.8
109.020	013	Nickel	EPA 200.8
109.020	014	Selenium	EPA 200.8
109.020	015	Silver	EPA 200.8
109.020	016	Thallium	EPA 200.8
109.020	017	Vanadium	EPA 200.8
109.020	018	Zinc	EPA 200.8
109.020	021	Iron	EPA 200.8
109.020	022	Tin	EPA 200.8
109.020	023	Titanium	EPA 200.8
109.104	001	Chromium (VI)	EPA 218.6
109.190	001	Mercury	EPA 245.1
109.824	001	Iron	SM3500-Fe B (20th)

Field of Testing: 110 - Volatile Organic Chemistry of Wastewater

110.040	000	Purgeable Organic Compounds	EPA 624
110.040	042	Oxygenates	EPA 624
110.040	043	Other Volatile Organics	EPA 624

Field of Testing: 111 - Semi-volatile Organic Chemistry of Wastewater

111.101	032	Polynuclear Aromatic Hydrocarbons	EPA 625
111.101	034	Phthalates	EPA 625
111.101	036	Other Extractables	EPA 625
111.170	030	Organochlorine Pesticides & PCBs	EPA 608
111.170	031	PCBs	EPA 608
111.272	001	Oil and Grease	SM5520B (20th)
111.273	001	Oil and Grease	EPA 1664A

Field of Testing: 114 - Inorganic Chemistry of Hazardous Waste

114.010	001	Antimony	EPA 6010B
114.010	002	Arsenic	EPA 6010B
114.010	003	Barium	EPA 6010B
114.010	004	Beryllium	EPA 6010B
114.010	005	Cadmium	EPA 6010B
114.010	006	Chromium	EPA 6010B
114.010	007	Cobalt	EPA 6010B
114.010	008	Copper	EPA 6010B
114.010	009	Lead	EPA 6010B
114.010	010	Molybdenum	EPA 6010B
114.010	011	Nickel	EPA 6010B
114.010	012	Selenium	EPA 6010B
114.010	013	Silver	EPA 6010B
114.010	014	Thallium	EPA 6010B
114.010	015	Vanadium	EPA 6010B
114.010	016	Zinc	EPA 6010B
114.020	001	Antimony	EPA 6020
114.020	002	Arsenic	EPA 6020
114.020	003	Barium	EPA 6020
114.020	004	Beryllium	EPA 6020
114.020	005	Cadmium	EPA 6020
114.020	006	Chromium	EPA 6020
114.020	007	Cobalt	EPA 6020
114.020	008	Copper	EPA 6020
114.020	009	Lead	EPA 6020
114.020	010	Molybdenum	EPA 6020
114.020	011	Nickel	EPA 6020
114.020	012	Selenium	EPA 6020
114.020	013	Silver	EPA 6020
114.020	014	Thallium	EPA 6020
114.020	015	Vanadium	EPA 6020
114.020	016	Zinc	EPA 6020
114.103	001	Chromium (VI)	EPA 7196A
114.106	001	Chromium (VI)	EPA 7199
114.140	001	Mercury	EPA 7470A

114.141	001	Mercury	EPA 7471A
114.222	001	Cyanide	EPA 9014
114.230	001	Sulfides, Total	EPA 9034
114.240	001	Corrosivity - pH Determination	EPA 9040B
114.241	001	Corrosivity - pH Determination	EPA 9045C
114.250	001	Fluoride	EPA 9056
114.270	001	Fluoride	EPA 9214
114.280	001	Organic Lead	HML 939-M

Field of Testing: 115 - Extraction Test of Hazardous Waste

115.020	001	Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311
115.030	001	Waste Extraction Test (WET)	CCR Chapter11, Article 5, Appendix II
115.040	001	Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312

Field of Testing: 116 - Volatile Organic Chemistry of Hazardous Waste

116.010	000	EDB and DBCP	EPA 8011
116.020	011	Ethylene Glycol	EPA 8015B
116.020	031	Ethanol and Methanol	EPA 8015B
116.030	001	Gasoline-range Organics	EPA 8015B
116.080	000	Volatile Organic Compounds	EPA 8260B
116.080	120	Oxygenates	EPA 8260B
116.100	010	BTEX and MTBE	LUFT GC/MS
116.110	001	Total Petroleum Hydrocarbons - Gasoline	LUFT

Field of Testing: 117 - Semi-volatile Organic Chemistry of Hazardous Waste

117.010	001	Diesel-range Total Petroleum Hydrocarbons	EPA 8015B
117.015	001	Diesel-range Total Petroleum Hydrocarbons	LUFT GC/MS
117.016	001	Diesel-range Total Petroleum Hydrocarbons	LUFT
117.017	001	TRPH Screening	EPA 418.1
117.110	000	Extractable Organics	EPA 8270C
117.111	073	Polynuclear Aromatic Hydrocarbons	EPA 8270C
117.111	075	Phthalates	EPA 8270C
117.111	076	Other Extractables	EPA 8270C
117.140	000	Polynuclear Aromatic Hydrocarbons	EPA 8310
117.171	000	Nitroaromatics and Nitramines	EPA 8330A
117.190	001	Nitroglycerine	EPA 8332
117.210	000	Organochlorine Pesticides & PCBs	EPA 8081A
117.220	000	PCBs	EPA 8082
117.250	000	Chlorinated Herbicides	EPA 8151A

Field of Testing: 120 - Physical Properties of Hazardous Waste

120.010	001	Ignitability	EPA 1010
120.040	001	Reactive Cyanide	Section 7.3 SW-846
120.050	001	Reactive Sulfide	Section 7.3 SW-846
120.070	001	Corrosivity - pH Determination	EPA 9040B
120.080	001	Corrosivity - pH Determination	EPA 9045C

LABORATORY ACCREDITATION BUREAU a division of A-S-B

Certificate of Accreditation

ISO/IEC 17025:2005 **Certificate Number L2278**

EMAX Laboratories, Inc.

1835 W. 205th St.
Torrance CA 90501

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: January 10, 2017

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 9th of January 2014

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).
Form 403.14 – Rev 1 7/3/13

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Scope of Accreditation
For
EMAX Laboratories, Inc.

1835 W 205th Street
Torrance, CA 90501
Kenette Pimentel
310-618-8889

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (LABPR 403 DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V5) based on the TNI Standard - Environmental Laboratory Sector, Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis, Sept 2009 (EL-V1-2009); accreditation is granted to **EMAX Laboratories, Inc.** to perform the following tests:

Accreditation granted through: **January 10, 2017**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GFAA	CA 939M	Organo Lead
Platinum Electrode	EPA 120.1	Specific Conductance
Titrimetric	EPA 130.2	Hardness
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
Turbidimetric	EPA 180.1	Turbidity
ICP	EPA 200.7	Aluminum
ICP	EPA 200.7	Antimony
ICP	EPA 200.7	Arsenic
ICP	EPA 200.7	Barium
ICP	EPA 200.7	Beryllium
ICP	EPA 200.7	Boron
ICP	EPA 200.7	Cadmium
ICP	EPA 200.7	Calcium
ICP	EPA 200.7	Chromium
ICP	EPA 200.7	Cobalt
ICP	EPA 200.7	Copper
ICP	EPA 200.7	Iron

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7	Lead
ICP	EPA 200.7	Magnesium
ICP	EPA 200.7	Manganese
ICP	EPA 200.7	Molybdenum
ICP	EPA 200.7	Nickel
ICP	EPA 200.7	Potassium
ICP	EPA 200.7	Selenium
ICP	EPA 200.7	Silver
ICP	EPA 200.7	Sodium
ICP	EPA 200.7	Strontium
ICP	EPA 200.7	Thallium
ICP	EPA 200.7	Tin
ICP	EPA 200.7	Titanium
ICP	EPA 200.7	Vanadium
ICP	EPA 200.7	Zinc
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Zinc
IC	EPA 218.6	Hexavalent Chromium
COLD VAPOR	EPA 245.1	Mercury
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Chloride
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Bromide
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Bromate
IC	EPA 300.0	Chlorate
IC	EPA 300M	Lactate
IC	EPA 300M	Acetate
IC	EPA 300M	Propionate
IC	EPA 300M	Butyrate
IC	EPA 300M	Pyruvate
IC	EPA 310.1	Alkalinity
IC	EPA 314.0	Perchlorate
Titrimetric	EPA 330.3	Total Residual Chlorine
Spectrometric	EPA 352.1	Nitrate-N
Spectrometric	EPA 353.3	Nitrate-N
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.1	Sulfide
Spectrometric	EPA 376.2	Sulfide
Electrode	EPA 405.1	BOD
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Spectrometric	EPA 420.1	Phenols
Spectrometric	EPA 425.1	MBAS
GC	EPA 504.1	DBCP
GC	EPA 504.1	EDB
GC	EPA 608	Aldrin
GC	EPA 608	alpha-BHC
GC	EPA 608	beta-BHC
GC	EPA 608	delta-BHC
GC	EPA 608	gamma-BHC (Lindane)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 608	DDD (4,4)
GC	EPA 608	DDE (4,4)
GC	EPA 608	DDT (4,4)
GC	EPA 608	Dieldrin
GC	EPA 608	Endosulfan I
GC	EPA 608	Endosulfan II
GC	EPA 608	Endosulfan sulfate
GC	EPA 608	Endrin
GC	EPA 608	Endrin Aldehyde
GC	EPA 608	Heptachlor
GC	EPA 608	Heptachlor epoxide
GC	EPA 608	Methoxychlor
GC	EPA 608	alpha-Chlordane
GC	EPA 608	gamma-Chlordane
GC	EPA 608	Endrin Ketone
GC	EPA 608	Toxaphene
GC	EPA 608	Technical Chlordane
GC	EPA 608	cis-Nonachlor
GC	EPA 608	DDD (2,4)
GC	EPA 608	DDE (2,4)
GC	EPA 608	DDT (2,4)
GC	EPA 608	Mirex
GC	EPA 608	Oxychlordane
GC	EPA 608	trans-Nonachlor
GC	EPA 608	PCB1016
GC	EPA 608	PCB1221
GC	EPA 608	PCB1232
GC	EPA 608	PCB1242
GC	EPA 608	PCB1248
GC	EPA 608	PCB1254
GC	EPA 608	PCB1260
GC	EPA 608	PCB1262
GC	EPA 608	PCB1268
GC-MS	EPA 624	Acrolein
GC-MS	EPA 624	Acrylonitrile
GC-MS	EPA 624	Benzene
GC-MS	EPA 624	Bromodichloromethane
GC-MS	EPA 624	Bromoform
GC-MS	EPA 624	Bromomethane
GC-MS	EPA 624	Carbon tetrachloride
GC-MS	EPA 624	Chlorobenzene
GC-MS	EPA 624	2-Chloroethyl vinyl ether
GC-MS	EPA 624	Chloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 624	Chloroform
GC-MS	EPA 624	Chloromethane
GC-MS	EPA 624	Dibromochloromethane
GC-MS	EPA 624	1,1-Dichloroethane
GC-MS	EPA 624	1,2-Dichloroethane
GC-MS	EPA 624	1,2-Dichlorobenzene
GC-MS	EPA 624	1,3-Dichlorobenzene
GC-MS	EPA 624	1,4-Dichlorobenzene
GC-MS	EPA 624	Dichlorodifluoromethane
GC-MS	EPA 624	1,1-Dichloroethene
GC-MS	EPA 624	cis-1,2-Dichloroethene
GC-MS	EPA 624	trans-1,2-Dichloroethene
GC-MS	EPA 624	1,2-Dichloropropane
GC-MS	EPA 624	cis-1,3-Dichloropropene
GC-MS	EPA 624	trans-1,3-Dichloropropene
GC-MS	EPA 624	Ethylbenzene
GC-MS	EPA 624	Methylene Chloride
GC-MS	EPA 624	tert-Butyl methyl ether
GC-MS	EPA 624	Styrene
GC-MS	EPA 624	1,1,2,2-Tetrachloroethane
GC-MS	EPA 624	Tetrachloroethene
GC-MS	EPA 624	Toluene
GC-MS	EPA 624	1,1,1-Trichloroethane
GC-MS	EPA 624	1,1,2-Trichloroethane
GC-MS	EPA 624	1,2,4-Trichlorobenzene
GC-MS	EPA 624	Trichloroethene
GC-MS	EPA 624	Trichlorofluoromethane
GC-MS	EPA 624	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 624	Vinyl Chloride
GC-MS	EPA 624	m-Xylene & p-xylene
GC-MS	EPA 624	o-Xylene
GC-MS	EPA 625	Acenaphthene
GC-MS	EPA 625	Acenaphthylene
GC-MS	EPA 625	Aniline
GC-MS	EPA 625	Anthracene
GC-MS	EPA 625	Azobenzene
GC-MS	EPA 625	Benzidine
GC-MS	EPA 625	Benzo(a)anthracene
GC-MS	EPA 625	benzo(a)pyrene
GC-MS	EPA 625	Benzo(b)fluoranthene
GC-MS	EPA 625	Benzo(e)pyrene
GC-MS	EPA 625	Benzo(g,h,i)perylene
GC-MS	EPA 625	Benzo(k)fluoranthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	Benzoic Acid
GC-MS	EPA 625	Benzyl Alcohol
GC-MS	EPA 625	Biphenyl
GC-MS	EPA 625	bis(2-chloroethoxy)methane
GC-MS	EPA 625	bis(2-chloroethyl)ether
GC-MS	EPA 625	bis(2-chloroisopropyl)ether
GC-MS	EPA 625	bis(2-Ethylhexyl)adipate
GC-MS	EPA 625	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 625	4-Bromophenyl-phenylether
GC-MS	EPA 625	Butylbenzylphthalate
GC-MS	EPA 625	Carbazole
GC-MS	EPA 625	4-Chloro-3-methylphenol
GC-MS	EPA 625	4-Chloroaniline
GC-MS	EPA 625	2-Chloronaphthalene
GC-MS	EPA 625	2-Chlorophenol
GC-MS	EPA 625	4-Chlorophenyl-phenylether
GC-MS	EPA 625	Chrysene
GC-MS	EPA 625	Dibenzo(a,h)anthracene
GC-MS	EPA 625	Dibenzofuran
GC-MS	EPA 625	1,2-Dichlorobenzene
GC-MS	EPA 625	1,3-Dichlorobenzene
GC-MS	EPA 625	1,4-Dichlorobenzene
GC-MS	EPA 625	3,3'-Dichlorobenzidine
GC-MS	EPA 625	2,4-Dichlorophenol
GC-MS	EPA 625	Diethylphthalate
GC-MS	EPA 625	2,6-Dimethylnaphthalene
GC-MS	EPA 625	2,4-Dimethylphenol
GC-MS	EPA 625	Dimethylphthalate
GC-MS	EPA 625	Di-n-butylphthalate
GC-MS	EPA 625	4,6-Dinitro-2-methylphenol
GC-MS	EPA 625	2,4-Dinitrophenol
GC-MS	EPA 625	2,4-Dinitrotoluene
GC-MS	EPA 625	2,6-Dinitrotoluene
GC-MS	EPA 625	Di-n-octylphthalate
GC-MS	EPA 625	1,2-Diphenylhydrazine
GC-MS	EPA 625	Fluoranthene
GC-MS	EPA 625	Fluorene
GC-MS	EPA 625	Hexachlorobenzene
GC-MS	EPA 625	Hexachlorobutadiene
GC-MS	EPA 625	Hexachlorocyclopentadiene
GC-MS	EPA 625	Hexachloroethane
GC-MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 625	Isophorone

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	1-Methylnaphthalene
GC-MS	EPA 625	2-Methylnaphthalene
GC-MS	EPA 625	1-Methylphenanthrene
GC-MS	EPA 625	2-Methylphenol
GC-MS	EPA 625	4-Methylphenol
GC-MS	EPA 625	Naphthalene
GC-MS	EPA 625	2-Nitroaniline
GC-MS	EPA 625	3-Nitroaniline
GC-MS	EPA 625	4-Nitroaniline
GC-MS	EPA 625	Nitrobenzene
GC-MS	EPA 625	2-Nitrophenol
GC-MS	EPA 625	4-Nitrophenol
GC-MS	EPA 625	n-Nitrosodimethylamine
GC-MS	EPA 625	n-Nitroso-di-n-propylamine
GC-MS	EPA 625	n-Nitrosodiphenylamine
GC-MS	EPA 625	Pentachlorophenol
GC-MS	EPA 625	Perylene
GC-MS	EPA 625	Phenanthrene
GC-MS	EPA 625	Phenol
GC-MS	EPA 625	Pyrene
GC-MS	EPA 625	Pyridine
GC-MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 625	1,2,4-Trichlorobenzene
GC-MS	EPA 625	2,3,4-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trichlorophenol
GC-MS	EPA 625	2,4,5-Trichlorophenol
GC-MS	EPA 625	2,4,6-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trimethylnaphthalene
Gravimetric	EPA 1664A / 1664 B	Oil & Grease
Pensky-Martens	EPA 1010 / 1010A	Ignitability
ICP	EPA 6010B / 6010C	Aluminum
ICP	EPA 6010B / 6010C	Antimony
ICP	EPA 6010B / 6010C	Arsenic
ICP	EPA 6010B / 6010C	Barium
ICP	EPA 6010B / 6010C	Beryllium
ICP	EPA 6010B / 6010C	Boron
ICP	EPA 6010B / 6010C	Cadmium
ICP	EPA 6010B / 6010C	Calcium
ICP	EPA 6010B / 6010C	Chromium
ICP	EPA 6010B / 6010C	Cobalt
ICP	EPA 6010B / 6010C	Copper
ICP	EPA 6010B / 6010C	Iron
ICP	EPA 6010B / 6010C	Lead

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B / 6010C	Magnesium
ICP	EPA 6010B / 6010C	Manganese
ICP	EPA 6010B / 6010C	Molybdenum
ICP	EPA 6010B / 6010C	Nickel
ICP	EPA 6010B / 6010C	Potassium
ICP	EPA 6010B / 6010C	Selenium
ICP	EPA 6010B / 6010C	Silver
ICP	EPA 6010B / 6010C	Sodium
ICP	EPA 6010B / 6010C	Strontium
ICP	EPA 6010B / 6010C	Thallium
ICP	EPA 6010B / 6010C	Tin
ICP	EPA 6010B / 6010C	Titanium
ICP	EPA 6010B / 6010C	Vanadium
ICP	EPA 6010B / 6010C	Zinc
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Zinc

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC-MS	EPA 6850	Perchlorate
Spectrometric	EPA 7196A	Hex. Chromium
IC	EPA 7199	Hex. Chromium
Cold-Vapor	EPA 7470A	Mercury
GC	EPA 8015B / 8015C / 8015D	Gasoline
GC	EPA 8015B / 8015C / 8015D	Diesel
GC	EPA 8015B / 8015C / 8015D	Motor Oil
GC	EPA 8015B / 8015C	Diethylene Glycol
GC	EPA 8015B / 8015C	Ethanol
GC	EPA 8015B / 8015C	Ethylene Glycol
GC	EPA 8015B / 8015C	Isopropanol
GC	EPA 8015B / 8015C / 8015D	JP4
GC	EPA 8015B / 8015C	Methanol
GC	EPA 8015B / 8015C	Propylene Glycol
GC	EPA 8015B / 8015C / 8015D	JP5
GC	EPA 8015B / 8015C	Triethylene Glycol
GC	EPA 8081A / 8081B	Aldrin
GC	EPA 8081A / 8081B	alpha-BHC
GC	EPA 8081A / 8081B	beta-BHC
GC	EPA 8081A / 8081B	delta-BHC
GC	EPA 8081A / 8081B	gamma-BHC (Lindane)
GC	EPA 8081A / 8081B	DDD (4,4)
GC	EPA 8081A / 8081B	DDE (4,4)
GC	EPA 8081A / 8081B	DDT (4,4)
GC	EPA 8081A / 8081B	Dieldrin
GC	EPA 8081A / 8081B	Endosulfan I
GC	EPA 8081A / 8081B	Endosulfan II
GC	EPA 8081A / 8081B	Endosulfan sulfate
GC	EPA 8081A / 8081B	Endrin
GC	EPA 8081A / 8081B	Endrin Aldehyde
GC	EPA 8081A / 8081B	Heptachlor
GC	EPA 8081A / 8081B	Heptachlor epoxide
GC	EPA 8081A / 8081B	Methoxychlor
GC	EPA 8081A / 8081B	alpha-Chlordane
GC	EPA 8081A / 8081B	gamma-Chlordane
GC	EPA 8081A / 8081B	Endrin Ketone
GC	EPA 8081A / 8081B	Toxaphene
GC	EPA 8081A / 8081B	Technical Chlordane
GC	EPA 8081A / 8081B	cis-Nonachlor
GC	EPA 8081A / 8081B	DDD (2,4)
GC	EPA 8081A / 8081B	DDE (2,4)
GC	EPA 8081A / 8081B	DDT (2,4)
GC	EPA 8081A / 8081B	Mirex

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8081A / 8081B	Oxychlordane
GC	EPA 8081A / 8081B	trans-Nonachlor
GC	EPA 8082 / 8082A	PCB1016
GC	EPA 8082 / 8082A	PCB1221
GC	EPA 8082 / 8082A	PCB1232
GC	EPA 8082 / 8082A	PCB1242
GC	EPA 8082 / 8082A	PCB1248
GC	EPA 8082 / 8082A	PCB1254
GC	EPA 8082 / 8082A	PCB1260
GC	EPA 8082 / 8082A	PCB1262
GC	EPA 8082 / 8082A	PCB1268
GC	EPA 8082 / 8082A	PCB 8
GC	EPA 8082 / 8082A	PCB 18
GC	EPA 8082 / 8082A	PCB 28
GC	EPA 8082 / 8082A	PCB 44
GC	EPA 8082 / 8082A	PCB 52
GC	EPA 8082 / 8082A	PCB 66
GC	EPA 8082 / 8082A	PCB 77
GC	EPA 8082 / 8082A	PCB 81
GC	EPA 8082 / 8082A	PCB 101
GC	EPA 8082 / 8082A	PCB 105
GC	EPA 8082 / 8082A	PCB 114
GC	EPA 8082 / 8082A	PCB 118
GC	EPA 8082 / 8082A	PCB 123
GC	EPA 8082 / 8082A	PCB 126
GC	EPA 8082 / 8082A	PCB 128
GC	EPA 8082 / 8082A	PCB 138
GC	EPA 8082 / 8082A	PCB 153
GC	EPA 8082 / 8082A	PCB 156
GC	EPA 8082 / 8082A	PCB 157
GC	EPA 8082 / 8082A	PCB 167
GC	EPA 8082 / 8082A	PCB 169
GC	EPA 8082 / 8082A	PCB 170
GC	EPA 8082 / 8082A	PCB 180
GC	EPA 8082 / 8082A	PCB 187
GC	EPA 8082 / 8082A	PCB 189
GC	EPA 8082 / 8082A	PCB 195
GC	EPA 8082 / 8082A	PCB 206
GC	EPA 8082 / 8082A	PCB 209
GC	EPA 8082 / 8082A	PCB 110
GC	EPA 8141A / 8141B	Azinphos-methyl
GC	EPA 8141A / 8141B	Bolstar
GC	EPA 8141A / 8141B	Chlorpyrifos

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8141A / 8141B	Coumaphos
GC	EPA 8141A / 8141B	Demeton
GC	EPA 8141A / 8141B	Diazinon
GC	EPA 8141A / 8141B	Dichlorvos
GC	EPA 8141A / 8141B	Disulfoton
GC	EPA 8141A / 8141B	Ethoprop
GC	EPA 8141A / 8141B	Fensulfothion
GC	EPA 8141A / 8141B	Fenthion
GC	EPA 8141A / 8141B	Merphos
GC	EPA 8141A / 8141B	Mevinphos
GC	EPA 8141A / 8141B	Naled
GC	EPA 8141A / 8141B	Methyl Parathion
GC	EPA 8141A / 8141B	Phorate
GC	EPA 8141A / 8141B	Ronnel
GC	EPA 8141A / 8141B	Stirophos
GC	EPA 8141A / 8141B	Tokuthion
GC	EPA 8141A / 8141B	Trichloronate
GC	EPA 8141A / 8141B	Dimethoate
GC	EPA 8141A / 8141B	EPN
GC	EPA 8141A / 8141B	Famphur
GC	EPA 8141A / 8141B	Malathion
GC	EPA 8141A / 8141B	Ethyl Parathion
GC	EPA 8141A / 8141B	O,O,O-Triethylphosphorothioate
GC	EPA 8141A / 8141B	Sulfotepp
GC	EPA 8141A / 8141B	Thionazin
GC	EPA 8141A / 8141B	Tributyl Phosphate
GC	EPA 8151A	Acifluorfen
GC	EPA 8151A	Bentazon
GC	EPA 8151A	Chloramben
GC	EPA 8151A	2,4-D
GC	EPA 8151A	2,4-DB
GC	EPA 8151A	Dacthal
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	3,5-Dichlorobenzoic acid
GC	EPA 8151A	Dichlorprop
GC	EPA 8151A	Dinoseb
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	4-Nitrophenol
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Picloram
GC	EPA 8151A	Silvex

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8151A	2,4,5-T
GC-MS	EPA 8260B / 8260C	Acetone
GC-MS	EPA 8260B / 8260C	Acrolein
GC-MS	EPA 8260B / 8260C	Acrylonitrile
GC-MS	EPA 8260B / 8260C	Benzene
GC-MS	EPA 8260B / 8260C	Bromobenzene
GC-MS	EPA 8260B / 8260C	Bromochloromethane
GC-MS	EPA 8260B / 8260C	Bromodichloromethane
GC-MS	EPA 8260B / 8260C	Bromoform
GC-MS	EPA 8260B / 8260C	Bromomethane
GC-MS	EPA 8260B / 8260C	tert-Butyl alcohol
GC-MS	EPA 8260B / 8260C	2-Butanone (MEK)
GC-MS	EPA 8260B / 8260C	n-Butylbenzene
GC-MS	EPA 8260B / 8260C	sec-Butylbenzene
GC-MS	EPA 8260B / 8260C	tert-Butylbenzene
GC-MS	EPA 8260B / 8260C	Carbon disulfide
GC-MS	EPA 8260B / 8260C	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C	Chlorobenzene
GC-MS	EPA 8260B / 8260C	2-Chloroethyl vinyl ether
GC-MS	EPA 8260B / 8260C	Chloroethane
GC-MS	EPA 8260B / 8260C	Chloroform
GC-MS	EPA 8260B / 8260C	1-Chlorohexane
GC-MS	EPA 8260B / 8260C	Chloromethane
GC-MS	EPA 8260B / 8260C	2-Chlorotoluene
GC-MS	EPA 8260B / 8260C	4-Chlorotoluene
GC-MS	EPA 8260B / 8260C	Isopropyl ether (DIPE)
GC-MS	EPA 8260B / 8260C	Dibromochloromethane
GC-MS	EPA 8260B / 8260C	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C	Dibromomethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	1,3-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-Butene
GC-MS	EPA 8260B / 8260C	1,4-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	Dichlorodifluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C	cis-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C	trans-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C	Dichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloropropene
GC-MS	EPA 8260B / 8260C	1,2-Dichloropropane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	1,3-Dichloropropane
GC-MS	EPA 8260B / 8260C	2,2-Dichloropropane
GC-MS	EPA 8260B / 8260C	cis-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	trans-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Ethylbenzene
GC-MS	EPA 8260B / 8260C	2-Hexanone (MBK)
GC-MS	EPA 8260B / 8260C	Hexachlorobutadiene
GC-MS	EPA 8260B / 8260C	Iodomethane
GC-MS	EPA 8260B / 8260C	Isopropylbenzene
GC-MS	EPA 8260B / 8260C	p-Isopropyltoluene
GC-MS	EPA 8260B / 8260C	Methylene Chloride
GC-MS	EPA 8260B / 8260C	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 8260B / 8260C	tert-Butyl methyl ether
GC-MS	EPA 8260B / 8260C	Naphthalene
GC-MS	EPA 8260B / 8260C	n-Propylbenzene
GC-MS	EPA 8260B / 8260C	Styrene
GC-MS	EPA 8260B / 8260C	tert-Amyl methyl ether (TAME)
GC-MS	EPA 8260B / 8260C	1,1,1,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	Tetrachloroethene
GC-MS	EPA 8260B / 8260C	Toluene
GC-MS	EPA 8260B / 8260C	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	1,2,4-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	Trichloroethene
GC-MS	EPA 8260B / 8260C	Trichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 8260B / 8260C	1,2,4-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	1,3,5-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	Vinyl Acetate
GC-MS	EPA 8260B / 8260C	Vinyl Chloride
GC-MS	EPA 8260B / 8260C	m-Xylene & p-xylene
GC-MS	EPA 8260B / 8260C	o-Xylene
GC-MS	EPA 8260B / 8260C	2-Butanol
GC-MS	EPA 8260B / 8260C	Cyclohexane
GC-MS	EPA 8260B / 8260C	1,4-Dioxane
GC-MS	EPA 8260B / 8260C	2-Chloro-1,1,1-trifluoroethane
GC-MS	EPA 8260B / 8260C	Chlorotrifluoroethylene
GC-MS	EPA 8260B / 8260C	cis-1,4-Dichloro-2-butene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	Ethanol
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Isobutyl Alcohol
GC-MS	EPA 8260B / 8260C	Methacrylonitrile
GC-MS	EPA 8260B / 8260C	Methyl Methacrylate
GC-MS	EPA 8260B / 8260C	Pentachloroethane
GC-MS	EPA 8260B / 8260C	Propionitrile
GC-MS	EPA 8260B / 8260C	Sec-Propyl alcohol
GC-MS	EPA 8260B / 8260C	Tetrahydrofuran
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-butene
GC-MS	EPA 8260B / 8260C SIM	Benzene
GC-MS	EPA 8260B / 8260C SIM	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C SIM	Chloroform
GC-MS	EPA 8260B / 8260C SIM	Chloromethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	cis-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	trans-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C SIM	Tetrachloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	Trichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C SIM	Vinyl Chloride
GC-MS	EPA 8260B / 8260C SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	Acenaphthene
GC-MS	EPA 8270C / 8270D	Acenaphthylene
GC-MS	EPA 8270C / 8270D	Aniline
GC-MS	EPA 8270C / 8270D	Anthracene
GC-MS	EPA 8270C / 8270D	Azobenzene
GC-MS	EPA 8270C / 8270D	Benzidine
GC-MS	EPA 8270C / 8270D	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzoic Acid
GC-MS	EPA 8270C / 8270D	Benzyl Alcohol
GC-MS	EPA 8270C / 8270D	Biphenyl

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	bis(2-chloroethoxy)methane
GC-MS	EPA 8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-chloroisopropyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)adipate
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D	Carbazole
GC-MS	EPA 8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D	4-Chloroaniline
GC-MS	EPA 8270C / 8270D	2-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	2-Chlorophenol
GC-MS	EPA 8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Chrysene
GC-MS	EPA 8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D	Dibenzofuran
GC-MS	EPA 8270C / 8270D	1,2-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	EPA 8270C / 8270D	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D	Diethylphthalate
GC-MS	EPA 8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	Dimethylphthalate
GC-MS	EPA 8270C / 8270D	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrophenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	2,6-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	Di-n-octylphthalate
GC-MS	EPA 8270C / 8270D	Fluoranthene
GC-MS	EPA 8270C / 8270D	Fluorene
GC-MS	EPA 8270C / 8270D	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D	Hexachlorobutadiene
GC-MS	EPA 8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	EPA 8270C / 8270D	Hexachloroethane
GC-MS	EPA 8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D	Isophorone
GC-MS	EPA 8270C / 8270D	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D	2-Methylphenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	4-Methylphenol
GC-MS	EPA 8270C / 8270D	Naphthalene
GC-MS	EPA 8270C / 8270D	2-Nitroaniline
GC-MS	EPA 8270C / 8270D	3-Nitroaniline
GC-MS	EPA 8270C / 8270D	4-Nitroaniline
GC-MS	EPA 8270C / 8270D	Nitrobenzene
GC-MS	EPA 8270C / 8270D	2-Nitrophenol
GC-MS	EPA 8270C / 8270D	4-Nitrophenol
GC-MS	EPA 8270C / 8270D	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	EPA 8270C / 8270D	Pentachlorophenol
GC-MS	EPA 8270C / 8270D	Perylene
GC-MS	EPA 8270C / 8270D	Phenanthrene
GC-MS	EPA 8270C / 8270D	Phenol
GC-MS	EPA 8270C / 8270D	Pyrene
GC-MS	EPA 8270C / 8270D	Pyridine
GC-MS	EPA 8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	EPA 8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D	1,2,4,5-Tetrachlorobenzene
GC-MS	EPA 8270C / 8270D	1,3,5-Trinitrobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dinitrobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	1,4-Naphthoquinone
GC-MS	EPA 8270C / 8270D	1-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	1-Naphthylamine
GC-MS	EPA 8270C / 8270D	2,6-Dichlorophenol
GC-MS	EPA 8270C / 8270D	2-acetylaminofluorene
GC-MS	EPA 8270C / 8270D	2-Naphthylamine
GC-MS	EPA 8270C / 8270D	2-Picoline
GC-MS	EPA 8270C / 8270D	3,3-Dimethylbenzidine
GC-MS	EPA 8270C / 8270D	3,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3-Methylchlolanthrene
GC-MS	EPA 8270C / 8270D	4-Aminobiphenyl
GC-MS	EPA 8270C / 8270D	4-Nitroquinoline-N-oxide
GC-MS	EPA 8270C / 8270D	5-Nitro-o-toluidine
GC-MS	EPA 8270C / 8270D	7,12-Dimethylbenz(a)anthracene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	a,a-dimethylphenethylamine
GC-MS	EPA 8270C / 8270D	Acetophenone
GC-MS	EPA 8270C / 8270D	Aramite
GC-MS	EPA 8270C / 8270D	Atrazine
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	Chlorobenzilate
GC-MS	EPA 8270C / 8270D	Diallate
GC-MS	EPA 8270C / 8270D	Dibenzo(a,j)acridine
GC-MS	EPA 8270C / 8270D	Dimethoate
GC-MS	EPA 8270C / 8270D	Dinoseb
GC-MS	EPA 8270C / 8270D	Diphenyl ether
GC-MS	EPA 8270C / 8270D	Disulfoton
GC-MS	EPA 8270C / 8270D	Ethyl methacrylate
GC-MS	EPA 8270C / 8270D	Ethyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Ethyl parathion
GC-MS	EPA 8270C / 8270D	Famphur
GC-MS	EPA 8270C / 8270D	Hexachlorophene
GC-MS	EPA 8270C / 8270D	Hexachloropropene
GC-MS	EPA 8270C / 8270D	Isodrin
GC-MS	EPA 8270C / 8270D	Isosafrole
GC-MS	EPA 8270C / 8270D	kepone
GC-MS	EPA 8270C / 8270D	Methapyrilene
GC-MS	EPA 8270C / 8270D	Methyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Methyl parathion
GC-MS	EPA 8270C / 8270D	N-nitrosodiethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosodi-n-butylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomethylethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomorpholine
GC-MS	EPA 8270C / 8270D	N-Nitrosopiperdine
GC-MS	EPA 8270C / 8270D	N-Nitrosopyrrolidine
GC-MS	EPA 8270C / 8270D	O,O,O-triethyl phosphorothi
GC-MS	EPA 8270C / 8270D	o-toluidine
GC-MS	EPA 8270C / 8270D	p-Dimethylaminoazobenze
GC-MS	EPA 8270C / 8270D	Pentachlorobenzene
GC-MS	EPA 8270C / 8270D	Pentachloroethane
GC-MS	EPA 8270C / 8270D	Pentachloronitrobenzene
GC-MS	EPA 8270C / 8270D	Phenacetin
GC-MS	EPA 8270C / 8270D	Phorate
GC-MS	EPA 8270C / 8270D	p-phenylenediamine
GC-MS	EPA 8270C / 8270D	Pronamide
GC-MS	EPA 8270C / 8270D	Safrole
GC-MS	EPA 8270C / 8270D	Sulfotepp
GC-MS	EPA 8270C / 8270D	Thionazin

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	Acenaphthene
GC-MS	EPA 8270C / 8270D SIM	Acenaphthylene
GC-MS	EPA 8270C / 8270D SIM	Anthracene
GC-MS	EPA 8270C / 8270D SIM	Azobenzene
GC-MS	EPA 8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D SIM	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Biphenyl
GC-MS	EPA 8270C / 8270D SIM	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D SIM	Carbazole
GC-MS	EPA 8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D SIM	2-Chlorophenol
GC-MS	EPA 8270C / 8270D SIM	Chrysene
GC-MS	EPA 8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D SIM	Fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Fluorene
GC-MS	EPA 8270C / 8270D SIM	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D SIM	Naphthalene
GC-MS	EPA 8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D SIM	Pentachlorophenol
GC-MS	EPA 8270C / 8270D SIM	Perylene
GC-MS	EPA 8270C / 8270D SIM	Phenanthrene
GC-MS	EPA 8270C / 8270D SIM	Phenol
GC-MS	EPA 8270C / 8270D SIM	Pyrene
GC-MS	EPA 8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D SIM	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D SIM	Diethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Dimethylphthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-octylphthalate
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g,h,i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenzo(a,h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A / 8330 B	HMX
HPLC	EPA 8330A / 8330 B	RDX
HPLC	EPA 8330A / 8330 B	1,3,5-TNB
HPLC	EPA 8330A / 8330 B	1,3-DNB
HPLC	EPA 8330A / 8330 B	Tetryl
HPLC	EPA 8330A / 8330 B	Nitrobenzene
HPLC	EPA 8330A / 8330 B	2,4,6-TNT
HPLC	EPA 8330A / 8330 B	4-AM-2,6-DNT
HPLC	EPA 8330A / 8330 B	2-AM-4,6-DNT
HPLC	EPA 8330A / 8330 B	2,6-DNT
HPLC	EPA 8330A / 8330 B	2,4-DNT
HPLC	EPA 8330A / 8330 B	2-Nitrotoluene
HPLC	EPA 8330A / 8330 B	4-Nitrotoluene
HPLC	EPA 8330A / 8330 B	3-Nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	2,4-Diamino-6-nitrotoluene
HPLC	EPA 8330A	2,6-Diamino-4-nitrotoluene
HPLC	EPA 8330A	Picric Acid
HPLC	EPA 8332	Nitroglycerine
HPLC	EPA 8332	PETN
Spectrometric	EPA 9014	Cyanide
Electrode	EPA 9040 B / 9040C	pH
IC	EPA 9056 / 9056A	Bromate

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	EPA 9056 / 9056A	Bromide
IC	EPA 9056 / 9056A	Chloride
IC	EPA 9056 / 9056A	Fluoride
IC	EPA 9056 / 9056A	Nitrate
IC	EPA 9056 / 9056A	Nitrite
IC	EPA 9056 / 9056A	Phosphate
IC	EPA 9056 / 9056A	Sulfate
IC	EPA 9056 / 9056A	Chlorate
Combustion-IR	EPA 9060A	TOC
Spectrometric	EPA 9065	Phenols
Gravimetric	EPA 9070A	Oil & Grease
Gravimetric	EPA 9071B	Oil & Grease
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM 4500-NH3C	Ammonia
Spectrometric	SM 4500-NH3F	Ammonia
Spectrometric	SM 4500-NOrgC	TKN
Spectrometric	SM 4500-PE	Phosphorus
Turbidimetric	SM 2130B	Turbidity
Titrimetric	SM 2310B	Acidity
Titrimetric	SM 2320B	Alkalinity
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Gravimetric	SM 2540B	Total Residue
Spectrometric	SM 3500-FeB	Ferrous iron
IC	SM 4110B	Bromate
IC	SM 4110B	Bromide
IC	SM 4110B	Chloride
IC	SM 4110B	Fluoride
IC	SM 4110B	Nitrate
IC	SM 4110B	Nitrite
IC	SM 4110B	Phosphate
IC	SM 4110B	Sulfate
IC	SM 4110B	Chlorate
Titrimetric	SM 4500-Cl-B	Chloride
Titrimetric	SM 4500-Cl B	Total Residual Chlorine
Spectrometric	SM 4500CNE	Cyanide

Non-Potable Water		
Technology	**Method**	**Analyte**
Electrode	SM 4500-FC	Fluoride
Electrode	SM 4500 HB	pH
Spectrometric	SM4500-NO2B	Nitrite-N
Spectrometric	SM4500-NO3E	Nitrate-N
Spectrometric	SM4500PE	Ortho-phosphate
Spectrometric	SM4500-PE(PB5)	Phosphorus
Spectrometric	SM4500-S2D	Sulfide
Titrimetric	SM4500-S2F	Sulfide
Spectrometric	SM4500-SiO2C	Silica
Electrode	SM5210B	BOD
Spectrometric	SM 5220D	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM5540C	Surfactants (MBAS)
Distillation	EPA 9010C	Cyanide
MicroDistillation	QuickChem 10-204-00-1-X	Cyanide
ICP/ICP-MS	SM2340B	Hardness
Preparation	**Method**	**Type**
Purge & Trap	EPA 5030B / 5030C	Volatiles Prep
Acid Digestion	EPA 3005A / EPA 3010A / EPA 200.8 / EPA 200.7	Metals Prep
Continuous Liquid-Liquid	EPA 3520C	Organic Extraction
Waste Dilution	EPA 3580A	Organic Extraction
TCLP	EPA 1311	Leaching
SPLP	EPA 1312	Leaching

Drinking Water		
Technology	**Method**	**Analyte**
Platinum Electrode	EPA 120.1	Specific Conductance
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium

Drinking Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
IC	EPA 218.6	Hexavalent Chromium
Cold Vapor	EPA 245.1	Mercury
IC	EPA 300.0	Bromate
IC	EPA 300.0	Bromide
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Chlorate
IC	EPA 300M	Acetate
IC	EPA 300M	Butyrate
IC	EPA 300M	Lactate
IC	EPA 300M	Propionate
IC	EPA 300M	Pyruvate
IC	EPA 314.0	Perchlorate
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 352.1	Nitrate-N

Drinking Water		
Technology	**Method**	**Analyte**
Spectrometric	EPA 353.3	Nitrate-N
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.1	Sulfide
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Spectrometric	EPA 420.1	Phenols
GC	EPA 504.1	DBCP
GC	EPA 504.1	EDB
GC-MS	EPA 524.2	Acetone
GC-MS	EPA 524.2	Benzene
GC-MS	EPA 524.2	Bromobenzene
GC-MS	EPA 524.2	Bromochloromethane
GC-MS	EPA 524.2	Bromodichloromethane
GC-MS	EPA 524.2	Bromoform
GC-MS	EPA 524.2	Bromomethane
GC-MS	EPA 524.2	tert-Butyl alcohol
GC-MS	EPA 524.2	2-Butanone (MEK)
GC-MS	EPA 524.2	n-Butylbenzene
GC-MS	EPA 524.2	sec-Butylbenzene
GC-MS	EPA 524.2	tert-Butylbenzene
GC-MS	EPA 524.2	Carbon disulfide
GC-MS	EPA 524.2	Carbon tetrachloride
GC-MS	EPA 524.2	Chlorobenzene
GC-MS	EPA 524.2	Chloroethane
GC-MS	EPA 524.2	Chloroform
GC-MS	EPA 524.2	Chloromethane
GC-MS	EPA 524.2	2-Chlorotoluene
GC-MS	EPA 524.2	4-Chlorotoluene
GC-MS	EPA 524.2	Dibromochloromethane
GC-MS	EPA 524.2	1,2-Dibromo-3-chloropropane
GC-MS	EPA 524.2	1,2-Dibromoethane
GC-MS	EPA 524.2	Dibromomethane
GC-MS	EPA 524.2	1,1-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichlorobenzene
GC-MS	EPA 524.2	1,3-Dichlorobenzene
GC-MS	EPA 524.2	1,4-Dichlorobenzene
GC-MS	EPA 524.2	Dichlorodifluoromethane

Drinking Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	1,1-Dichloroethene
GC-MS	EPA 524.2	cis-1,2-Dichloroethene
GC-MS	EPA 524.2	trans-1,2-Dichloroethene
GC-MS	EPA 524.2	1,1-Dichloropropene
GC-MS	EPA 524.2	1,2-Dichloropropane
GC-MS	EPA 524.2	1,3-Dichloropropane
GC-MS	EPA 524.2	2,2-Dichloropropane
GC-MS	EPA 524.2	cis-1,3-Dichloropropene
GC-MS	EPA 524.2	trans-1,3-Dichloropropene
GC-MS	EPA 524.2	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 524.2	Ethylbenzene
GC-MS	EPA 524.2	2-Hexanone (MBK)
GC-MS	EPA 524.2	Hexachlorobutadiene
GC-MS	EPA 524.2	Isopropyl ether (DIPE)
GC-MS	EPA 524.2	Isopropylbenzene
GC-MS	EPA 524.2	p-Isopropyltoluene
GC-MS	EPA 524.2	Methylene Chloride
GC-MS	EPA 524.2	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 524.2	tert-Butyl methyl ether
GC-MS	EPA 524.2	Naphthalene
GC-MS	EPA 524.2	n-Propylbenzene
GC-MS	EPA 524.2	Styrene
GC-MS	EPA 524.2	tert-Amyl methyl ether (TAME)
GC-MS	EPA 524.2	1,1,1,2-Tetrachloroethane
GC-MS	EPA 524.2	1,1,2,2-Tetrachloroethane
GC-MS	EPA 524.2	Tetrachloroethene
GC-MS	EPA 524.2	Toluene
GC-MS	EPA 524.2	1,1,1-Trichloroethane
GC-MS	EPA 524.2	1,1,2-Trichloroethane
GC-MS	EPA 524.2	1,2,3-Trichlorobenzene
GC-MS	EPA 524.2	1,2,4-Trichlorobenzene
GC-MS	EPA 524.2	Trichloroethene
GC-MS	EPA 524.2	Trichlorofluoromethane
GC-MS	EPA 524.2	1,2,3-Trichloropropane
GC-MS	EPA 524.2	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 524.2	1,2,4-Trimethylbenzene
GC-MS	EPA 524.2	1,3,5-Trimethylbenzene
GC-MS	EPA 524.2	Vinyl Chloride
GC-MS	EPA 524.2	m-Xylene & p-xylene
GC-MS	EPA 524.2	o-Xylene
Titrimetric	SM 2320B	Alkalinity

Drinking Water		
Technology	**Method**	**Analyte**
HPLC-MS	EPA 6850	Perchlorate
ICP/ICP-MS by Calculation	SM 2340B	Hardness
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540B	Total Residue
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Spectrometric	SM 3500- FeB	Ferrous Iron
Spectrometric	SM 4500-CNE	Cyanide
Electrode	SM 4500 HB	pH
Spectrometric	SM 4500-NH3C	Ammonia
Spectrometric	SM 4500-NH3F	Ammonia
Spectrometric	SM 4500-NO2B	Nitrite-N
Spectrometric	SM 4500-NO3E	Nitrate-N
Spectrometric	SM 4500-NOrgC	TKN
Spectrometric	SM 4500-PE	Ortho-phosphate
Spectrometric	SM 4500-PE(PB5)	Phosphorus
Titrimetric	SM 4500-S2F	Sulfide
Spectrometric	SM 4500-SiO2C	Silica
Spectrometric	SM 5220D	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM 5540C	Surfactants
MicroDistillation	QuickChem 10-204-00-1-X	Cyanide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GC	AZ8015	DRO (C10-C22)
GC	AZ8015	ORO (C22-C32)
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Spectrometric	SM4500-PE(PB5)	Phosphorus
Titrimetric	Walkley Black	TOC
Electrode	EPA 9045C / 9045D	pH
Spectrometric	EPA 9065	Phenols
Penskey-Martens	EPA 1010/ 1010A	Ignitability
ICP	EPA 6010B / 6010C	Aluminum
ICP	EPA 6010B / 6010C	Antimony
ICP	EPA 6010B / 6010C	Arsenic
ICP	EPA 6010B / 6010C	Barium
ICP	EPA 6010B / 6010C	Beryllium
ICP	EPA 6010B / 6010C	Boron
ICP	EPA 6010B / 6010C	Cadmium
ICP	EPA 6010B / 6010C	Calcium
ICP	EPA 6010B / 6010C	Chromium
ICP	EPA 6010B / 6010C	Cobalt
ICP	EPA 6010B / 6010C	Copper
ICP	EPA 6010B / 6010C	Iron
ICP	EPA 6010B / 6010C	Lead
ICP	EPA 6010B / 6010C	Lithium
ICP	EPA 6010B / 6010C	Magnesium
ICP	EPA 6010B / 6010C	Manganese
ICP	EPA 6010B / 6010C	Molybdenum
ICP	EPA 6010B / 6010C	Nickel
ICP	EPA 6010B / 6010C	Potassium
ICP	EPA 6010B / 6010C	Selenium
ICP	EPA 6010B / 6010C	Silver
ICP	EPA 6010B / 6010C	Sodium
ICP	EPA 6010B / 6010C	Strontium
ICP	EPA 6010B / 6010C	Thallium
ICP	EPA 6010B / 6010C	Tin
ICP	EPA 6010B / 6010C	Titanium
ICP	EPA 6010B / 6010C	Vanadium
ICP	EPA 6010B / 6010C	Zinc
IPC-MS	EPA 6020A	Aluminum
IPC-MS	EPA 6020A	Antimony
IPC-MS	EPA 6020A	Arsenic
IPC-MS	EPA 6020A	Barium
IPC-MS	EPA 6020A	Beryllium
IPC-MS	EPA 6020A	Boron
IPC-MS	EPA 6020A	Cadmium
IPC-MS	EPA 6020A	Calcium
IPC-MS	EPA 6020A	Chromium
IPC-MS	EPA 6020A	Cobalt

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
IPC-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Zinc
HPLC-MS	EPA 6850	Perchlorate
Spectrometric	EPA 7196A	Hex. Chromium
IC	EPA 7199	Hex. Chromium
Cold-Vapor	EPA 7471A / 7471B	Mercury
GC	EPA 8011	DBCP
GC	EPA 8011	EDB
GC	EPA 8015B / 8015C / 8015D	Gasoline
GC	EPA 8015B / 8015C / 8015D	Diesel
GC	EPA 8015B / 8015C / 8015D	Motor Oil
GC	EPA 8015B / 8015C / 8015D	JP5
GC	EPA 8015B / 8015C	Ethanol
GC	EPA 8015B / 8015C	Isopropanol
GC	EPA 8015B / 8015C	Diethylene Glycol
GC	EPA 8015B / 8015C	Ethylene Glycol
GC	EPA 8015B / 8015C	Triethylene Glycol
GC	EPA 8015B / 8015C / 8015D	JP4
GC	EPA 8015B / 8015C	Methanol
GC	EPA 8015B / 8015C	Propylene Glycol
GC	EPA 8081A / 8081B	Aldrin
GC	EPA 8081A / 8081B	alpha-BHC
GC	EPA 8081A / 8081B	beta-BHC
GC	EPA 8081A / 8081B	delta-BHC
GC	EPA 8081A / 8081B	gamma-BHC (Lindane)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8081A / 8081B	DDD (4,4)
GC	EPA 8081A / 8081B	DDE (4,4)
GC	EPA 8081A / 8081B	DDT (4,4)
GC	EPA 8081A / 8081B	Dieldrin
GC	EPA 8081A / 8081B	Endosulfan I
GC	EPA 8081A / 8081B	Endosulfan II
GC	EPA 8081A / 8081B	Endosulfan sulfate
GC	EPA 8081A / 8081B	Endrin
GC	EPA 8081A / 8081B	Endrin Aldehyde
GC	EPA 8081A / 8081B	Heptachlor
GC	EPA 8081A / 8081B	Heptachlor epoxide
GC	EPA 8081A / 8081B	Methoxychlor
GC	EPA 8081A / 8081B	alpha-Chlordane
GC	EPA 8081A / 8081B	gamma-Chlordane
GC	EPA 8081A / 8081B	Endrin Ketone
GC	EPA 8081A / 8081B	Toxaphene
GC	EPA 8081A / 8081B	Technical Chlordane
GC	EPA 8081A / 8081B	cis-Nonachlor
GC	EPA 8081A / 8081B	DDD (2,4)
GC	EPA 8081A / 8081B	DDE (2,4)
GC	EPA 8081A / 8081B	DDT (2,4)
GC	EPA 8081A / 8081B	Mirex
GC	EPA 8081A / 8081B	Oxychlordane
GC	EPA 8081A / 8081B	trans-Nonachlor
GC	EPA 8082 / 8082A	PCB1016
GC	EPA 8082 / 8082A	PCB1221
GC	EPA 8082 / 8082A	PCB1232
GC	EPA 8082 / 8082A	PCB1242
GC	EPA 8082 / 8082A	PCB1248
GC	EPA 8082 / 8082A	PCB1254
GC	EPA 8082 / 8082A	PCB1260
GC	EPA 8082 / 8082A	PCB1262
GC	EPA 8082 / 8082A	PCB1268
GC	EPA 8082 / 8082A	PCB 8
GC	EPA 8082 / 8082A	PCB 18
GC	EPA 8082 / 8082A	PCB 28
GC	EPA 8082 / 8082A	PCB 44
GC	EPA 8082 / 8082A	PCB 52
GC	EPA 8082 / 8082A	PCB 66
GC	EPA 8082 / 8082A	PCB 77
GC	EPA 8082 / 8082A	PCB 81
GC	EPA 8082 / 8082A	PCB 101
GC	EPA 8082 / 8082A	PCB 105

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8082 / 8082A	PCB 110
GC	EPA 8082 / 8082A	PCB 114
GC	EPA 8082 / 8082A	PCB 118
GC	EPA 8082 / 8082A	PCB 123
GC	EPA 8082 / 8082A	PCB 126
GC	EPA 8082 / 8082A	PCB 128
GC	EPA 8082 / 8082A	PCB 138
GC	EPA 8082 / 8082A	PCB 153
GC	EPA 8082 / 8082A	PCB 156
GC	EPA 8082 / 8082A	PCB 157
GC	EPA 8082 / 8082A	PCB 167
GC	EPA 8082 / 8082A	PCB 169
GC	EPA 8082 / 8082A	PCB 170
GC	EPA 8082 / 8082A	PCB 180
GC	EPA 8082 / 8082A	PCB 187
GC	EPA 8082 / 8082A	PCB 189
GC	EPA 8082 / 8082A	PCB 195
GC	EPA 8082 / 8082A	PCB 206
GC	EPA 8082 / 8082A	PCB 209
GC	EPA 8141A / 8141B	Azinphos-methyl
GC	EPA 8141A / 8141B	Bolstar
GC	EPA 8141A / 8141B	Chlorpyrifos
GC	EPA 8141A / 8141B	Coumaphos
GC	EPA 8141A / 8141B	Demeton
GC	EPA 8141A / 8141B	Diazinon
GC	EPA 8141A / 8141B	Dichlorvos
GC	EPA 8141A / 8141B	Disulfoton
GC	EPA 8141A / 8141B	Ethoprop
GC	EPA 8141A / 8141B	Fensulfothion
GC	EPA 8141A / 8141B	Fenthion
GC	EPA 8141A / 8141B	Merphos
GC	EPA 8141A / 8141B	Mevinphos
GC	EPA 8141A / 8141B	Naled
GC	EPA 8141A / 8141B	Methyl Parathion
GC	EPA 8141A / 8141B	Phorate
GC	EPA 8141A / 8141B	Ronnel
GC	EPA 8141A / 8141B	Stirophos
GC	EPA 8141A / 8141B	Tokuthion
GC	EPA 8141A / 8141B	Trichloronate
GC	EPA 8141A / 8141B	Dimethoate
GC	EPA 8141A / 8141B	EPN
GC	EPA 8141A / 8141B	Famphur
GC	EPA 8141A / 8141B	Malathion

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8141A / 8141B	Ethyl Parathion
GC	EPA 8141A / 8141B	O,O,O-Triethylphosphorothioate
GC	EPA 8141A / 8141B	Sulfotepp
GC	EPA 8141A / 8141B	Thionazin
GC	EPA 8141A / 8141B	Tributyl Phosphate
GC-MS	EPA 8260B / 8260C	Acetone
GC-MS	EPA 8260B / 8260C	Acrolein
GC-MS	EPA 8260B / 8260C	Acrylonitrile
GC-MS	EPA 8260B / 8260C	Benzene
GC-MS	EPA 8260B / 8260C	Bromobenzene
GC-MS	EPA 8260B / 8260C	Bromochloromethane
GC-MS	EPA 8260B / 8260C	Bromodichloromethane
GC-MS	EPA 8260B / 8260C	Bromoform
GC-MS	EPA 8260B / 8260C	Bromomethane
GC-MS	EPA 8260B / 8260C	tert-Butyl alcohol
GC-MS	EPA 8260B / 8260C	2-Butanone (MEK)
GC-MS	EPA 8260B / 8260C	n-Butylbenzene
GC-MS	EPA 8260B / 8260C	sec-Butylbenzene
GC-MS	EPA 8260B / 8260C	tert-Butylbenzene
GC-MS	EPA 8260B / 8260C	Carbon disulfide
GC-MS	EPA 8260B / 8260C	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C	Chlorobenzene
GC-MS	EPA 8260B / 8260C	2-Chloroethyl vinyl ether
GC-MS	EPA 8260B / 8260C	Chloroethane
GC-MS	EPA 8260B / 8260C	Chloroform
GC-MS	EPA 8260B / 8260C	1-Chlorohexane
GC-MS	EPA 8260B / 8260C	Chloromethane
GC-MS	EPA 8260B / 8260C	2-Chlorotoluene
GC-MS	EPA 8260B / 8260C	4-Chlorotoluene
GC-MS	EPA 8260B / 8260C	Isopropyl ether (DIPE)
GC-MS	EPA 8260B / 8260C	Dibromochloromethane
GC-MS	EPA 8260B / 8260C	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C	Dibromomethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	1,3-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-Butene
GC-MS	EPA 8260B / 8260C	1,4-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	Dichlorodifluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C	cis-1,2-Dichloroethene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	trans-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C	Dichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloropropene
GC-MS	EPA 8260B / 8260C	1,2-Dichloropropane
GC-MS	EPA 8260B / 8260C	1,3-Dichloropropane
GC-MS	EPA 8260B / 8260C	2,2-Dichloropropane
GC-MS	EPA 8260B / 8260C	cis-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	trans-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Ethylbenzene
GC-MS	EPA 8260B / 8260C	2-Hexanone (MBK)
GC-MS	EPA 8260B / 8260C	Hexachlorobutadiene
GC-MS	EPA 8260B / 8260C	Iodomethane
GC-MS	EPA 8260B / 8260C	Isopropylbenzene
GC-MS	EPA 8260B / 8260C	p-Isopropyltoluene
GC-MS	EPA 8260B / 8260C	Methylene Chloride
GC-MS	EPA 8260B / 8260C	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 8260B / 8260C	tert-Butyl methyl ether
GC-MS	EPA 8260B / 8260C	Naphthalene
GC-MS	EPA 8260B / 8260C	n-Propylbenzene
GC-MS	EPA 8260B / 8260C	Styrene
GC-MS	EPA 8260B / 8260C	tert-Amyl methyl ether (TAME)
GC-MS	EPA 8260B / 8260C	1,1,1,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	Tetrachloroethene
GC-MS	EPA 8260B / 8260C	Toluene
GC-MS	EPA 8260B / 8260C	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	1,2,4-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	Trichloroethene
GC-MS	EPA 8260B / 8260C	Trichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 8260B / 8260C	1,2,4-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	1,3,5-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	Vinyl Acetate
GC-MS	EPA 8260B / 8260C	Vinyl Chloride
GC-MS	EPA 8260B / 8260C	m-Xylene & p-xylene
GC-MS	EPA 8260B / 8260C	o-Xylene
GC-MS	EPA 8260B / 8260C	2-Butanol
GC-MS	EPA 8260B / 8260C	Cyclohexane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	1,4-Dioxane
GC-MS	EPA 8260B / 8260C	2-Chloro-1,1,1-trifluoroethane
GC-MS	EPA 8260B / 8260C	Chlorotrifluoroethylene
GC-MS	EPA 8260B / 8260C	cis-1,4-Dichloro-2-butene
GC-MS	EPA 8260B / 8260C	Ethanol
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Isobutyl Alcohol
GC-MS	EPA 8260B / 8260C	Methacrylonitrile
GC-MS	EPA 8260B / 8260C	Methyl Methacrylate
GC-MS	EPA 8260B / 8260C	Pentachloroethane
GC-MS	EPA 8260B / 8260C	Propionitrile
GC-MS	EPA 8260B / 8260C	Sec-Propyl alcohol
GC-MS	EPA 8260B / 8260C	Tetrahydrofuran
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-butene
GC-MS	EPA 8260B / 8260C SIM	Benzene
GC-MS	EPA 8260B / 8260C SIM	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C SIM	Chloroform
GC-MS	EPA 8260B / 8260C SIM	Chloromethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	cis-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	trans-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C SIM	Tetrachloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	Trichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C SIM	Vinyl Chloride
GC-MS	EPA 8260B / 8260C SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	Acenaphthene
GC-MS	EPA 8270C / 8270D	Acenaphthylene
GC-MS	EPA 8270C / 8270D	Aniline
GC-MS	EPA 8270C / 8270D	Anthracene
GC-MS	EPA 8270C / 8270D	Azobenzene
GC-MS	EPA 8270C / 8270D	Benzidine
GC-MS	EPA 8270C / 8270D	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(g,h,i)perylene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzoic Acid
GC-MS	EPA 8270C / 8270D	Benzyl Alcohol
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	bis(2-chloroethoxy)methane
GC-MS	EPA 8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-chloroisopropyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)adipate
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D	Carbazole
GC-MS	EPA 8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D	4-Chloroaniline
GC-MS	EPA 8270C / 8270D	2-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	2-Chlorophenol
GC-MS	EPA 8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Chrysene
GC-MS	EPA 8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D	Dibenzofuran
GC-MS	EPA 8270C / 8270D	1,2-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	EPA 8270C / 8270D	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D	Diethylphthalate
GC-MS	EPA 8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	Dimethylphthalate
GC-MS	EPA 8270C / 8270D	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrophenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	2,6-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	Di-n-octylphthalate
GC-MS	EPA 8270C / 8270D	Fluoranthene
GC-MS	EPA 8270C / 8270D	Fluorene
GC-MS	EPA 8270C / 8270D	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D	Hexachlorobutadiene
GC-MS	EPA 8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	EPA 8270C / 8270D	Hexachloroethane
GC-MS	EPA 8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D	Isophorone

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D	2-Methylphenol
GC-MS	EPA 8270C / 8270D	4-Methylphenol
GC-MS	EPA 8270C / 8270D	Naphthalene
GC-MS	EPA 8270C / 8270D	2-Nitroaniline
GC-MS	EPA 8270C / 8270D	3-Nitroaniline
GC-MS	EPA 8270C / 8270D	4-Nitroaniline
GC-MS	EPA 8270C / 8270D	Nitrobenzene
GC-MS	EPA 8270C / 8270D	2-Nitrophenol
GC-MS	EPA 8270C / 8270D	4-Nitrophenol
GC-MS	EPA 8270C / 8270D	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	EPA 8270C / 8270D	Pentachlorophenol
GC-MS	EPA 8270C / 8270D	Perylene
GC-MS	EPA 8270C / 8270D	Phenanthrene
GC-MS	EPA 8270C / 8270D	Phenol
GC-MS	EPA 8270C / 8270D	Pyrene
GC-MS	EPA 8270C / 8270D	Pyridine
GC-MS	EPA 8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	EPA 8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D	1,2,4,5-Tetrachlorobenzene
GC-MS	EPA 8270C / 8270D	1,3,5-Trinitrobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dinitrobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	1,4-Naphthoquinone
GC-MS	EPA 8270C / 8270D	1-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	1-Naphthylamine
GC-MS	EPA 8270C / 8270D	2,6-Dichlorophenol
GC-MS	EPA 8270C / 8270D	2-acetylaminofluorene
GC-MS	EPA 8270C / 8270D	2-Naphthylamine
GC-MS	EPA 8270C / 8270D	2-Picoline
GC-MS	EPA 8270C / 8270D	3,3-Dimethylbenzidine
GC-MS	EPA 8270C / 8270D	3,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3-Methylchlolanthrene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	4-Aminobiphenyl
GC-MS	EPA 8270C / 8270D	4-Nitroquinoline-N-oxide
GC-MS	EPA 8270C / 8270D	5-Nitro-o-toluidine
GC-MS	EPA 8270C / 8270D	7,12-Dimethylbenz(a)anthracene
GC-MS	EPA 8270C / 8270D	Acetophenone
GC-MS	EPA 8270C / 8270D	Aramite
GC-MS	EPA 8270C / 8270D	Atrazine
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	Chlorobenzilate
GC-MS	EPA 8270C / 8270D	Diallate
GC-MS	EPA 8270C / 8270D	Dibenzo(a,j)acridine
GC-MS	EPA 8270C / 8270D	Dimethoate
GC-MS	EPA 8270C / 8270D	Dinoseb
GC-MS	EPA 8270C / 8270D	Diphenyl ether
GC-MS	EPA 8270C / 8270D	Disulfoton
GC-MS	EPA 8270C / 8270D	Ethyl methacrylate
GC-MS	EPA 8270C / 8270D	Ethyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Ethyl parathion
GC-MS	EPA 8270C / 8270D	Famphur
GC-MS	EPA 8270C / 8270D	Hexachlorophene
GC-MS	EPA 8270C / 8270D	Hexachloropropene
GC-MS	EPA 8270C / 8270D	Isodrin
GC-MS	EPA 8270C / 8270D	Isosafrole
GC-MS	EPA 8270C / 8270D	kepone
GC-MS	EPA 8270C / 8270D	Methapyrilene
GC-MS	EPA 8270C / 8270D	Methyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Methyl parathion
GC-MS	EPA 8270C / 8270D	N-nitrosodiethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosodi-n-butylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomethylethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomorpholine
GC-MS	EPA 8270C / 8270D	N-Nitrosopiperdine
GC-MS	EPA 8270C / 8270D	N-Nitrosopyrrolidine
GC-MS	EPA 8270C / 8270D	O,O,O-triethyl phosphorothi
GC-MS	EPA 8270C / 8270D	o-toluidine
GC-MS	EPA 8270C / 8270D	p-Dimethylaminoazobenze
GC-MS	EPA 8270C / 8270D	Pentachlorobenzene
GC-MS	EPA 8270C / 8270D	Pentachloroethane
GC-MS	EPA 8270C / 8270D	Pentachloronitrobenzene
GC-MS	EPA 8270C / 8270D	Phenacetin
GC-MS	EPA 8270C / 8270D	Phorate
GC-MS	EPA 8270C / 8270D	p-phenylenediamine
GC-MS	EPA 8270C / 8270D	Pronamide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Safrole
GC-MS	EPA 8270C / 8270D	Sulfotepp
GC-MS	EPA 8270C / 8270D	Thionazin
GC-MS	EPA 8270C / 8270D SIM	Acenaphthene
GC-MS	EPA 8270C / 8270D SIM	Acenaphthylene
GC-MS	EPA 8270C / 8270D SIM	Anthracene
GC-MS	EPA 8270C / 8270D SIM	Azobenzene
GC-MS	EPA 8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D SIM	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Biphenyl
GC-MS	EPA 8270C / 8270D SIM	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D SIM	Carbazole
GC-MS	EPA 8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D SIM	2-Chlorophenol
GC-MS	EPA 8270C / 8270D SIM	Chrysene
GC-MS	EPA 8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D SIM	Fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Fluorene
GC-MS	EPA 8270C / 8270D SIM	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D SIM	Naphthalene
GC-MS	EPA 8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D SIM	Pentachlorophenol
GC-MS	EPA 8270C / 8270D SIM	Perylene
GC-MS	EPA 8270C / 8270D SIM	Phenanthrene
GC-MS	EPA 8270C / 8270D SIM	Phenol
GC-MS	EPA 8270C / 8270D SIM	Pyrene
GC-MS	EPA 8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1,4-Dioxane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D SIM	Diethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Dimethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-octylphthalate
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g,h,i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenzo(a,h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A	HMX
HPLC	EPA 8330A	RDX
HPLC	EPA 8330A	1,3,5-TNB
HPLC	EPA 8330A	1,3-DNB
HPLC	EPA 8330A	Tetryl
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	2,4,6-TNT
HPLC	EPA 8330A	4-AM-2,6-DNT
HPLC	EPA 8330A	2-AM-4,6-DNT
HPLC	EPA 8330A	2,6-DNT
HPLC	EPA 8330A	2,4-DNT
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	2,4-Diamino-6-nitrotoluene
HPLC	EPA 8330A	2,6-Diamino-4-nitrotoluene
HPLC	EPA 8330A	Picric Acid

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8332	Nitroglycerine
HPLC	EPA 8332	PETN
Combustion-IR	EPA 9060A	TOC
IC	EPA 9056 / 9056A	Bromate
IC	EPA 9056 / 9056A	Bromide
IC	EPA 9056 / 9056A	Chloride
IC	EPA 9056 / 9056A	Fluoride
IC	EPA 9056 / 9056A	Nitrate
IC	EPA 9056 / 9056A	Nitrite
IC	EPA 9056 / 9056A	Phosphate
IC	EPA 9056 / 9056A	Sulfate
IC	EPA 9056 / 9056A	Chlorate
GC	EPA 8151A	Acifluorfen
GC	EPA 8151A	Bentazon
GC	EPA 8151A	Chloramben
GC	EPA 8151A	2,4-D
GC	EPA 8151A	2,4-DB
GC	EPA 8151A	Dacthal
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	3,5-Dichlorobenzoic acid
GC	EPA 8151A	Dichlorprop
GC	EPA 8151A	Dinoseb
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Picloram
GC	EPA 8151A	Silvex
GC	EPA 8151A	2,4,5-T
Spectrometric	EPA 9014	Cyanide
Gravimetric	EPA 9071B	Oil & Grease
GFAA	CA 939M	Organo Lead
Preparation	**Method**	**Type**
Purge &Trap	EPA 5030B / EPA 5035	Volatiles Prep
Acid Digestion	EPA 3050B	Metals Prep
Alkaline Digestion	EPA 3060A	Hexavalent Chrom
Soxhlet	EPA 3540C	Organic Extraction
Sonication	EPA 3550C	Organic Extraction
Waste Dilution	EPA 3580A	Organic Extraction
Microwave	EPA 3546	Organic Extraction
TCLP	EPA 1311	Leaching

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
SPLP	EPA 1312	Leaching
Floricil Clean-up	EPA 3620C	Extract Clean-Up
GPC Clean-up	EPA 3640A	Extract Clean-Up
Sulfur Clean-up	EPA 3660B	Extract Clean-Up
Acid/Permanganate Clean-up	EPA 3665A	Extract Clean-Up

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	1,1,1-trichloroethane
GC-MS	TO-15	1,1,2,2-tetrachloroethane
GC-MS	TO-15	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	TO-15	1,1,2-trichloroethane
GC-MS	TO-15	1,1-dichloroethane
GC-MS	TO-15	1,1-Dichloroethene
GC-MS	TO-15	1,2,4-trichlorobenzene
GC-MS	TO-15	1,2,4-trimethylbenzene
GC-MS	TO-15	1,2-dibromoethane
GC-MS	TO-15	1,2-dichlorobenzene
GC-MS	TO-15	1,2-dichloroethane
GC-MS	TO-15	1,2-dichloroethene
GC-MS	TO-15	1,2-dichloropropane
GC-MS	TO-15	1,3,5-trimethylbenzene
GC-MS	TO-15	1,3-Butadiene
GC-MS	TO-15	1,3-Butadiene, 1,1,2,3,4,Hexachloro
GC-MS	TO-15	1,3-dichlorobenzene
GC-MS	TO-15	1,4-dichlorobenzene
GC-MS	TO-15	1,4-Dioxane
GC-MS	TO-15	2,2,4-Trimethylpentane
GC-MS	TO-15	4-Ethyltoluene
GC-MS	TO-15	Acetone
GC-MS	TO-15	Acrylonitrile
GC-MS	TO-15	Allyl Chloride
GC-MS	TO-15	Benzene
GC-MS	TO-15	Benzyl Chloride
GC-MS	TO-15	Bromodichloromethane
GC-MS	TO-15	Bromoform
GC-MS	TO-15	Bromomethane
GC-MS	TO-15	Carbon Disulfide
GC-MS	TO-15	Carbon Tetrachloride

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	Chlorobenzene
GC-MS	TO-15	Chloroethane
GC-MS	TO-15	Chloroethene
GC-MS	TO-15	Chloroform
GC-MS	TO-15	Chloromethane
GC-MS	TO-15	cis-1,3-Dichloropropene
GC-MS	TO-15	Cyclohexane
GC-MS	TO-15	Dibromochloromethane
GC-MS	TO-15	Dichlorodifluoromethane
GC-MS	TO-15	Dichlorotetrafluoroethane
GC-MS	TO-15	Ethyl Acetate
GC-MS	TO-15	Ethylbenzene
GC-MS	TO-15	Isopropyl Alcohol
GC-MS	TO-15	m+p-Xylene
GC-MS	TO-15	Methyl butyl Ketone
GC-MS	TO-15	Methyl Ethyl Ketone
GC-MS	TO-15	Methyl Isobutyl Ketone
GC-MS	TO-15	Methyl Tert-Butyl Ether
GC-MS	TO-15	Methylene Chloride
GC-MS	TO-15	n-Heptane
GC-MS	TO-15	n-Hexane
GC-MS	TO-15	o-Xylene
GC-MS	TO-15	Styrene
GC-MS	TO-15	Tetrachloroethylene
GC-MS	TO-15	Tetrahydrofuran
GC-MS	TO-15	Toluene
GC-MS	TO-15	Trans-1,2-Dichloroethene
GC-MS	TO-15	trans-1,3-Dichloropropene
GC-MS	TO-15	Trichloroethylene
GC-MS	TO-15	Trichloromonofluoromethan
GC-MS	TO-15	Vinyl Acetate
GC-MS	TO-15	Vinyl Bromide

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: September 25, 2014

R. Douglas Leonard
Chief Technical Officer

Reissued: 1/9/14 Revised: 9/25/14

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM BRANCH

CERTIFICATE OF ENVIRONMENTAL ACCREDITATION

Is hereby granted to

Columbia Analytical Services, DBA ALS Group

19408 Park Row, Suite 320

Houston, TX 77084

Scope of the certificate is limited to the
"Fields of Testing"
which accompany this Certificate.

Continued accredited status depends on successful completion of on-site, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **2452**

Expiration Date: **02/28/2015**

Effective Date: **03/01/2013**

Richmond, California
subject to forfeiture or revocation

David Mazzera, Ph.D., Assistant Division Chief
Division of Drinking Water and Environmental Management

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

Columbia Analytical Services, Inc.
19408 Park Row, Suite 320
Houston, TX 77084
Phone: (713) 266-1599

Certificate No.: 2452
Renew Date: 2/28/2013

Field of Testing: 105 - Semi-volatile Organic Chemistry of Drinking Water

105.230	000	Dioxins	EPA 1613
105.230	001	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	EPA 1613

Field of Testing: 111 - Semi-volatile Organic Chemistry of Wastewater

111.111	000	Dioxins	EPA 1613B

Field of Testing: 117 - Semi-volatile Organic Chemistry of Hazardous Waste

117.120	000	Dioxins and Dibenzofurans	EPA 8280A
117.130	000	Dioxins and Dibenzofurans	EPA 8290

As of 1/30/2012 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ALS ENVIRONMENTAL – HOUSTON HRMS
10450 STANCLIFF RD. 210
HOUSTON, TX 77099
Rebecca Pierrot Phone: (713) 266 1599
rebecca.pierrot@alsglobal.com

ENVIRONMENTAL

Valid To: November 30, 2015 Certificate Number: 2897.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

High Resolution Gas Chromatography/High Resolution Mass Spectrometry

Parameter/Analyte	**Solid Hazardous Waste**		**Tissue**	**Air/Emissions**
	Aqueous	**Solid**		
PCBs				
PCB 1	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 2	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 3	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 4	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 5	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 6	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 7	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 8	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 9	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 10	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 11	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 12	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 13	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 14	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 15	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 16	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 17	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 19	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 20	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 21	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 22	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 23	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 24	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 25	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 26	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 27	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 28	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 29	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 30	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 31	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 32	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 33	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 34	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 35	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 36	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 37	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 38	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 39	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 40	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 41	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 42	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 43	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 44	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 45	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 46	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 47	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 48	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 49	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 50	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 51	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 52	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 53	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 54	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 55	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 56	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 57	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 58	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 59	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 60	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 61	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 62	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 63	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 64	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 65	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 66	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 67	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 68	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 69	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 70	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 71	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 72	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 73	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 74	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 75	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 76	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 77	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 78	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 79	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 80	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 81	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 82	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 83	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 84	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 85	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 86	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 87	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 88	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 89	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 90	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 91	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 92	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 93	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 94	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 95	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 96	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 97	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 98	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 99	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 100	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 101	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 102	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 103	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 104	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 105	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 106	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 107	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 108	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 109	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 110	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 111	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 112	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 113	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 114	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 115	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 116	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 117	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 118	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 119	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 120	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 121	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 122	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 123	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 124	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 125	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 126	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 127	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 128	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 129	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 130	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 131	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 132	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 133	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 134	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 135	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 136	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 137	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 138	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 139	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 140	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 141	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 142	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 143	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 144	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 145	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 146	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 147	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 148	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 149	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 150	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 151	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 152	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 153	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 154	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 155	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 156	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 157	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 158	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 159	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 160	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 161	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 162	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 163	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 164	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 165	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 166	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 167	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 168	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 169	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 170	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 171	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 172	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 173	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 174	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 175	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 176	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 177	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 178	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 179	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 180	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 181	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 182	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 183	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
PCB 184	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 185	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 186	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 187	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 188	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 189	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 190	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 191	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 192	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 193	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 194	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 195	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 196	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 197	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 198	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 199	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	**Solid**		
PCB 200	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 201	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 202	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 203	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 204	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 205	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 206	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 207	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 208	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
PCB 209	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C	EPA 1668A EPA 1668B EPA 1668C
Sample Preparation	Liquid Liquid Extraction	Liquid Extraction, Soxhlet	Soxhlet	Soxhlet
Dioxins/Furans				
2,3,7,8-TCDD	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,7,8-PeCDD	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,4,7,8-HxCDD	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	Solid		
1,2,3,6,7,8-HxCDD	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,7,8,9-HxCDD	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,4,6,7,8-HpCDD	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
OCDD	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
2,3,7,8-TCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,7,8-PeCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
2,3,4,7,8-PeCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,4,7,8-HxCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,6,7,8-HxCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,7,8,9-HxCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
2,3,4,6,7,8-HxCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
1,2,3,4,6,7,8-HpCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23

Parameter/Analyte	Solid Hazardous Waste		Tissue	Air/Emissions
	Aqueous	**Solid**		
1,2,3,4,7,8,9-HpCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
OCDF	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	EPA 1613B EPA 8290 EPA 8290A EPA 8280A	TO-9A EPA Method 23
Sample Preparation	Liquid-Liquid Extraction	Liquid Extraction , Soxhlet	Soxhlet	Soxhlet

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below, and for the test methods applicable to ISO IEC 17025:2005:

Parameter/Analyte	Potable Water	Solid Hazardous Waste		Foods
Dioxins/Furans		**Aqueous**	**Solid**	
2,3,7,8-TCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8-PeCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,6,7,8-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8,9-HxCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,6,7,8-HpCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
OCDD	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,7,8-TCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8-PeCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,4,7,8-PeCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,6,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,7,8,9-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
2,3,4,6,7,8-HxCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,6,7,8-HpCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
1,2,3,4,7,8,9-HpCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
OCDF	EPA 1613B	EPA 1613B	EPA 1613B	EPA 1613B
Sample Preparation	Liquid/Liquid	Liquid/liquid	Soxhlet	Soxhlet,

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Appendix B: Biological Avoidance and Minimization Plan

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FINAL Biological Avoidance and Minimization Plan for the Remedial Investigation at Installation Restoration Program Sites 34b and 34d on Naval Weapons Station Seal Beach Detachment Fallbrook, California

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RECON Number 6974
October 1, 2014

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1.0 Introduction

This Biological Avoidance and Minimization Plan (BAMP) describes potential effects to federally listed threatened or endangered species that either occur or have the potential for presence during the Remedial Investigation (RI) at Installation Restoration Program (IR) Site 34b and IR Site 34d, located at Naval Weapons Station (NAVWPNSTA) Seal Beach Detachment (Det) Fallbrook, California (Figure 1).

The purpose of the RI is to characterize the nature and extent of soil contamination at IR Sites 34b and 34d. Potential sediment and surface water contamination will also be characterized at IR Site 34d. These sites have been grouped together because of the sites' similar contaminants, histories, and position in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) response process. Soil contamination at these sites is thought to be associated with the deposition of dunnage and other debris on the ground surface or in shallow trenches. Dunnage includes generally low-value packing materials used for shipping products, presumably munitions at NAVWPNSTA Seal Beach Det Fallbrook.

The RI will characterize impacted soil (and sediment and surface water at IR Site 34d) to evaluate the extent of chemicals of potential concern (COPC) to human health and/or chemicals of potential ecological concern (COPEC) in the environment. The RI field investigation for IR Site 34d includes an offsite area adjacent east of IR Site 34d where debris was observed during the Site Inspection (SI) (ChaduxTt 2010).

IR Sites 34b and 34d are located on NAVWPNSTA Seal Beach Det Fallbrook in northern San Diego County. NAVWPNSTA Seal Beach Det Fallbrook is approximately 9 miles inland from the Pacific Ocean and approximately 53 miles north of San Diego, California, and adjoins a portion of the eastern border of Marine Corps Base Camp Pendleton. Elevations within the central part of the installation range from 300 to 840 feet above mean sea level, and the topography is characterized by low hills and shallow west-flowing drainages. The exception is the deeply incised Santa Margarita River channel located along the northern boundary of the installation that has a base elevation between 160 and 300 feet above mean sea level. The installation occupies 8,852 acres and is secured by a chain-link fence. The location of the installation and IR Sites 34b and 34d are shown on a United States Geological Survey (USGS) map in Figure 2.

A review of a number of resources was conducted to evaluate the potential for sensitive species to occur on the project area prior to the site visit. These resources included NAVWPNSTA Seal Beach Det Fallbrook vegetation community maps and sensitive species data (Fallbrook 2014), California Natural Diversity Database (CNDDB; 2014), U.S. Fish and Wildlife Service (USFWS) sensitive species data (USFWS 2014), and associated abiotic data including soil type, slope, aspect, and topography. Based on

Project Location

NAVWPNSTA Seal Beach Detachment Fallbrook Boundary

RECON

M:\JOBS4\6974\common_gis\fig1.mxd 9/26/2014 fmm

FIGURE 1

Regional Location

Map Source: USGS 7.5 minute topographic map series,Morro Hill quadrangle, 1968, Santa Margarita y Las Flores Landgrant

0 Feet 2,000

Project Boundaries

RECON

M:\JOBS4\6974\common_gis\fig2.mxd 9/25/2014 fmm

FIGURE 2

Project Location on USGS Map

the results of this preliminary research, this BAMP was prepared to evaluate the following federally listed species or species proposed for federal listing:

- Coastal California gnatcatcher (*Polioptila californica californica*)
- Stephen's kangaroo rat (*Dipodomys stephensi*)
- Least bell's vireo (*Vireo pusillus bellii*)
- Southwestern willow flycatcher (*Empidonax traillii extimus*)

USFWS has designated critical habitat for all of these species. However, no critical habitat has been designated on NAVWPNSTA Seal Beach Det Fallbrook. Given the absence of critical habitat on NAVWPNSTA Seal Beach Det Fallbrook, this topic is not discussed further in this document.
It is intended that this BAMP will provide the information necessary to coordinate with the USFWS in the manner described in the U.S. Environmental Protection Agency's (EPA's) "CERCLA Compliance with other Laws Manual" (OSWER Directive 9234.1-02). This BAMP provides the best available scientific data for the above-listed species in the action area.

2.0 Proposed Action

This BAMP was prepared in conjunction with the work plan prepared by Trevet (2014), who will conduct a Remedial Investigation (RI) at Installation Restoration Program (IR) Site 34b and IR Site 34d, located at Naval Weapons Station Seal Beach Det Fallbrook, California.

The work plan was prepared on behalf of the United States Department of the Navy (DON), under Naval Facilities Engineering Command Southwest (NAVFAC SW) Contract Number N62473-10-D-4009, Task Order 0096. Trevet prepared the work plan under subcontract to CB&I Federal Services (CFS). The RI will be performed in accordance with the National Oil and Hazardous Substances Contingency Plan; Comprehensive Environmental Response, CERCLA; U.S. EPA guidance; and Navy policy. Regulatory agencies, including the California Department of Toxic Substances Control (DTSC) and California Regional Water Quality Control Board, San Diego Region (RWQCB), will also provide oversight for the RI activities.

2.1 IR Site 34b Objectives and Summary

IR Site 34b was established to investigate soil impacts from disposal activities at Dunnage Disposal Site 2 (DDS 2) from 1942 until 1978. The objectives of the RI for IR Site 34b are to delineate the extent of impacts from the known disposal trench identified during the SI as well as the extent of possible debris in three other suspected disposal trenches (Figure 3). Soil impacts from buried debris will be characterized to evaluate if volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and/or dioxins and furans are present in soil at concentrations that may pose a risk to human health and/or the environment.

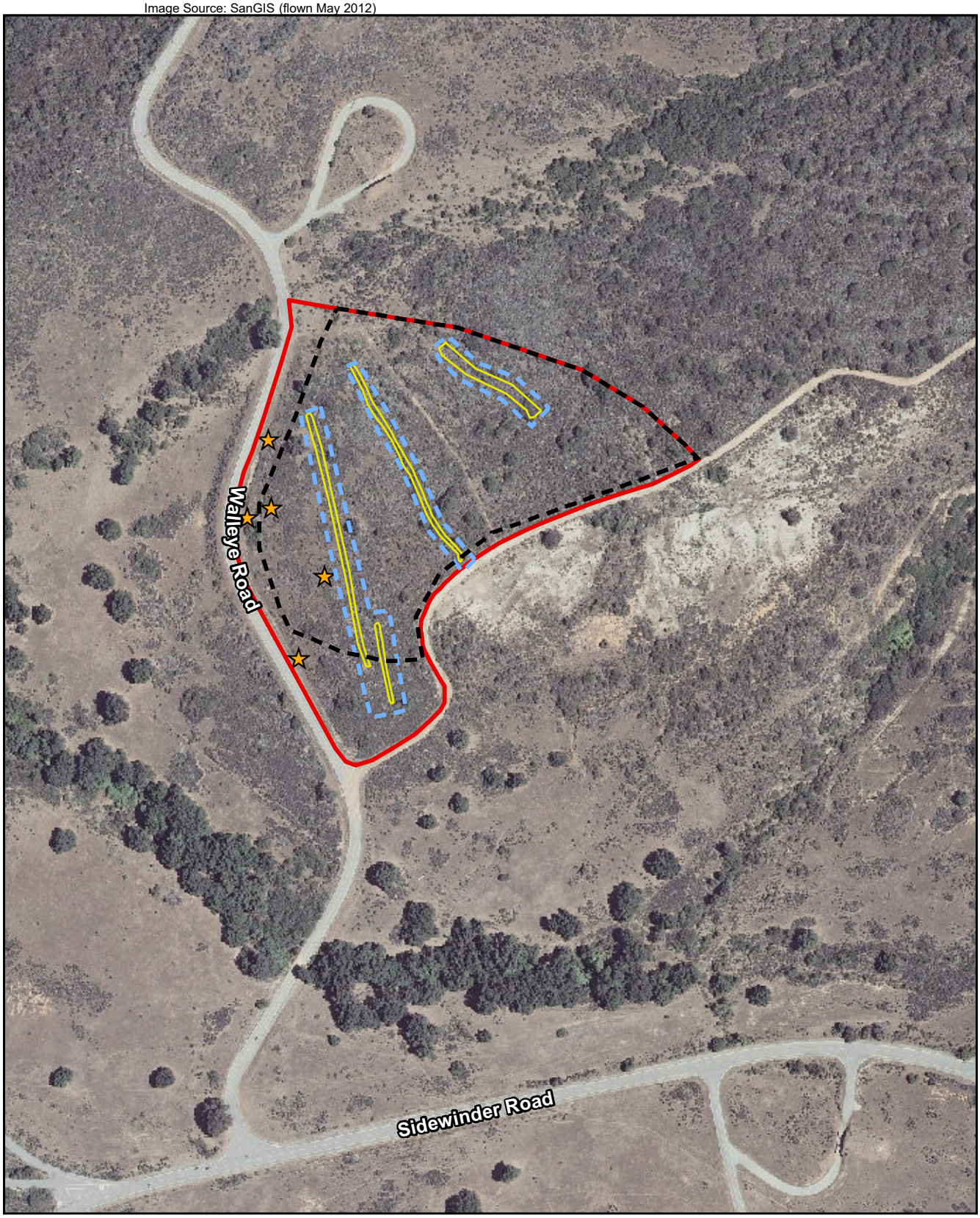
IR Site 34b is located in the north-central portion of NAVWPNSTA Seal Beach Det Fallbrook, east of Walleye Road (see Figure 3). It encompasses approximately 12 acres of northwest-facing hillside covered with native vegetation. Historical information documented in the Preliminary Assessment (PA) indicated that IR Site 34b was reportedly used as a disposal or burial area for dunnage and other debris from 1942 to 1978. The site is not developed and has no current land use other than open space. No manmade structures or evidence of previously existing structures were observed at the site during the SI (ChaduxTt 2010).

The SI report identified a shallow waste disposal trench in the central portion of the site as the primary area of concern (AOC) for IR Site 34b. This trench will be referred to as the "known disposal trench" in this BAMP. The known disposal trench extended 480 feet in a northwesterly direction downslope from a nearby access road. The known disposal trench was estimated to be 3.5 feet wide and contained debris from the surface to a depth of 4 feet below the surface. The known disposal trench was partially filled with

undocumented fill soil or slough from the trench walls, along with metal, wood, and glass debris. The debris consisted of weathered and deteriorated 2- to 5-gallon metal containers, metal banding, empty 55-gallon drums, glass bottles, cans, and other miscellaneous solid waste, some of which indicated that it had been burned. The known disposal trench was identified in a 1953 photograph along with two less conspicuous linear features identified, located farther west, that were similar in appearance to the known disposal trench. The two additional linear surface disturbances are suspected to also be disposal trenches and were therefore included as AOCs for IR Site 34b (ChaduxTt 2010). A fourth potential disposal area east of the known disposal trench is also included as an AOC for IR Site 34b.

During a site visit conducted after the Tomahawk Fire wildfire that burned IR Sites 34b and 34d in May 2014, the three potential disposal trenches were not observed. The fire cleared much of the vegetation at IR Site 34b, and little dunnage and/or debris was visible outside of the known disposal trench. However, the three potential disposal trenches will still be investigated.

Image Source: SanGIS (flown May 2012)



0 Feet 300

Action Area
IR Site 34b Boundary
Geophysical Investigation Area
Existing Disposal Trench
Potential Kangaroo Rat Burrows

FIGURE 3

IR Site 34b Action Area on Aerial Photograph

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2.2 IR Site 34d Objectives and Summary

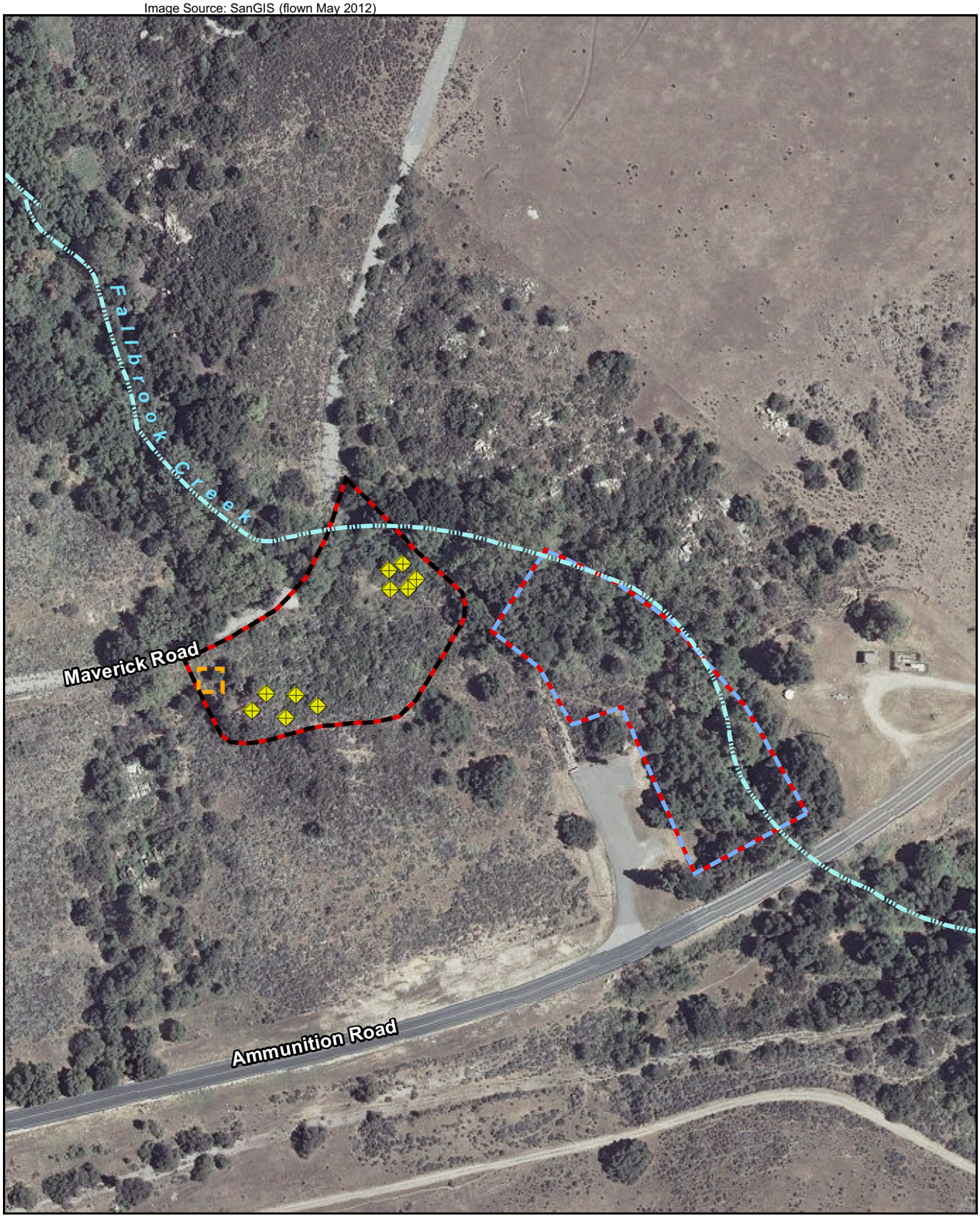
IR Site 34d was established to investigate soil impacts from disposal activities at Dunnage Disposal Site 4 (DDS 4) from 1942 until 1978. The objectives of the RI for IR Site 34d are to delineate the extent of soil impacts near former Buildings 341 and 430 and the debris near borings IRP34D-SB01, IRP34D-SB04, and IRP34D-SB05. The extent and nature of potential impacts from the area east of the site where debris has been observed will also be characterized. The delineation and characterization activities will evaluate whether VOCs, SVOCs, and metals are present in soil at concentrations that pose a risk to human health and/or the environment. Dioxins and furans will also be characterized for the area containing burnt wood debris near borings IRP34D-SB04 and IRP34D-SB05. Sediment and surface water samples will also be collected from Fallbrook Creek adjacent to the site to determine if VOCs, SVOCs, metals, and/or dioxins/furans are present at concentrations that may pose a risk to human health and/or the environment.

IR Site 34d is located in the central portion of NAVWPNSTA Seal Beach Det Fallbrook, north of Ammunition Road and along the south side of Fallbrook Creek (Figure 4). The site encompasses 1.8 acres, and the total proposed action area covers approximately 3 acres. Old asphalt paving associated with Maverick Road and improvements related to the former crossing over Fallbrook Creek are located in the northern portion of the site. Fallbrook Creek flows westward through the northern portion of the site (see Figure 4). The site is vacant and has no current land use other than open space.

IR Site 34d was evidently used as a disposal and possibly a burial area for dunnage and other debris. In addition to the possible disposal of dunnage, at least three former structures were known to have existed at the site: Buildings 341, 430, and 325. The SI identified these former buildings as a former restroom, a former boiler house, and a former wooden ammunition magazine, respectively. Only the remnants of the concrete slab from Building 341 and the adjacent below-grade three-stage concrete sump (Building 430) with an adjoining drainpipe currently remain on-site. The drainpipe appears to discharge to Fallbrook Creek. These building remnants are located within the western portion of IR Site 34d. No remnants of Building 325 were evident at the site.

During the SI field investigation, surficial and buried debris was observed near the slab remnants of former Building 341. Detector-aided visual surveys performed during the SI indicated metal debris, construction debris, and other debris within and adjacent (uphill to the east) to IR Site 34d. Debris observed at the site and adjacent to Fallbrook Creek included metal piping, asphalt, wood pallets, boards and burnt wood remains, plastic piping, aluminum canisters, and glass. Three magnetic anomalies were detected with a hand-held magnetic gradiometer along the location of the former access road that cuts through the site. Along with observed debris, several weathered small arms ammunition

Image Source: SanGIS (flown May 2012)



Action Area
IR Site 34d Boundary
Geophysical Investigation Area
Excavation Area
Proposed Hand Auger Sampling

0 Feet 200

FIGURE 4

IR Site 34d Action Area on Aerial Photograph

RECON

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canisters and spent small caliber blank casings were observed on the south side of the creek. The canisters and casings are considered isolated debris and did not indicate the presence of munitions and explosives of concern (MEC) or munitions constituents (MC) at the site (ChaduxTt 2010).

The SI identified the following areas that will be investigated further as AOCs in this RI for IR Site 34d:

- Areas near the slab of former Building 341 and three-stage concrete sump (Building 430) and drainpipe to investigate the soil impacts from historical operations.
- The areas near the wood debris and burnt wood located near borings IRP34D-SB01, IRP34D-SB04, and IRP34D-SB05.
- The off-site area east of IR Site 34d and Fallbrook Creek to investigate the extent and soil impacts of buried debris.

2.3 Project Activities

The proposed project consists of conducting a geophysical investigation, preparing the site for intrusive investigations, and excavating test pits at both IR Sites 34b and 34d. Additional soil sampling will also be collected at IR Site 34d. These are detailed in the work plan (Trevet 2014) and summarized below.

2.3.1 Geophysical Investigation

A geophysical investigation at IR Sites 34b and 34d is being conducted as part of the RI at both sites. It is anticipated that the geophysical investigation will be completed during regulatory review of the draft RI Work Plan. Results for the geophysical investigation will be submitted to the Navy and regulatory agencies prior to completion of the review of the Draft Work Plan, and the results will be incorporated into the Final Work Plan.

2.3.2 Site Preparation for Intrusive Investigation

Based on the results of the geophysical investigation, the proposed locations for the test pits and hand auger locations will be selected to include geophysical anomalies that are most likely to represent buried dunnage or other debris. Proposed test pit and hand auger boring locations will be identified using Global Positioning System equipment and staked or marked on the ground with the test pit or proposed boring number. To allow access for sampling directly beneath the concrete slab (Building 341) and three-stage concrete sump (Building 430), these structures will be crushed, removed with an excavator, and stockpiled on-site.

An investigation-derived waste (IDW) staging area will be selected prior to initiating fieldwork. The staging area will be used to store IDW generated during field efforts. IDW wastes will be stored in roll-off bins and/or 55-gallon Department of Transportation (DOT) approved drums in a secondary containment area. The IDW staging area will likely be established at IR Site 34d.

2.3.3 Excavations

Excavations will take place at IR Site 34b in the form of test pits and at IR Site 34d in the form of removing a concrete slab and sump using a backhoe excavator. These are detailed in the work plan (Trevet 2014) and summarized below.

2.3.3.1 IR Site 34b

For IR Site 34b, a total of seven test pits will be excavated to investigate visible dunnage or other debris, previous soil samples, and geophysical anomalies identified in the geophysical survey. Test pits will be excavated to a depth of 3 to 6 feet below ground surface, depending on the depth of debris at that location. These pits are estimated to be approximately 5 feet wide and 20 feet long. The actual dimensions of these pits will be based on information gathered from the geophysical investigation. Soil samples will be

collected from each test pit at the geologist's discretion based on visual evidence of debris and/or soil impacts.

2.3.3.2 IR Site 34d

For IR Site 34d, the area surrounding the concrete slab and three stage-stage concrete sumps will be excavated with a backhoe excavator. The proposed excavation area is expected to be approximately 30 feet by 30 feet and 10 feet below ground surface.

2.3.4 Other Soil Sampling at IR Site 34d

In addition to the test pit excavations, other samples will be collected at IR Site 34d. Soil samples will be collected near both the removed concrete slab (former Building 341) and the three-stage concrete sump (former Building 430). Soil sampling will also be conducted at the terminus of the clay drainpipe west of former Building 430. Ten hand auger borings approximately 4 inches in diameter will also be advanced near previous SI borings IRP34D-SB01, IRP34D-SB04, and IRP34D-SB05 to collect soil samples.

2.3.5 Sediment and Surface Water Sampling from Fallbrook Creek

Four sediment samples and four surface water samples will be collected from portions of Fallbrook Creek that are adjacent to or east of the site. The surface water and sediment samples will be collocated. Surface water samples will only be collected if Fallbrook Creek, an ephemeral stream, is flowing during the fieldwork activities. One of the four sediment/surface water sample locations will be collected from an upstream portion of Fallbrook Creek for comparison to the three samples collected adjacent to the site.

The sediment samples, which will be obtained from wet granular material in the stream channel axis, will be collected using disposable plastic scoops to transfer soil into laboratory-supplied containers. If Fallbrook Creek contains water during fieldwork activities, surface water samples will be collected by dipping laboratory-supplied containers directly in the creek without overfilling and washing out preservatives.

2.3.6 Equipment Decontamination

Hand augers and all non-consumable equipment that comes into contact with sampling media during the sampling events will be decontaminated between borings.

All decontamination water will be containerized in DOT-approved 55-gallon drums and stored at the designated IDW staging area.

2.3.7 Investigation-derived Waste

All soil cuttings and IDW fluids will be containerized in roll-off bins or DOT-approved 55-gallon drums and place in secondary containment for storage. The bins and drums will be stored on-site in a designated IDW storage area. All wastes will be removed from the site within 90 days and will be transported via a licensed transporter.

2.4 Proposed Action Impacts

As described above, the Proposed Action comprises several different components. Table 1 provides a quantification of the estimated disturbance to vegetation communities by project component. The total area of proposed disturbance will be revised following completion of the geophysical investigation, which will further refine the locations of the project activities.

TABLE 1
PROPOSED IMPACTS FOR THE REMEDIAL INVESTIGATION PROGRAM ACTION AREA

Project Component	IR Site 34b	IR Site 34d	Total
Geophysical Investigation	1.65 acres	1.88 acres	3.53 acres
Excavation	0.02 acre (700 sq. ft.)*	0.03 acre (1,096 sq. ft.)	0.05 acre (1,796 sq. ft)
Hand Auger Sampling (up to 4-inch diameter auger, 10 samples)	--	0.87 sq. ft.	0.87 sq. ft.
TOTAL PROJECT IMPACTS	**1.67 acres**	**1.91 acres**	**3.58 acres**

* Up to seven 20'x5' trenches may be excavated to expose material detected in the preliminary assessment. Exact locations will be determined following the geophysical investigation and will vary based on its findings.

3.0 Avoidance and Minimization Measures

The Proposed Action includes minimization and mitigation measures designed to avoid and minimize direct and indirect harm or injury to federally listed species and their habitat. Based on the review of existing biological and natural resource data, the results of the site visit, and a review of the proposed activities, the following measures are proposed to avoid any impacts to sensitive biological resources within IR Sites 34b
and 34d.

3.1 General Measures

The following would be implemented when installing any of the project components:

1. The boundaries of all proposed project components will be clearly delineated with stakes, flagging, fencing, or other markers prior to any surface disturbing activities. All surface disturbances, vehicles, and equipment will be confined to the flagged areas. Access for staking and flagging will be by foot, not via vehicular access.
2. Prior to project initiation, an environmental worker education awareness program will be developed and implemented. The education program will include the following elements:
   - Description of all protection measures designed to reduce potential impacts to sensitive species
   - Function of flagging designating authorized work areas
   - Reporting procedures to be used if any sensitive species are encountered in the field.

3.2 Migratory Bird Treaty Act Specific Measures

All project-related activities must comply with the Migratory Bird Treaty Act (MBTA). Active nests (i.e., nests with eggs or chicks) are protected year-round by the MBTA. To protect active nests and migratory birds, the following will apply:

1. Structures must be surveyed for active nests and nesting migratory birds prior to project-related activities.
2. Project-related activities that will require removal of an active nest create disturbance to an active nest or cause a breeding bird to leave the nest for prolonged lengths of time are not permitted without NAVWPNSTA Seal Beach Det Fallbrook concurrence.

3. Trimming, removal, or disturbance of vegetation during the peak breeding season (15 February–31 August) requires a pre-activity survey by a qualified wildlife biologist to determine that active nests will not be affected.
4. All active nests within the project area must be reported to NAVWPNSTA Seal Beach Det Fallbrook.

3.3 Stephen's Kangaroo Rat Species-specific Measures

To avoid impacts to this species at IR Site 34b, the following measures are recommended:

1. Potential Stephens' kangaroo rat burrows will be flagged to avoid within the action area. Only minimized foot traffic is authorized within the flagged area.
2. Small motorized vehicles, or any other vehicles, are not authorized off the established roads within the vicinity of potential Stephens' kangaroo rat burrows. Any other activities that could crush Stephens' kangaroo rat in their burrow, dig them up, or bury them are not permitted. Vehicle/equipment operations near known habitat should be kept on existing roads, year round.
3. Project activities are to be conducted after dawn and before dusk to avoid impacts to Stephens' kangaroo rat during their active period while they are out of their burrows.
4. All test/sampling pits will be backfilled to sufficiently allow for any potential Stephens' kangaroo rat to escape the pits in the event that they accidentally fall in.

3.4 Least Bell's Vireo Species-specific Measures

To avoid impacts to this species at IR Site 34d, the following measures are recommended:

1. All work should be timed to occur outside of the least Bell's vireo breeding season (1 April–31 July).
2. Any work that must be conducted within the riparian habitat during the breeding season (1 April–31 July) should have a pre-activity survey completed by a qualified wildlife biologist to determine if this species is present. Trimming or removal of vegetation during the peak breeding season should be avoided to the extent possible.
3. All sightings of this species and active nests within the project area must be reported to NAVWPNSTA Seal Beach Det Fallbrook.

4.0 Existing Conditions Including Federally Listed (and/or Proposed) Species or Critical Habitat, Within the Action Area

The following description of the project area is based on geographic information system (GIS) data provided by NAVWPNSTA Seal Beach Det Fallbrook and the habitat assessments conducted by RECON biologists during biological surveys.

4.1 Topography and Soils

4.1.1 IR Site 34b

IR Site 34b is located on the side of a small hill generally with 15–30 percent slopes. A small portion of the western border that runs along Walleye Road contains almost no slope as it was cut from the hillside to create a flat area for the road. The soils mapped for IR Site 34b eroded Fallbrook sandy loam (USDA 1973).

The Fallbrook soil series consists of well-drained, moderately deep to deep sandy loams that formed in material weathered in place from granodiorite. Fallbrook sandy loam, 15 to 30 percent slopes, eroded, is moderately steep and is 27–50 inches deep over rock. This soil is a well-drained, moderately deep sandy loam that develops from material weathered in place from granodiorite. Runoff is medium to rapid, permeability is moderate, and the erosion hazard is moderate to high.

4.1.2 IR Site 34d

IR Site 34d is located within the Fallbrook Creek drainage system and contains slopes of various steepness and aspects. Certain portions of the creek channel are incised and create steep rock slopes. while other portions of the Site transition to flat terrain creating areas of gentle slopes and flat areas within the Site. IR Site 34b also contains eroded Fallbrook sandy loam, as described above.

4.2 Vegetation Communities

Prior to the current biological survey, a total of three plant communities had been mapped by NAVWPNSTA Seal Beach Det Fallbrook over the two sites, IR Site 34b and IR Site 34d (Table 2, Figure 5). This mapping was conducted prior to the May 2014 Tomahawk Fire, which burned approximately 5,400 acres at NAVWPNSTA Seal Beach Det Fallbrook. The current biological survey was conducted by RECON Environmental, Inc. biologists Alex Fromer and Wendy Loeffler. Fire damage was clear on both IR Sites 34b and 34d. The existing vegetation communities had dramatically changed compared to their pre-fire conditions.

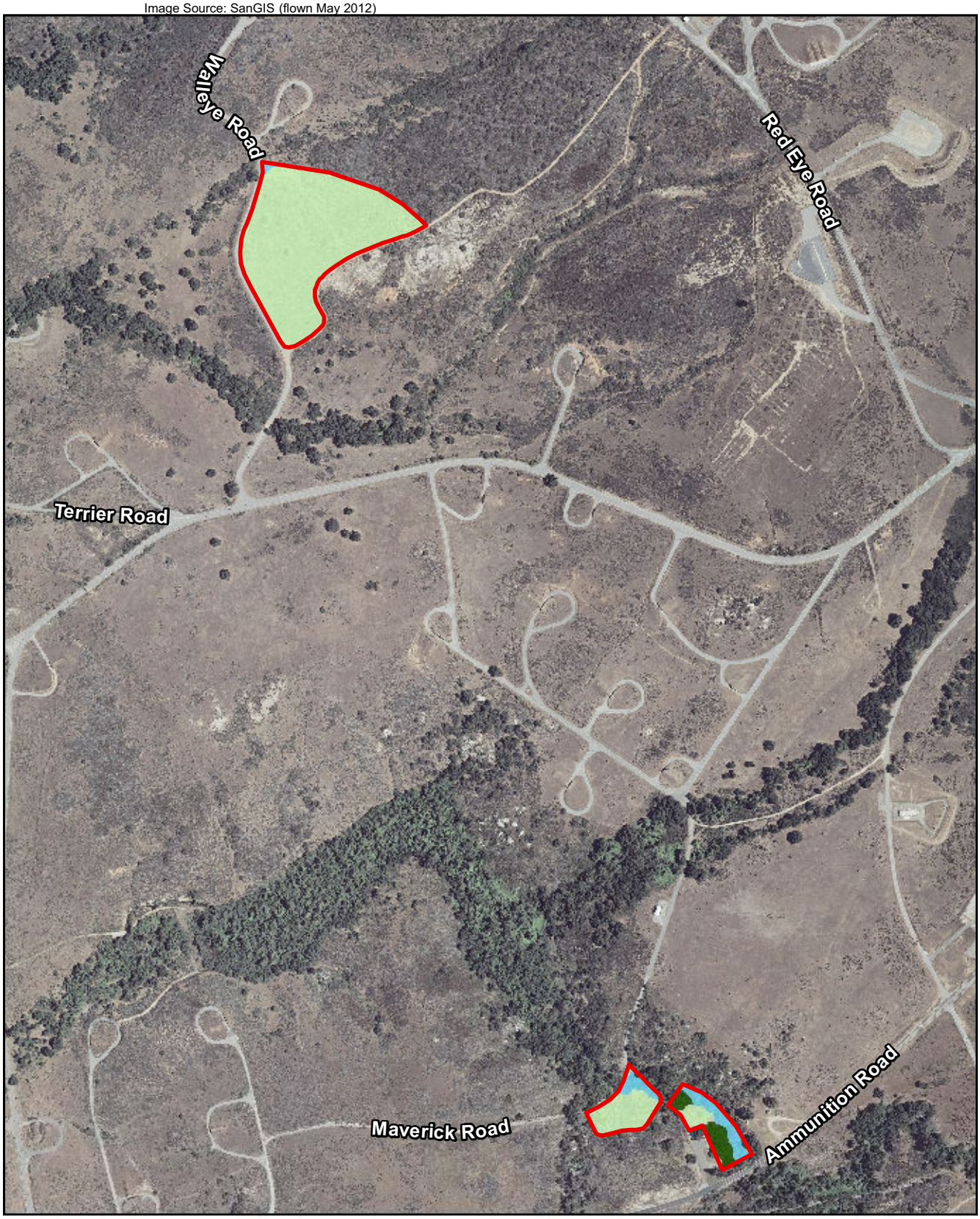
TABLE 2
VEGETATION COMMUNITIES WITHIN THE
REMEDIAL INVESTIGATION PROGRAM ACTION AREA

Vegetation Community	IR Site 34b (acres)	IR Site 34d (acres)
Coastal Sage Scrub (burned)	11.26	1.80
Oak Woodland (burned)	--	0.78
Riparian Woodland (burned)	0.49	0.70
TOTAL	**11.75**	**3.28**

4.2.1 IR Site 34b

IR Site 34b originally supported coastal sage scrub habitat dominated by California sagebrush (*Artemisia californica*) (see Table 2). Currently, the site supports bare ground with some remnant fire-disturbed patches of coastal sage scrub and a few individual oaks scattered throughout the area. There is some resprout of native coastal sage species evident, and a few of the oaks appeared to be alive and are expected to recover post-fire. However, the vast majority of existing vegetation has been burned by the Tomahawk Fire wildfire in 2014 with little to no herbaceous vegetative cover.

Image Source: SanGIS (flown May 2012)



Action Area

2010 Vegetation

Coastal Sage Scrub

Coast Live Oak Woodland

Riparian Woodland

0 Feet 750

FIGURE 5

Action Area with Previously Mapped Vegetation Types

RECON

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4.2.2 IR Site 34d

IR Site 34d originally supported coastal sage scrub, oak woodland, and riparian woodland prior the Tomahawk Fire in May 2014. The riparian woodland appears to have been dominated by black willow (*Salix gooddingii*) and California sycamore (*Platanas racemosa*) with small patches of oak woodland, dominated by coast live oak (*Quercus agrifolia*) throughout. The current biological survey showed that most of the coastal sage scrub had burned to bare ground, and much of the oak woodland and riparian woodland had been damaged by the fire. While the canopy within the woodlands remained largely intact, many of the trees were damaged and lost much of their foliage. Additionally, almost all herbaceous vegetation understory burned during the fire. However, many of the larger riparian trees survived and already some showed signs of recovery in the form of re-growth along the trunks and in the canopy.

4.3 Description of Listed Species with the Potential to Occur within the Action Area

Based on known occurrences or presence of suitable habitat on or in the immediate vicinity of IR Sites 34b and 34d, this document evaluates the following federally listed species: coastal California gnatcatcher, Stephen's kangaroo rat, least Bell's vireo, and southwestern willow flycatcher. No designated critical habitat exists within, or in the vicinity of, the action area for IR Sites 34b and 34d. Locations of historical occurrences of these species are presented in Figure 6.

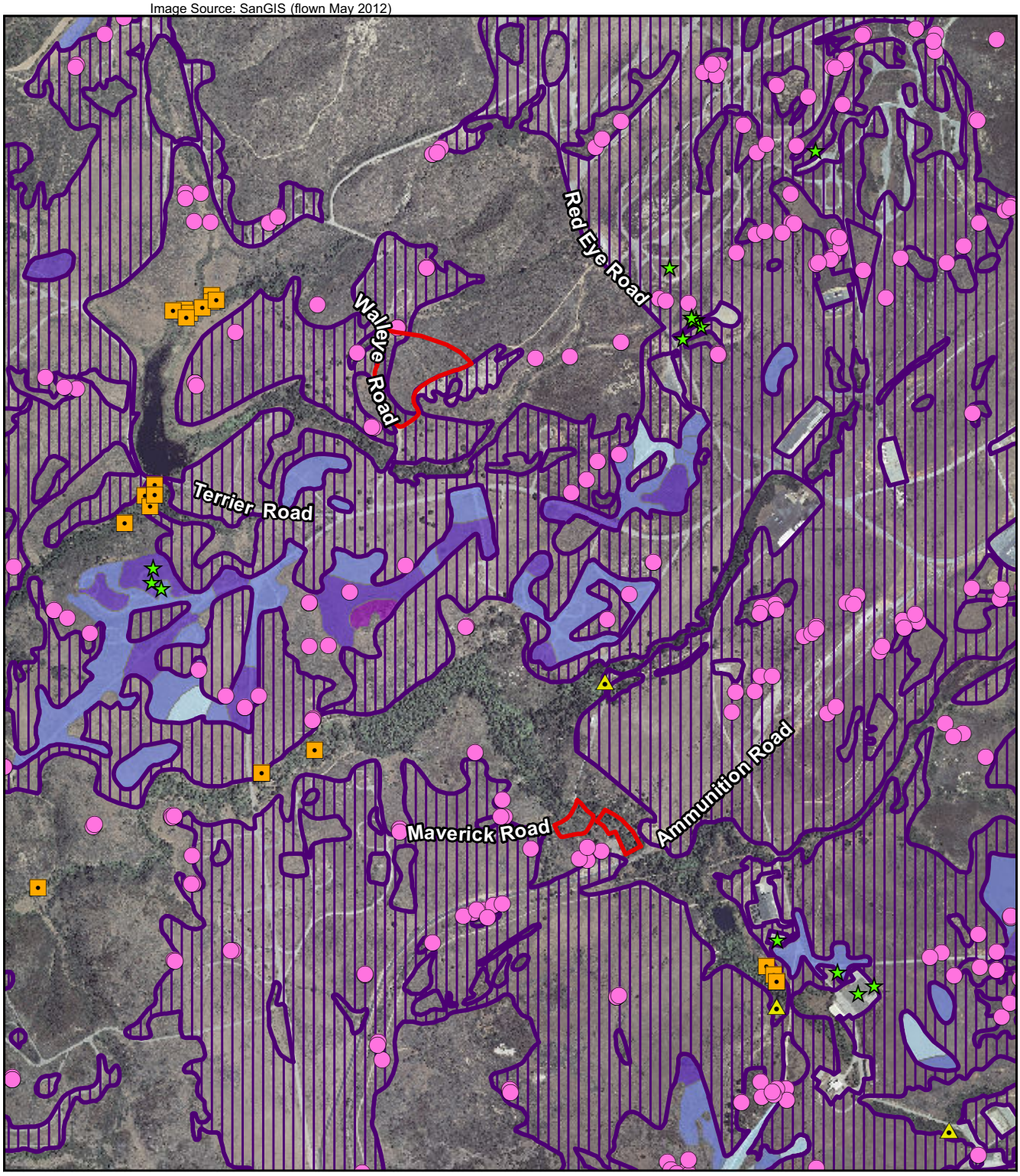
4.3.1 Coastal California Gnatcatcher

On March 30, 1993, the USFWS listed the coastal California gnatcatcher as threatened (USFWS 1993) pursuant to the federal Endangered Species Act (ESA) of 1973 as amended.

4.3.1.1 Life History

The coastal California gnatcatcher is a small slate-colored bird with a long, black tail that is edged and tipped with white, which it flicks erratically as it perches. The bird has a distinct kitten-like mewing call, which distinguishes the California gnatcatcher from the black-tailed gnatcatcher (*Polioptila melanura*) (Atwood and Bontrager 2001). During the breeding season, the male develops a black cap that distinguishes it from the female. The coastal California gnatcatcher is a nonmigratory songbird found on the coastal slopes of southern California. It ranges from Ventura County south to northwest Baja California, Mexico (Atwood 1990; Jones and Ramirez 1995). The breeding season of the coastal California gnatcatcher extends from late February through August with the peak of nesting occurring from mid-March through mid-May. The breeding territory size of the

Image Source: SanGIS (flown May 2012)



Action Area

Historic Occurrences

- Stephens' Kangaroo Rat
- Coastal California Gnatcatcher
- Least Bell's Vireo
- Southwestern Willow Flycatcher

SKR Occupied Habitat Density

- High
- Medium
- Low
- Trace
- Suitable/Unoccupied SKR Habitat

0 Feet 1,500

FIGURE 6

Action Area and Threatened and Endangered Species Historic Occurences

RECON

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coastal California gnatcatcher ranges from 2 to 14 acres, with home ranges expanding from 13 to 39 acres during the non-breeding season (USFWS 1993). Nest parasitism by brown-headed cowbirds (*Molothrus ater*) has been documented (Unitt 2004). Typically, there is a high rate of nest failure each breeding season. This is offset by rapid and persistent re-nesting efforts; a breeding pair may attempt to nest as many as ten times in a year, producing up to three successful broods in a season (Atwood and Bontrager 2001). There is evidence that this bird is also susceptible to nest predation by various animals such as snakes, coyotes (*Canis latrans*), fox, rodents, and other birds, such as western scrub-jays (*Aphelocoma californica*) (Atwood 1990).

The coastal California gnatcatcher is strongly associated with coastal sage scrub habitats below 820 feet in coastal areas and between 820 and 1,640 feet in inland areas (Atwood and Bolsinger 1992); however, not all types of coastal sage scrub communities are used or preferred. This bird appears to be most abundant in areas dominated by California sagebrush (*Artemisia californica*) and California buckwheat (*Eriogonum fasciculatum*) (Unitt 2004).The bird's numbers are generally low in coastal habitats dominated by black sage (*Salvia mellifera*), white sage (*Salvia apiana*), or lemonadeberry (*Rhus integrifolia*); in inland areas, habitats dominated by black sage may be used more regularly (Atwood and Bontrager 2001).

4.3.1.2 Distribution

Population estimates for the coastal California gnatcatcher vary. Atwood (1992) estimated that 1,811 to 2,291 pairs of coastal California gnatcatchers existed in 1992 throughout its range in southern California. In 1996, the USFWS estimated the population in San Diego County at 3,000 pairs, excluding pairs located on sites where habitat loss had already been approved (Atwood and Bontrager 2001). According to a 1999 population estimate in San Diego and other southern California counties, the USFWS estimated the population in San Diego at 1,917 pairs, Orange County at 643 pairs, Los Angeles County at 144 pairs, San Bernardino County at 27 pairs, and Ventura County at 4 pairs (Atwood and Bontrager 2001).

4.3.1.3 Occurrence within IR Site 34b

Coastal California gnatcatcher has been historically observed within the immediate vicinity of IR Site 34b (Fallbrook 2014). The Tomahawk Fire in May 2014 burned all of the coastal sage scrub, and no remaining suitable habitat exists within the action area. Based on the observed habitat conditions, current regional drought conditions, and the anticipated timeline for project completion, it is not anticipated that the existing vegetation will recover to the point of supporting coastal California gnatcatcher within the timeframe of the project activities for either foraging or nesting. Therefore, this species will not be further discussed with relation to IR Site 34b in this document until the conclusion.

4.3.1.4 Occurrence within IR Site 34d

Coastal California gnatcatcher has been historically observed within the vicinity of IR Site 34d (Fallbrook 2014). The Tomahawk Fire in May 2014 burned all of the coastal sage scrub and no remaining suitable habitat exists within Action Area. Based on the observed habitat conditions, current regional drought conditions, and the anticipated timeline for project completion, it is not anticipated that any of the existing vegetation will recover to the point of supporting coastal California gnatcatcher within the timeframe of the project activities for either foraging or nesting. Therefore, this species will not be further discussed with relation to IR Site 34d in this document until the conclusion.

4.3.2 Stephen's Kangaroo Rat

The Stephens' kangaroo rat was federally listed as endangered on September 30, 1988 (USFWS 1988).

4.3.2.1 Life History

Stephens' kangaroo rat is one of 19 species of kangaroo rats in North America. Kangaroo rat characteristics include large heads with external cheek pouches, small front legs, large hind legs, and long tails. Stephens' kangaroo rat is medium-sized with dusky cinnamon overfur and white underfur. The tail is crested and bicolored with a white band. Stephens' kangaroo rats differ from other *Dipodomys* in their range by making use of sparse habitat that is not favorable to other members of its genus (USFWS 1997).

Habitat for the Stephens' kangaroo rat includes open grasslands, fallow agricultural fields, and sparse coastal sage scrub vegetation types in areas with penetrable soils and a flat to fairly steep sloping topography at elevations of 180 to 4,100 feet (USFWS 1997). The majority of Stephens' kangaroo rat populations are located at elevations below 2,000 feet. Habitat for the Stephens' kangaroo rat varies in

composition and density from place to place and season to season, although areas with dense grass cover are not suitable for Stephens' kangaroo rat (USFWS 1997). Filaree (*Erodium* sp.) frequently dominates the best Stephens' kangaroo rat habitat, especially during and shortly after the rainy season (RECON 1989). Stephens' kangaroo rats are nocturnal and forage at night for seeds and fresh vegetation.
Stephens' kangaroo rats breed in late spring and early summer. Population densities for Stephens' kangaroo rat are variable depending on rainfall and location and can vary from year to year at individual locations. The reported population density range is from 3 to 23 individuals per acre during the summer and 2 to 6 individuals per acre in the winter (USFWS 1997). O'Farrell and Uptain (1989, as cited in USFWS 1997) report that the majority of Stephens' kangaroo rat populations are of low to medium density, with less than four individuals per acre. Home range sizes are smaller for female Stephens' kangaroo rat than male Stephens' kangaroo rat. Female home ranges tend not to overlap, and male home ranges often overlap the home ranges of neighboring females. Home range size ranges from 0.1 to 0.4 acre (USFWS 1997).

4.3.2.2 Distribution

Stephens' kangaroo rat historically ranged from southwestern San Bernardino County south through Riverside County into San Diego County. Stephens' kangaroo rat may no longer be extant in San Bernardino County (USFWS 1997). The entire range of Stephens' kangaroo rat is estimated to encompass 1,108 square miles, which is considered small when compared to range distributions of other rodents and species of kangaroo rats (USFWS 1997). Currently, there are three distinct regions that support Stephens' kangaroo rat populations: western Riverside County and western and central San Diego County.

4.3.2.3 Occurrence within IR Site 34b

Historically, IR Site 34b supported a dense canopy of coastal sage scrub which is not conducive to supporting Stephens' kangaroo rat, and the site was mostly identified as unsuitable habitat (Fallbrook 2014). The western and southern edges of the site were historically mapped as suitable, but unoccupied habitat, with a few patches of habitat identified as occupied and low density, located 1,000 feet to the southwest and south of the site (Fallbrook 2014). Post-fire site conditions including sparse shrub cover, minimal herbaceous growth, friable soils, and less than 15 percent slopes in some areas, now meet the criteria for potentially suitable habitat for this species. In addition, the wildfire has increased connectivity between adjacent mapped suitable but unoccupied habitat and the low-density occupied habitat approximately 1,000 feet away, which could allow for existing Stephens' kangaroo rat populations to move into the action area. Several potential kangaroo rat burrows and other sign (scat and tail-drags) were identified and flagged within the IR Site 34b Action Area (see Figure 3). It is not possible to determine the species of kangaroo rat that may be using these burrows without trapping, thus there is the low potential for these burrows to be that of Stephen's kangaroo rat.

4.3.2.4 Occurrence within IR Site 34d

IR Site 34d previously supported high-density coastal sage scrub, oak woodland, and riparian woodland, none of which is considered suitable habitat for Stephens' kangaroo rat. However, suitable but unoccupied habitat is mapped within the adjacent areas to the south, and low- to medium-density occupied habitat is mapped within 3,000 feet to the north and southeast. While the Tomahawk Fire opened up the vegetative cover and the site supports the appropriate friable soils, the slopes on this site are too steep to support Stephens' kangaroo rat. In addition, no potential kangaroo rat sign was observed during the survey, and there was very little general rodent sign apparent throughout the action area. This species will not be further discussed in this document with regards to IR Site 34d.

4.3.3 Least Bell's Vireo

Least Bell's vireo was federally listed as an endangered species on May 2, 1986 (USFWS 1986).

4.3.3.1 Life History

Least Bell's vireo is a small, nondescript vireo, with generally gray plumage, rounded wings with pale white wing bars and narrow white eye rings. Juveniles are distinguished from adults by whiter plumage and more distinct wing bars. This species has a distinctive song and is most easily located through its vocalizations. Least Bell's vireo is a migratory songbird that winters in Baja California, Mexico, arriving in California from mid-March to April and departing for Baja California again in September (Brown 1993). Breeding season generally ranges from March through July. Nests are commonly located on branches

approximately 1.5–5 feet above the ground (Brown 1993). Most pairs produce only one brood per season but have been documented to produce up to four in one season (Franzreb 1989). Least Bell's vireo is parasitized throughout its breeding range by brown-headed cowbirds, which are the cause of a substantial proportion of nest failures (Brown 1993).

These birds are restricted to dense riparian habitats that usually have a canopy of willows (*Salix* spp.) and an understory comprised of mule fat (*Baccharis* sp.), wild rose (*Rosa californica*), and other riparian species (Franzreb 1989). Least Bell's vireos select riparian areas with dense shrub cover and a well-developed understory for nesting. Degradation of riparian habitat due to invasion by exotic plants, grazing practices, and other causes have decreased the amount of available habitat for least Bell's vireo.

4.3.3.2 Distribution

Least Bell's vireo was historically common, ranging from near Red Bluff in Tehama County south through the Central Valley and the foothills of the Sierra Nevada. In the coastal region this bird ranged from Santa Clara County south to San Fernando in Baja California. Desert sites include Owens Valley, Death Valley, and oases in the Mojave Desert (Franzreb 1989).

After 1940, extensive habitat loss and nest parasitism by the brown-headed cowbird caused the population to decline, and this species has been extirpated from many historic areas, including the Central Valley (Franzreb 1989). It has been estimated that 95–97 percent of the riparian habitat within the floodplain of southern California has been lost due to flood control measures and development (Faber et al. 1989). In 1986 when least Bell's vireo was listed as endangered, the total population in California was estimated at 300 pairs, with the majority of the birds located in San Diego County. Following the listing, intensive brown-headed cowbird trapping programs were initiated and the population began to increase, showing exponential growth in some locations such as the Santa Margarita River, Tijuana River, and Prado Basin and Hidden Valley Drain on the Santa Ana River. The population of least Bell's vireo in California was estimated to be 1,346 pairs in 1996 (USFWS 1998).

Currently, least Bell's vireo is known from coastal Santa Barbara County south into Baja California. Least Bell's vireo is also present in the desert of San Diego County. Large populations are located on the Santa Margarita River in San Diego County and Prado Basin in western Riverside County (USFWS 1998). In 2001, over 940 least Bell's vireo pairs were recorded in San Diego County (Kus 2001).

4.3.3.3 Occurrence on within IR Site 34d

Least Bell's vireo has not historically known from IR Site 34d; however, it is has been detected within Fallbrook Creek drainage system approximately 2,000 feet to the southeast (Fallbrook 2014). The riparian and oak woodland canopies are damaged but still intact, post-fire, and there are instances of vegetative regrowth; however, much of the understory vegetation was burned, affecting the density and diversity of plant material within the riparian corridor. In its current state, the riparian habitat does not appear to be suitable to support least Bell's vireo. However, some of the burned willows are showing substantial regrowth that may have the potential to support least Bell's vireo during the next breeding season. In addition, while breeding vireo habitat may not currently exist, the existing vegetation within the action area does support
foraging habitat.

4.3.4 Southwestern Willow Flycatcher

Southwestern willow flycatcher is federally listed as endangered in 1995 (USFWS 1995).

4.3.4.1 Life History

Willow flycatchers are in the Tyrannidae family and are one of ten species of *Empidonax* flycatchers in the United States. *Empidonax* flycatchers are difficult to distinguish visually but have distinctive songs. The southwestern willow flycatcher is generally paler than other willow flycatcher subspecies and also differs in morphology. Southwestern willow flycatchers are migrants, arriving on their breeding grounds in mid-May to early June (Garrett and Dunn 1981; Unitt 2004). The southwestern willow flycatcher migrates from its breeding range in August or September. Several subspecies of willow flycatcher migrate through southern California, with the most common migrant being *E. t. brewsteri* (Unitt 2004). It is virtually impossible to differentiate between subspecies of willow flycatcher during migration.

The southwestern willow flycatcher requires riparian habitat with willow thickets (Grinnell and Miller 1944). Understory species include mule fat and arrow weed (*Pluchea* sp.). Southwestern willow flycatchers

also nest in areas with tamarisk (*Tamarix* spp.) and Russian olive (*Eleagnus angustifolia*) in areas where these species have replaced the native willow. Surface water is required at nesting sites. Estimated nesting habitat patch size varies from 0.2 to 1.5 acres. Nests are constructed in densely vegetated thickets with trees between 13 and 23 feet in height (Tibbitts et al. 1994; USFWS 1995).

4.3.4.2 Distribution

The southwestern willow flycatcher breeds in southern California, Arizona, New Mexico, southern Nevada, southern Utah, western Texas, northwestern Mexico, and possibly southwestern Colorado and winters in Mexico, Central America, and possibly northern South America (USFWS 1995). Historically common in all the lower-elevation riparian areas of southern California, the southwestern willow flycatcher was found in the Los Angeles Basin, San Bernardino/Riverside County area, and San Diego County (Unitt 2004). Southwestern willow flycatcher persists in the Colorado, Owens, Kern, Mojave, Santa Ana, Santa Margarita, San Luis Rey, Santa Clara, Santa Ynez, Sweetwater, and San Dieguito river systems and in San Timeteo, Pilgrim, and Temecula creeks. Currently, permanent populations of southwestern willow flycatchers are located on the Santa Inez River in Santa Barbara County, the Kern River in Kern County, the Prado Basin in Riverside County, and the Santa Margarita River and San Luis Rey River in San Diego County.

4.3.4.3 Occurrence on within IR Site 34d

Historically, this species has not been detected within the action area, with the nearest willow flycatchers detected along Fallbrook Creek in 2001 and 2002 approximately 1,500–2,000 feet from the IR Site 34d (Fallbrook 2014). The riparian and oak woodland canopies are damaged but still intact, post-fire, and there are instances of vegetative regrowth; however, much of the understory vegetation was burned, affecting the density and diversity of plant material within the riparian corridor. In its current state, based on the lack of dense understory within the riparian habitat, IR Site 34d is not suitable to support southwestern willow flycatcher for nesting, as they tend to require more mature, densely vegetated riparian habitat. This species will not be further discussed in this document until the conclusion.

5.0 Assessment of Potential Effects

5.1 IR Site 34b

5.1.1 Stephen’s Kangaroo Rat

5.1.1.1 Direct Effects

Heavy foot traffic and equipment will be directed to avoid all potential kangaroo rat burrows and work shall be conducted between dawn and dusk, to coincide when the individual kangaroo rats are underground. Project activities may result in the creation of dust, noise, and soil vibrations, which has the potential to cause temporary evacuation or relocation of some individuals to adjacent habitat. However, the extent of ground disturbance within the action area will be limited in location and duration.

5.1.1.2 Indirect Effects

As listed in Section 3.2.1, all open pits and trenches will be backfilled, which will eliminate fall hazards and any erosional effects. Based on this, there are no indirect effects expected to occur.

5.1.1.3 Effects Analysis

Based on the preceding analysis concerning the effects of the Proposed Action on Stephens’ kangaroo rat, it has been determined that the Proposed Action may affect, but is not likely to adversely affect Stephens’ kangaroo rat. This determination represents the net effect of all positive and negative influences associated with the Proposed Action. They thus represent the overall finding concerning the need to consult, pursuant to Section 7 of the ESA.

5.2 IR Site 34d

5.2.1 Least Bell's Vireo

Least Bell's vireo has the potential to occur within the riparian woodland within IR Site 34d.

5.2.1.1 Direct Effects

All project activities are proposed to be completed outside of least Bell's vireo breeding season. As mentioned in Section 3.4, if the Proposed Action is to take place during the breeding season, any work conducted within the riparian habitat should have a pre-activity survey completed by a qualified wildlife biologist to determine if this species is present. As such, no direct effects are anticipated to least Bell's vireo.

5.2.1.2 Indirect Effects

No trimming or removal of vegetation is proposed for the project that could affect the quality of habitat for this species; thus no indirect effects are anticipated to least Bell's vireo.

5.2.1.3 Effects Analysis

Based on the preceding analysis concerning the effects of the Proposed Action on least Bell's vireo, it has been determined that the Proposed Action will have no effect on least Bell's vireo. This determination represents the net effect of all positive and negative influences associated with the Proposed Action. They thus represent the overall finding concerning the need to consult, pursuant to Section 7 of the ESA.

6.0 Conclusion

Based on the impacts outlined by the Proposed Action, the impact avoidance, minimization and compensation measures, and effects determinations are shown below for each of the potentially affected species.

No Effect

- Coastal California gnatcatcher based on the lack of suitable habitat post-Tomahawk Fire
- Least Bell's vireo based on avoidance through the implementation of breeding season restrictions and pre-activity surveys if any work must be conducted during the breeding season.
- Southwestern willow flycatcher based on the lack of suitable breeding habitat both historically and post-Tomahawk Fire.

May Affect, Not Likely to Adversely Affect

- Stephens' kangaroo rat based on the presence of kangaroo rat sign on IR Site 34b and adjacency to suitable habitat. However, effects will be minimized through avoidance of all mapped kangaroo rat sign, conducting work when kangaroo rats are underground, and the fact that the duration and geographic extent of the proposed action is minimal.

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Appendix C: Human Health Risk Assessment Work Plan

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FINAL

Appendix C

Human Health Risk Assessment Work Plan IR Sites 34b and 34d, Dunnage Disposal Areas 2 and 4

Naval Weapons Station Seal Beach Detachment Fallbrook Fallbrook, California

May 2015

Prepared for:

Naval Facilities Engineering Command Southwest

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Prepared under:

Contract Number: N62473-10-D-4009
Task Order Number: 0096
DCN: CBI-4009-0096-2146

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Acronyms and Abbreviations

AOC	Area of Concern
ATSDR	Agency for Toxic Substances Disease Registry
bgs	below ground surface
CDC	Centers for Disease Control and Prevention
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSEM	conceptual site exposure model
CSF	cancer slope factor
DDD	Dunnage Disposal Site
Det.	Detachment
DON	U.S. Department of the Navy
DQO	data quality objectives
DTSC	California Department of Toxic Substances Control
EPC	exposure point concentration
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic (Model for Lead)
IR	installation restoration
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
µg/dL	microgram per deciliter
MEC	munitions explosives constituent
mg/kg	milligrams per kilogram
MRL	Minimum Risk Levels
MRP	munitions response program
NAVFAC SW	Naval Facilities Engineering Command Southwest
NAVWPNSTA	Naval Weapons Station
OEHHA	California Office of Environmental Health Hazard Assessment

PA	Preliminary Assessment
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PPRTV	Provisional Peer Reviewed Toxicity Values
QA/QC	quality assurance/quality control
RAGs	risk assessment guidance for Superfund
RBC	risk based concentrations
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
RSL	regional screening level
SAP	sampling and analysis plan
SI	site inspection
SL	screening level
SVOC	semi-volatile organic compound
TCDD	tetrachloro-dibenzo-p-dioxin
TEF	toxicity equivalency factor
TEQ	Toxicity Equivalents
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
UXO	unexploded ordnance
VOC	volatile organic compound

Section 1 Introduction

This Human Health Risk Assessment (HHRA) work plan has been prepared for the Remedial Investigation (RI) of IR Sites 34b and 34d (Dunnage Disposal Sites 2 and 4) at Naval Weapons Station (NAVWPNSTA) Seal Beach Detachment (Det.) Fallbrook, California (Figure 1). The RI is being performed under the Department of the Navy (DON), Naval Facilities Engineering Command Southwest (NAVFAC SW), Contract Number N62473-10-D-4009, Task Order Number 0096.

1.1 Objective and Background

The objective of the HHRA will be to evaluate potential health risks and hazards for potential current and future receptors exposed to potential site contaminants (i.e., volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and/or dioxins and furans) at IR Sites 34b and 34d (Figures 2 and 3). Based on this evaluation, an HHRA report will be prepared and submitted as part of the RI report.

1.2 IR Sites 34b and 34d Summary

IR Sites 34b and 34d were established to investigate soil impacts from disposal activities at Dunnage Disposal Site 2 (DDS 2) and Dunnage Disposal Site 4 (DDS 4), respectively, from 1942 until 1978. Based on installation record reviews, visual surveys, and interviews, sites DDS 2 and DDS 4 were not used as munitions burial sites; therefore, the chemicals of potential concern (COPCs) to human health and/or chemicals of potential ecological concern (COPECs) in the environment have been limited to chemical impacts from buried debris. The following sections further summarize IR Sites 34b and 34d.

1.2.1 IR Site 34b – Dunnage Disposal Site 2

IR Site 34b is located in the north-central portion of NAVWPNSTA Seal Beach Det. Fallbrook (Figures 1 and 2), east of Walleye Road. It encompasses approximately 9 acres of northwest-facing hillside covered with native vegetation. Historical information documented in the Preliminary Assessment (PA) (Malcolm Pirnie 2006) indicated that IR Site 34b was reportedly used as a disposal or burial area for dunnage and other debris from 1942 to 1978. The site is not developed and has no current land use other than open space. No manmade structures or evidence of previously existing structures were observed at the site during the SI (ChaduxTt 2010).

The SI report identified a shallow waste disposal trench in the central portion of the site as the primary area of concern (AOC) for IR Site 34b. This trench will be referred to as the “known disposal trench” in this work plan. The known disposal trench extended 480 feet in a

northwesterly direction down slope from a nearby access road (Figure 2). The known disposal trench was estimated to be 3.5 feet wide and contained debris from the surface to a depth of 4 feet below the surface. The known disposal trench was partially filled with undocumented fill soil or slough from the trench walls, along with metal, wood, and glass debris. The debris consisted of weathered and deteriorated 2- to 5-gallon metal containers, metal banding, empty 55-gallon drums, glass bottles, cans, and other miscellaneous solid waste, some of which indicated that it had been burned. The known disposal trench was identified in a 1953 photograph along with two less conspicuous linear features identified located farther west, which were similar in appearance to the known disposal trench (Figure 2). The two additional linear surface disturbances are suspected to also be disposal trenches and were therefore included as AOCs for IR Site 34b (ChaduxTt 2010). A fourth potential disposal area east of the known disposal trench is also included as an AOC for IR Site 34b (Figure 2).

During a site visit after the May 2014 wildfires that burned IR Sites 34b and 34d, the three potential disposal trenches were not observed. The fire cleared much of the vegetation at IR Site 34b and little dunnage and/or debris was visible outside of the known disposal trench. However, the three potential disposal trenches will still be investigated.

1.2.2 IRP Site 34d – Dunnage Disposal Site 4

IR Site 34d is located in the central portion of NAVWPNSTA Seal Beach Det. Fallbrook, north of Ammunition Road and along the south side of Fallbrook Creek (Figures 1 and 3). The site encompasses 1.8 acres. Old asphalt paving associated with Maverick Road and improvements related to the former crossing over Fallbrook Creek are located in the northern portion of the site. Fallbrook Creek flows westward through the northern portion of the site (Figures 3 and 4). The site is vacant and has no current land use other than open space.

IR Site 34d was evidently used as a disposal and possibly a burial area for dunnage and other debris. In addition to the possible disposal of dunnage, at least three former structures were known to have existed at the site: Buildings 341, 430, and 325 (Figure 3). The SI identified these former buildings as a former restroom, a former boiler house, and a former wooden ammunition magazine, respectively. Only the remnants of the concrete slab from Building 341 and the adjacent below grade three-stage concrete sump (Building 430) with an adjoining drainpipe currently remain on site. The drainpipe appears to discharge to Fallbrook Creek. These building remnants are located within the western portion of IR Site 34d (Figure 3). No remnants of Building 325 were evident at the site.

During the SI field investigation, surficial and buried debris was observed near the slab remnants of former Building 341. Detector-aided visual surveys performed during the SI indicated metal debris, construction debris, and other debris within and adjacent (uphill to the east) to IR Site

34d. Debris observed at the site and adjacent to Fallbrook Creek included metal piping, asphalt, wood pallets, boards and burnt wood remains, plastic piping, aluminum canisters, and glass. Three magnetic anomalies were detected with a hand-held magnetic gradiometer along the location of the former access road that cuts through the site. Along with observed debris, several weathered small arms ammunition canisters and spent small caliber blank casings were observed on the south side of the creek. The canisters and casings are considered isolated debris and did not indicate the presence of munitions and explosives of concern (MEC) or munitions constituents (MC) at the site (ChaduxTt 2010).

The SI identified the following areas that will be investigated further as AOCs in this RI for IR Site 34d:

- areas near the slab of former Building 341 and three-stage concrete sump (Building 430) and drainpipe to investigate the soil impacts from historical operations
- the areas near the wood debris and burnt wood located near borings IRP34D-SB01, IRP34D-SB04, and IRP34D-SB05 (Figure 3)
- the offsite area east of IR Site 34d and Fallbrook Creek to investigate the extent and soil impacts of buried debris

1.3 Purpose

The purpose of this HHRA Work Plan is to describe the data collection and evaluation process, present the conceptual site exposure model (CSEM), and provide the exposure assumptions that will be used in the HHRA for IR Sites 34b and 34d. This HHRA will be performed in accordance with Risk Assessment Guidance for Superfund (RAGS) (EPA 1989, 2001, 2002a, and 2004). As part of this HHRA Work Plan, preliminary RAGS-D (EPA 2001) Standard Table 1 and Table 4s are included. This HHRA Work Plan is intended to serve as a means of obtaining consensus among stakeholders of the approach to the risk assessment. The organization of this HHRA Work Plan is as follows:

- Section 2.0 summarizes the sampling and analysis program. A detailed description is presented in the RI Work Plan for IR Sites 34b and 34d Sampling and Analysis Plan (SAP).
- Section 3.0 describes the process for selecting COPCs for the risk assessment.
- Section 4.0 presents the preliminary CSEM.
- Sections 5.0 and 6.0 explain the procedures for the exposure assessment and the toxicity assessment.
- Section 7.0 discusses how the HHRA will characterize risk and hazard for IR Sites 34b and 34d
- Section 8.0 provides references.

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Section 2 Data Collection

This HHRA for IR Sites 34b and 34d will be based on the data set that has been compiled under the previous SI (ChaduxTt 2010), as well as the sample collection planned as part of the RI. Data collected as part of the SI consisted of soil samples. These data will be used in the HHRA assuming minimal quality assurance/quality control (QA/QC) requirements have been met. Additional soil data are to be collected for VOCs, SVOCs, metals, and dioxin/furans as discussed in the RI Work Plan for IR Sites 34b and 34d.

The sampling and analysis approach for the RI at IR Sites 34b and 34d is discussed in the RI Work Plan. It outlines the sampling protocols and specifies the analyses for the COPCs. The approach described in the RI Work Plan will provide additional data for use in the risk assessment for IR Sites 34b and 34d.

The depth interval for surface soils is defined to be from 0 to 0.5 feet (EPA 1992), unless site-specific conditions warrant otherwise. For example, if some soil samples were collected from 0 to 1.0 feet, these will be treated as surface soil. Subsurface soil samples are defined as those samples collected from a depth between 0.5 feet and 10 feet below ground surface.

Soil samples have previously been collected on site. These data will be further supplemented by additional sampling, as discussed previously.

Surface water and sediment samples will be collected from Fallbrook Creek that is adjacent to IR Site 34d, as site contaminants may migrate to the creek as a result of overland flow during precipitation events. Multiple site samples adjacent to the creek are proposed, as well as one upstream sample. The upstream sample will be used to assess whether or not detected chemicals are site-related or related to an upstream source such as the town of Fallbrook.

Background data are relevant to IR Sites 34b and 34d since inorganics are part of the focus of the investigation. A separate Facility-wide Background Study has been conducted (SES-Tech 2012). A description of the background study is summarized in the RI Work Plan for IR Sites 34b and 34d.

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Section 3 Selection of Chemicals of Potential Concern for Risk Assessment

All detected analytes will be retained as COPCs and carried through the screening-level HHRA (and quantitative HHRA, if needed), with the exception of inorganic chemicals determined to be related to background (as recommended by DTSC 1997). The screening-level HHRA will be based on a ratiometric approach, using 95% upper confidence limit (UCL) exposure point concentrations (EPCs) and appropriate risk-based screening levels (SLs) (see Section 5.1 for the EPC calculation approach and Table C1 for risk-based SLs). The screening-level HHRA will be employed as an initial screening step, as requested in the Performance Work Statement (Department of the Navy 2012) to determine if a quantitative HHRA is required for each Site. Screening-level risks and hazards for each Site will be estimated by dividing selected chemical's 95% UCL EPCs by the associated cancer risk- and/or non-cancer hazard-based level, (SL_c and/or SL_h, respectively), summing these fractions, and then scaling the results using a target cancer risk of 1E-6 and target non-cancer hazard of 1.0, as shown as follows:

$$\text{Total Cancer Risk} = \sum [\text{EPC COPC}_a/SL_{a,c} + \text{EPC COPC}_b/SL_{b,c} + \ldots \text{EPC COPC}_n/SL_{n,c}] \times 1\text{E-6}$$

$$\text{Total Hazard Index} = \sum [\text{EPC COPC}_a/SL_{a,h} + \text{EPC COPC}_b/SL_{b,h} + \ldots \text{EPC COPC}_n/SL_{n,h}] \times 1.0$$

If the total HI exceeds 1, a chemical-specific evaluation of target organ toxicity will be performed, as hazard quotients (HQs) are not technically considered to be additive unless the same target organ is affected. If the results of this screening-level HHRA suggest Site risks exceed 1E-6 or Site hazards exceed 1.0, a quantitative HHRA will be performed.

To support the SAP and project data quality objectives (DQOs) for soil, surface water, and sediment, and to ensure analytical detection limits are appropriately low, risk-based concentrations (RBCs), also referred to as SLs, based on a conservative assumption of future residential land use at IR Sites 34b and 34d are presented in Table C1, using Regional Screening Levels (RSLs) (EPA 2014) and California Alternate RSLs (DTSC 2013), whichever are lower.

The process for selecting COPCs for the HHRA, by soil depth, and for surface water and sediment is summarized in the following sections.

3.1 Surface Soil

For surface soil, all detected constituents will be retained as COPCs and carried through the screening-level HHRA, and if required, the quantitative HHRA, except for background inorganics as discussed previously.

3.2 Total Soil

To address potential future development, construction, or utility work, it will be assumed that subsurface soil would remain at the surface as a result of soil disturbance. Therefore, surface and subsurface soil data sets will be combined and designated as "total soil." A conservative assumption of exposure to combined surface soil and subsurface soil, as a result of future disturbance or development, is based on EPA (1989). All detected constituents will be retained as COPCs and carried through the screening-level HHRA, and if required, the quantitative HHRA, except for background inorganics as discussed previously.

3.3 Surface Water

For surface water, all detected constituents from surface water samples collected at IR Site 34d will be retained as COPCs and carried through the screening-level HHRA, and if required, the quantitative HHRA. Results from the upstream background sample will be used to differentiate between chemicals likely to be related to the site versus those from an upstream source (such as the town of Fallbrook). Inorganics determined to be related to upstream background will not be carried through the HHRA.

3.4 Sediment

For sediment, all detected constituents from sediment samples collected at IR Site 34d will be retained as COPCs and carried through the screening-level HHRA, and if required, the quantitative HHRA. Results from the upstream background sample will be used to differentiate between chemicals likely to be related to the site versus those from an upstream source (such as the town of Fallbrook). Inorganics determined to be related to upstream background will not be carried through the HHRA.

3.5 Background

The statistical approach that will be used for the comparison of metals concentrations in soil sampled at IR Sites 34b and 34d with site-specific background concentrations is described below.

Background distributions for 23 Target Analyte List metals, strontium, and tin in soil at the installation have been determined as part of the site-specific background study for NAVWPNSTA Seal Beach Det. Fallbrook (SES-Tech 2012). Statistical descriptions of these background data, by parent rock type, include a 95th upper tolerance limit (UTL) for each element along with other parameters (minimum, maximum, frequency of detection, data distribution, etc.). The 95th UTL provides an upper bound on the true the 95th percentile of the background population, and will be used a background screening value. Concentrations in

samples from IR Sites 34b and 34d (that have a parent rock type of tonalite) will be compared to the background distributions[1] by comparing the maximum detected concentration to the 95th UTL background screening value, and by directly comparing the IR Sites 34b and 34d (for each Site separately) and background data distributions using ProUCL (EPA 2013) via the Wilcoxon rank sum test performed at a 95 percent confidence level.

Metals that fail either of these two tests may be subject to a geochemical evaluation using the methods of Myers and Thorbjornsen (2004) and Thorbjornsen and Myers (2007) to determine if the statistical exceedances are due to naturally high concentrations or due to Site contamination. Metals identified by this process as contaminants will be considered as being site related (i.e., not related to background).

For surface water and sediment data to be collected from IR Site 34d, a simple comparison of the three proposed site samples with the one upstream sample will be used to assess whether or not a detected chemical is potentially site related. If the maximum detected site sample result exceeds the upstream concentration, then the chemical will be considered to be site-related. As the DTSC (1997) background guidance only addresses inorganics, organic compounds detected in surface water and/or sediment that are potentially background related will be conservatively carried though the HHRA. However, at the conclusion of the HHRA, those non-site-related organics that may be found to be risk- or hazard-drivers in surface water and/or sediment will be identified and discussed in detail.

[1] The combined parent rock type of gabbro/granodiorite/tonalite from the Background Study will be used, as the 14 soil samples from each of these three soil types were determined to be statistically similar (SES-Tech 2012).

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Section 4 Preliminary Conceptual Site Exposure Model

This section describes the current and future conditions at IR Sites 34b and 34d, the current and potential future land use, the exposure areas, and the potential human receptors. The preliminary CSEM is presented in Figure 4 for IR Sites 34b and 34d exposure scenarios.

4.1 Land Use

NAVWPNSTA Seal Beach Det. Fallbrook has a complement of approximately 85 military personnel and a civil service force of approximately 100 (Wikipedia 2014). The population of the nearby unincorporated community of Fallbrook is approximately 30,534, according to the U.S. Census Bureau 2010 estimate.

As discussed in Section 1.2, IR Sites 34b located in the north-central portion of the installation, east of Walleye Road; it encompasses 9 acres of shallow north-sloping natural topography covered with native vegetation. Potable groundwater is anticipated to be located at a depth greater than 100 feet in this area (ChaduxTt 2010).

As discussed in Section 1.2, IR Site 34d is located in the central portion of the installation, immediately north of Ammunition Road and along the south side of Fallbrook Creek. The irregular-shaped site encompasses 1.8 acres. Old asphalt paving associated with Maverick Road and improvements related to the former crossing over Fallbrook Creek are located in the northwestern portion of the site. Fallbrook Creek flows westward through the northern portion of the site as well, north of Maverick Road (ChaduxTt 2010).

4.2 Conceptual Site Exposure Model

A CSEM is provided in Figure 4 and the selection of exposure pathways is shown in Table C2.

4.2.1 Receptors and Exposure Media

For a site-related chemical to pose a potential risk to a receptor there must be a complete exposure pathway from the affected media to the receptor. A complete exposure pathway consists of the following: (1) a source; (2) a release mechanism and/or exposure point; (3) a viable exposure route; and (4) a receptor. In any one of these four components is not present, the exposure pathway is considered incomplete. Potential receptors are defined as individuals that may contact (i.e., be exposed to) site-related chemicals in environmental media.

Relevant exposure pathways include only those associated with soil: incidental ingestion, direct dermal contact, and inhalation for the residential, occupational worker, and construction worker scenarios. As volatilization of some compounds might occur, this transport pathway is

considered for volatile compounds. Mobilization to air is also considered to occur via particulate wind erosion, for non-volatile compounds. Although VOCs and the more volatile SVOCs detected in soil could potentially migrate into indoor air, no buildings current exist on either Site, and soil gas samples are not proposed for collection. Therefore, although this vapor intrusion exposure pathway may exist in the future if buildings are constructed, there is no accurate methodology currently available to model this potential indoor air exposure using soil data. The uncertainties with this potential limitation will be discussed in the HHRA uncertainty section.

Groundwater at IR Sites 34b and 34d is not a current source of drinking water and groundwater impacts from IR Sites 34b and 34d are not expected, therefore groundwater sampling is not planned. Current groundwater exposure pathways are not considered complete for this Site, although the groundwater pathway is potentially complete for future receptors because there are no groundwater use restrictions at IR Sites 34b and 34d and groundwater may be used as a source of drinking water in the future. The RI will evaluate the soil data to determine whether any site-related chemicals (i.e., those determined not to be related to background) are present at concentrations that might pose a threat to groundwater. If such chemicals are identified, they will be recommended for further evaluation. The Sites are currently vacant land and not used, therefore, no current receptors exist. The Sites are located in a generally remote location, fenced, and not expected to be visited by trespassers. However, the HHRA uncertainty section will qualitatively assess potential current trespasser exposure. While there are no current plans for future Site use, potential future use could consist of build-out for occupational workers or residents. Occupational workers and construction workers will be the primary future receptors at IR Sites 34b and 34d.

Future hypothetical residential adults and children will also be evaluated as potential receptors at IR Sites 34b and 34d to provide a baseline for the evaluation of potential recommendation of no further action.

Affected media for exposure of occupational, construction, and residential receptors, consistent with future hypothetical land-use scenarios, are described in the following subsections.

Soil. Soil samples are to be collected from IR Sites 34b and 34d to supplement the soil samples collected during the SI. Chemicals detected in soil could serve as a source of exposure for future occupational receptors, future construction workers, and hypothetical future residents.

Surface Water and Sediment. Chemicals detected in surface water and sediment adjacent to IR Site 34d could serve as a source of exposure for future occupational receptors and hypothetical future residents. Future construction workers would not be expected to frequent Fallbrook Creek.

Groundwater and Soil Gas. As discussed previously, groundwater beneath the Sites is not planned for sampling, nor is soil gas.

In summary, the receptors for the HHRA are as follows:

- Future occupational workers
- Future construction workers
- Hypothetical future residential adults and children.

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Section 5 Exposure Assessment

A summary of potentially complete exposure pathways is provided in RAGS-D Standard Table 1 (EPA 2001) (Table C2). Exposure pathways and selected exposure factor values are discussed in the following sections. The values were generally obtained from federal USEPA guidance documents. Where indicated, values may be site-specific or chemical-specific, or may be calculated using site data.

5.1 Exposure Point Concentrations

The EPC for each COPC present within an exposure medium (soil, surface water, and sediment) will be represented by the 95% UCL of the arithmetic mean concentration of the data set. For the total soil medium, all surface and subsurface soil sample results for IR Sites 34b and 34d (separately) will be used to calculate the 95% UCL for the COPC. Methods used to calculate 95% UCLs are based on guidance provided in the following documents *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (EPA 2002b) and *ProUCL Version 5.0.00 Technical Guide* (EPA 2013).

The ProUCL 5.0.00 statistical program will be used to estimate 95% UCL values for the COPC data sets, as appropriate. For data sets with non-detects, ProUCL uses the Kaplan-Meier estimation method to derive a recommended 95% UCL (EPA 2013). Where ProUCL recommends the results of more than one statistical approach, the most conservative (highest) 95% UCL value will be used in the HHRA. Where fewer than three samples have detected values, ProUCL does not recommend a 95% UCL value. In these cases, 95% UCL values will be derived using a bootstrap-t statistical program, described by Efron (1982) and discussed in EPA (1997a). Non-detect values are represented in this bootstrap-t program as random numbers between zero and the detection limit that are generated by the iterative process written into the program.

5.2 Exposure Pathways

Potentially impacted media at IR Sites 34b and 34d that will be quantified in the HHRA is limited to soil, and for IR Site 34d, surface water and sediment. The potential future exposure pathways at IR Sites 34b and 34d are briefly discussed below. The equations, exposure factors, and assumptions for the receptor exposures at IR Sites 34b and 34d are provided in RAGS-D Standard Table 4s (EPA 2001) (Tables C3 through C12), including default exposure factors from EPA (2011a and 2014a).

Currently, soil is exposed throughout IR Sites 34b and 34d, thus presenting a potential direct exposure pathway for future occupational workers exposed to surface soil, construction workers exposed to total soil, and hypothetical future residents exposed to total soil. As discussed

previously, potential current trespasser use of the Sites will be assessed in the HHRA uncertainty section. Exposure pathways include incidental ingestion, dermal absorption, and inhalation of particulates (and volatile compounds, if detected) released from soil to ambient air. Inhalation of volatile compounds in indoor air (via vapor intrusion[2], if volatile explosive compounds are detected in soil) will not be quantified. As construction and/or excavation might occur at IR Sites 34b and 34d, it is assumed that subsurface soil can be exposed. Future exposure pathways could therefore include direct contact with surface and subsurface soil by construction workers. Therefore, the surface (0 – 0.5 ft) and subsurface soil (0.5 - 10 ft) data sets will be combined in the risk assessment to evaluate exposure by construction workers. In addition, future exposure pathways could include exposure to COPCs in surface and subsurface soil by residential adults and children (assuming subsoil is exposed during hypothetical future home construction). Therefore, the surface (0 – 0.5 ft) and subsurface soil (0.5 - 10 ft) data sets will also be combined in the risk assessment to evaluate exposure by hypothetical future residents. The recommended depth intervals of 0 - 0.5 ft. and 0.5 – 10 ft. are from DTSC (2011).

Exposure factors and assumptions for these pathways are presented for the future occupational worker, future construction worker, and hypothetical future adult and child residents in Tables C3 through C12.

[2] Although the Johnson and Ettinger (1991) Vapor Intrusion Model does contain a component to estimate indoor air concentrations from soil, there are important uncertainties associated with this component of the Model, and therefore this potential pathway will not be quantified. These uncertainties will be discussed in the HHRA Uncertainty Section (if volatile compounds are detected).

Section 6 Toxicity Assessment

The methodologies used to develop toxicity factors differ depending on whether the chemical is a potential carcinogen or has non-cancer adverse effects. The most recently available toxicity factors recommended by California, and then as presented in USEPA's Integrated Risk Information System database will be used, followed by the hierarchy of sources from (EPA 2003a) to fill in missing values, summarized as follows:

- Tier 1 – California Office of Environmental Health Hazard Assessment (OEHHA) Toxicity Criteria Database (OEHHA 2014), for those chemicals listed for soil and water in California DTSC (2013).
- Tier 2 – Integrated Risk Information System (IRIS) (EPA 2014b).
- Tier 3 – Provisional Peer Reviewed Toxicity Values (PPRTVs) - as developed on a chemical-specific basis by the Office of Superfund Remediation and Technology Innovation (EPA 2014c), and as summarized on the EPA Regional SL Table (EPA 2014b).
- Tier 4 – Other Toxicity Values – including additional EPA and non-EPA sources of toxicity information, such as the Agency for Toxic Substances Disease Registry (ATSDR) Minimum Risk Levels (MRLs), and the Health Effects Assessment Summary Tables (HEAST) (EPA 1997b).

Quantitative oral toxicity criteria are not available for lead. EPA's Adult Lead Methodology (EPA 2003b), is typically used to evaluate risks associated with nonresidential adult exposures to lead in soil. The potential risks associated with residential exposures to lead will be addressed using the Integrated Exposure Uptake Biokinetic (IEUBK) Lead Model for Windows®, (EPA 1994, 2002d, 2010). The IEUBK model was designed to provide predictions of the probability of elevated blood lead levels for children. This model addresses three components of environmental risk assessments: the multimedia nature of exposures to lead, lead pharmacokinetics, and significant variability in exposure and risk, through estimation of probability distributions of blood lead levels for children exposed to similar environmental concentrations. The model output includes probability distribution plots, predicted geometric mean blood lead levels, and the percentages of the population potentially experiencing concentrations above 10 micrograms per deciliter (µg/dL) (below which adverse manifestations are not expected). The lead risks are considered unacceptable by EPA if the child-blood lead level for more than 5 percent of children is estimated to equal or exceed the Centers for Disease Control and Prevention (CDC) concern threshold of 10 µg/dL.

It should be noted that the CDC has recently recommended that the concern threshold be lowered to 5 µg/dL (CDC, 2012); however, EPA has not yet fully indorsed this value.

There are 210 individual compounds or "congeners" of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofuran (PCDFs). USEPA has developed procedures for assessing the cancer risks associated with exposure to the many PCDDs and PCDFs. These procedures are used to assess risk on the basis of the relative toxicity of 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD), which is the most toxic dioxin. Each congener has been assigned a value, referred to as a toxicity equivalency factor (TEF), which corresponds to its toxicity in relation to 2,3,7,8-TCDD. For example, 2,3,7,8-TCDD has a TEF of 1.0, and other PCDDs and PCDFs have TEFs between 0.0 and 1.0. USEPA's protocol guidance and other USEPA guidance recommend that risk assessments include all PCDDs or PCDFs with chlorine molecules substituted in the 2,3,7, and 8 positions. There are seventeen of these dioxin-like PCDDs and PCDFs that are considered in the analysis. TEF values for these seventeen congeners from Van den Berg et al. (2006) will be used in the HHRA.

The combined risk resulting from exposure to a mixture of the seventeen dioxin-like congeners will be computed using the TEFs with the assumption that the risks are cumulative. Results for 2,3,7,8-TCDD Toxicity Equivalent (TEQ) will be determined by y multiplying by the congener-specific TEF by the detected congener concentration(s) in each sample. Cancer risk on a 2,3,7,8-TCDD TEQ basis will be assessed using the cancer slope factor for 2,3,7,8-TCDD.

Section 7 Risk Characterization

Risk characterization for the HHRA will be presented as both quantitative and qualitative descriptions of exposure, land use, receptors, and risk/hazard.

For exposures to potential carcinogens, the individual upper-bound excess lifetime cancer risk will be calculated by multiplying the estimated ingestion or dermal dose by the upper-bound cancer slope factor (CSF), while inhalation risks will be estimated by multiplying the estimated concentration in air (adjusted for exposure, as shown in Tables C3, C4, C5, and C6) by the inhalation unit risk (IUR).

The approach of calculating carcinogenic risks by multiplying the dose by the CSF assumes that the increased risk of cancer resulting from exposure to a constituent is linearly proportional to the amount of chemical intake averaged over a lifetime. According to EPA (1989) risk assessment guidance, this approach is appropriate when the estimated carcinogenic risks calculated are less than 1E-2 (i.e., one excess cancer case per 100 people exposed). If the estimated risks are above 1E-2, the assumption of linearity is not valid. In such cases, the carcinogenic risks will be calculated using the following equation, per EPA risk assessment guidance (EPA 1989):

$$\text{Risk} = 1 - e^{(-\text{Dose} * \text{CSF})}$$

For noncarcinogens, potential adverse health effects for noncarcinogens will be calculated by means of the hazard index (HI) recommended by EPA (1989). The calculated dose divided by the reference dose (dose/RfD) will be derived for each chemical. For inhalation hazards, the HI will be estimated by dividing the estimated concentration in air (adjusted for exposure, as shown in Tables C3, C4, C5, and C6) by the reference concentration (RfC).

The cumulative cancer risk for each Site will be compared with EPA's risk range of 1E-6 to 1E-4 (EPA 1990). The cumulative HIs for non-cancer effects will be compared with a target HI of 1. HIs that exceed an HI of 1 will be further evaluated by target organ. Receptor populations with estimated risks greater than 1E-6 and estimated HIs greater than 1 will be identified in the HHRA.

As discussed in Section 3.5, organic compounds detected in surface water and/or sediment that are potentially related to an upstream source will be conservatively carried though the HHRA. However, at the conclusion of the HHRA, those non-site-related organics that may be found to be risk- or hazard-drivers in surface water and/or sediment will be identified and discussed in detail. If results of a weight-of-evidence evaluation suggest that these organics are not likely to

be site related (e.g., site concentrations are equal to or less than the upstream result and/or the organic was not detected in site soil) they will be dropped from further consideration.

Based on the results of the HHRA, a list of COCs will be developed for each Site. COCs will be defined as those chemicals that are present at concentrations exceeding a risk of 1E-6 and/or HI of 1 (EPA 1991), are not related to background or for surface water and sediment from IR Site 34d, are not related to an upstream source.

7.1 Uncertainties

Risk assessments involve the use of assumptions, judgments, and incomplete data to varying degrees that contribute to the uncertainty of the final estimates of risk. Uncertainties result both from the use of assumptions or models in lieu of actual data and from the error inherent in the estimation of risk related parameters and may cause risk to be overestimated or underestimated. Based on uncertainties, risk assessments should not be construed as presenting an absolute estimate of risk to persons potentially exposed to COPCs.

Consideration of the uncertainty attached to various aspects of the risk assessment allows better interpretation of the risk assessment results and understanding of the potential adverse effects on human health. In general, the primary sources of uncertainty are associated with environmental sampling and analysis, selection of chemicals for evaluation, toxicological data, exposure assessment, and background and/or upstream sources.

Future hypothetical residential exposure to total soil, assuming soil mixing during site redevelopment, is a standard default scenario discussed in Risk Assessment guidance and is recommended for the HHRA. However, as it is possible that hypothetical residential exposure to only surface soil may occur, this exposure pathway will be evaluated in the HHRA Report Uncertainty Section. This evaluation will be performed by comparing COPC concentrations in total soil and surface soil, and scaling risks and/or hazards, as appropriate.

Potential current trespass exposure will be semi-quantitatively evaluated in the HHRA by scaling the estimated future residential risks and hazards to determine the theoretical exposure frequency that would be needed to trigger an unacceptable risk and/or hazard for this receptor. If the estimated trespasser exposure frequency exceeds what might occur at the Sites, it will be concluded that this potential current receptor is of minimal concern. This approach is recommended due to the fact that an accurate exposure frequency cannot be determined for a hypothetical trespasser.

The quantification of the beef ingestion pathway is not appropriate for the Sites because the chemicals being analyzed in soil, and likely to be detected, are generally not considered to be important bioaccumulators in both plants and beef tissue. Although 2,3,7,8-TCDD TEQ is an

important bioaccumulator for the beef pathway, as dioxin/furans are not very water soluble, this compound would not be expected to bioaccumulate in plants growing on potentially impacted Site soil. However, future use of the Sites as grazing areas for cattle may be possible. For completeness, the beef ingestion pathway will be discussed in the HHRA Uncertainty Section.

There is currently no readily-available transport model to estimate potential exposure to soil vapor in a trench by construction workers, and this pathway is shown as incomplete in Figure 4 (although it is theoretically possible). It is believed potential future occupational worker exposure to soil vapors in ambient air (for 250 days a year for 25 years) may serve as a conservative surrogate for potential future construction worker exposure to sol vapors in trench air (for 125 days a year for 1 year), i.e., if occupational worker exposure to VOCs in ambient air is acceptable, then future construction worker exposure to VOCs in a trench would also be expected to be acceptable. The uncertainty associated with using this surrogate approach will be discussed in the HHRA Uncertainty Section of the completed report.

Special consideration will be included to address potential exposure to subsurface COPCs only, due to erosion, as the sites may be prone to this type of environmental disturbance for those portions of the sampled areas situated on a hillside. Although this scenario is considered unlikely (given an average annual precipitation at Fallbrook, California of approximately 16 inches), it is hypothetically possible that erosion of the top 0.5 ft. of soil (or more) could occur, resulting in future exposure to exposed subsurface soils. The potential risks and hazards associated with this scenario will be discussed in the HHRA Uncertainty Section of the completed report.

Detected compounds for which screening criteria are not available (and logical surrogates do not exist), will be qualitatively evaluated within the HHRA Uncertainty Section.

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Figures

Figure 1. Site Location Map
Figure 2. IR Site 34b Site Plan
Figure 3. IR Site 34d Site Plan
Figure 4. Human Health Conceptual Site Exposure Model

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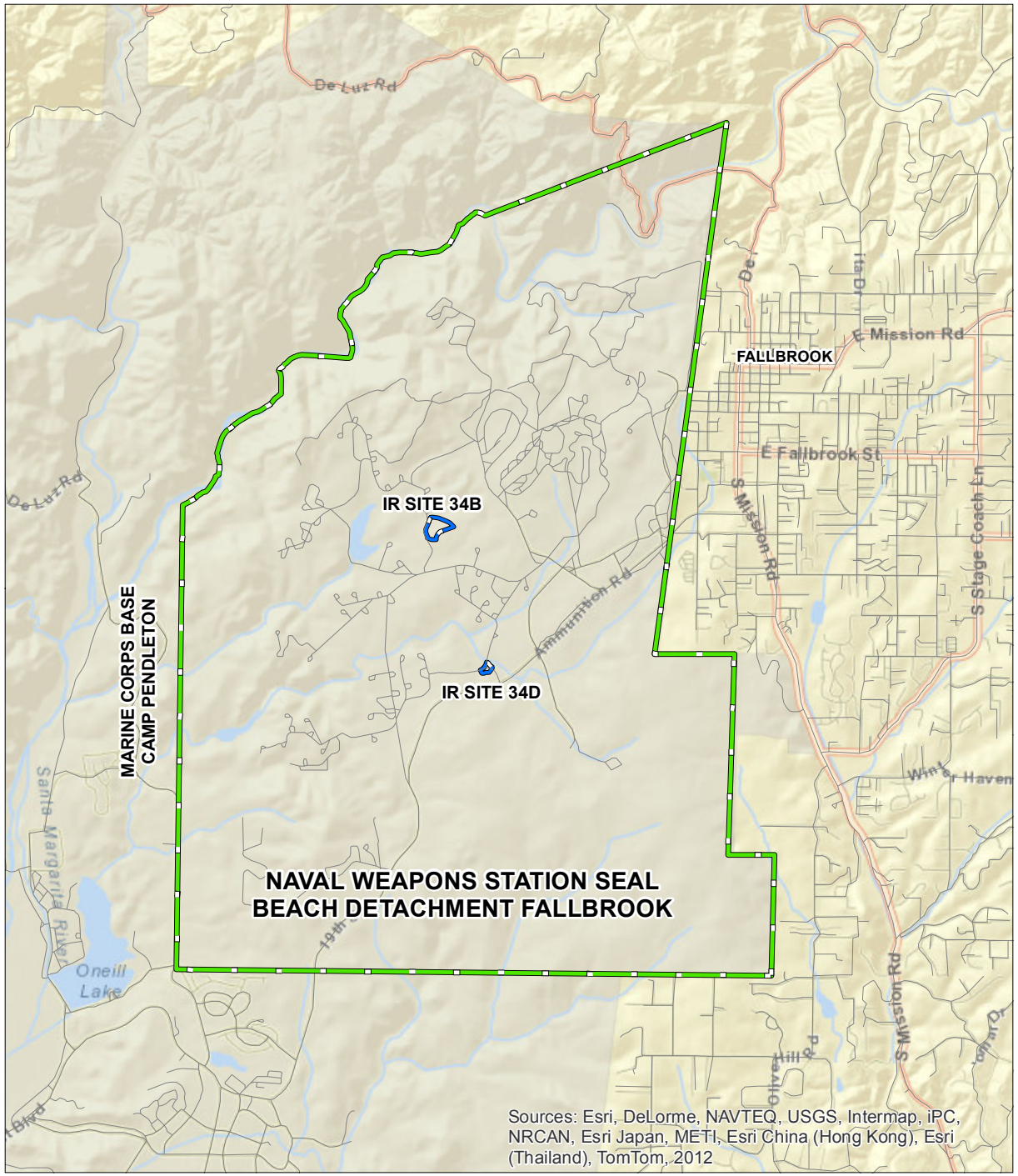
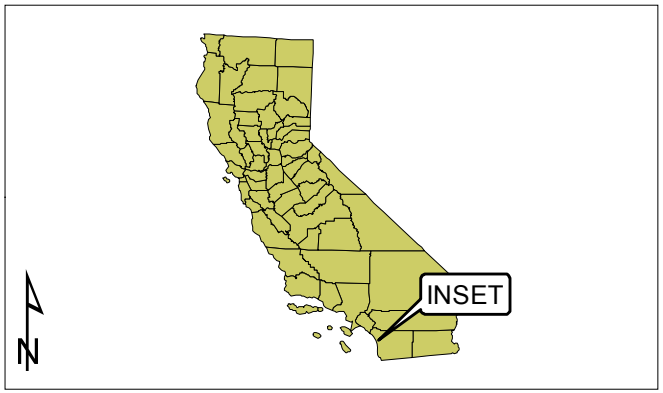
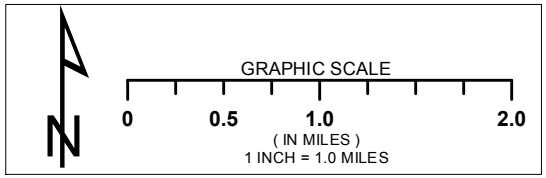




LEGEND

IR SITE BOUNDARY

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT FALLBROOK



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 1

SITE LOCATION MAP

TREVET

DATE: JULY 2014

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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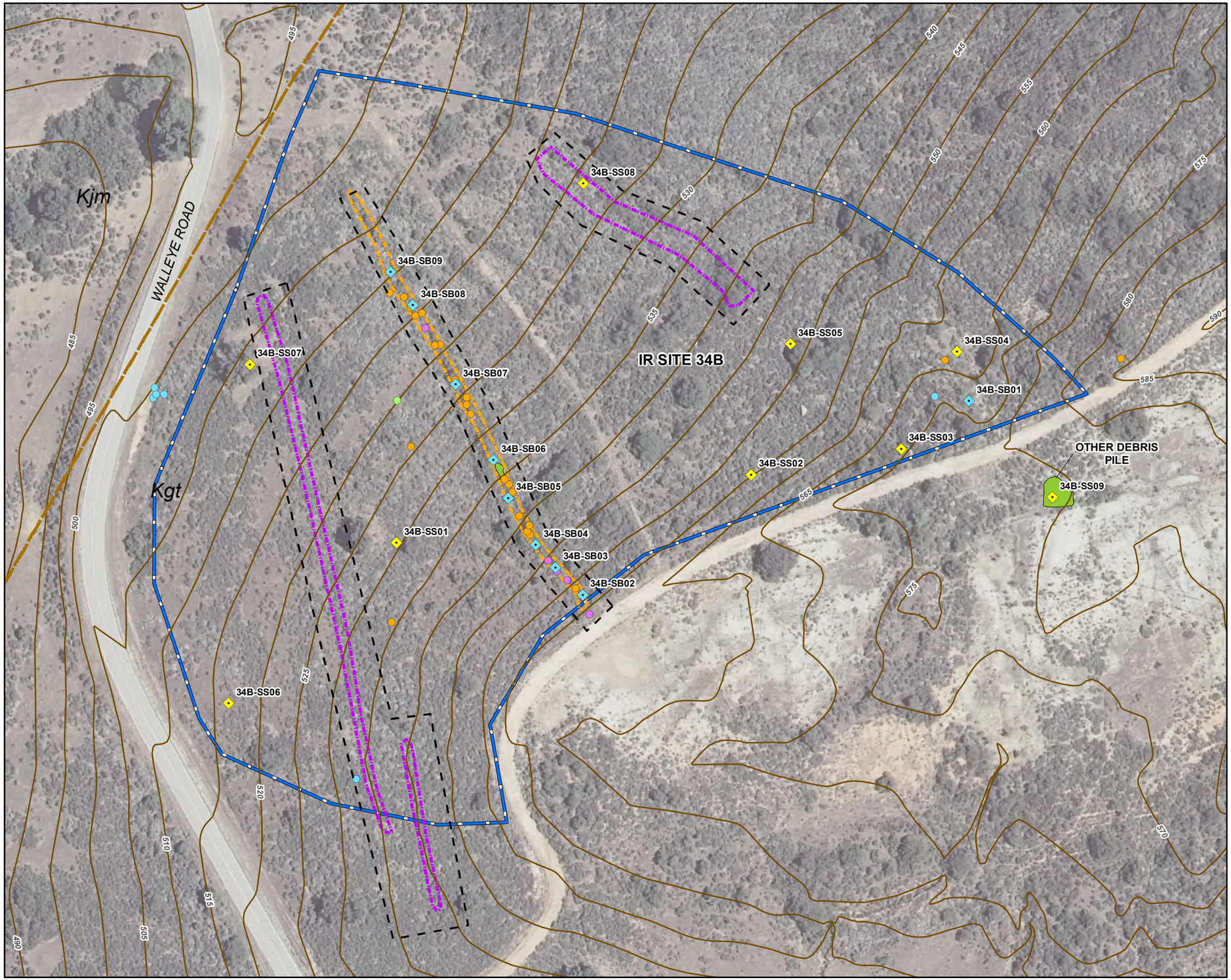

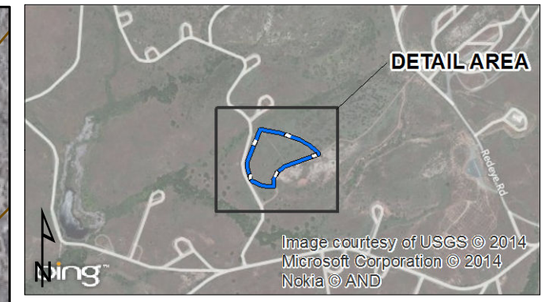

LEGEND

- MAGNETIC ANOMALIES
- METAL DEBRIS
- CONSTRUCTION DEBRIS
- OTHER DEBRIS
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- WASTE DISPOSAL TRENCH
- GEOLOGIC CONTACT
- TOPOGRAPHIC CONTOUR
- SUSPECTED WASTE DISPOSAL TRENCH
- GEOPHYSICAL INVESTIGATION AREA
- IR SITE 34B BOUNDARY

NOTES::
Kjm - METAVOLCANICS
Kgt - TONALITE

SOURCE:
GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 2

IR SITE 34B SITE PLAN

TREVET

DATE: JULY 2014

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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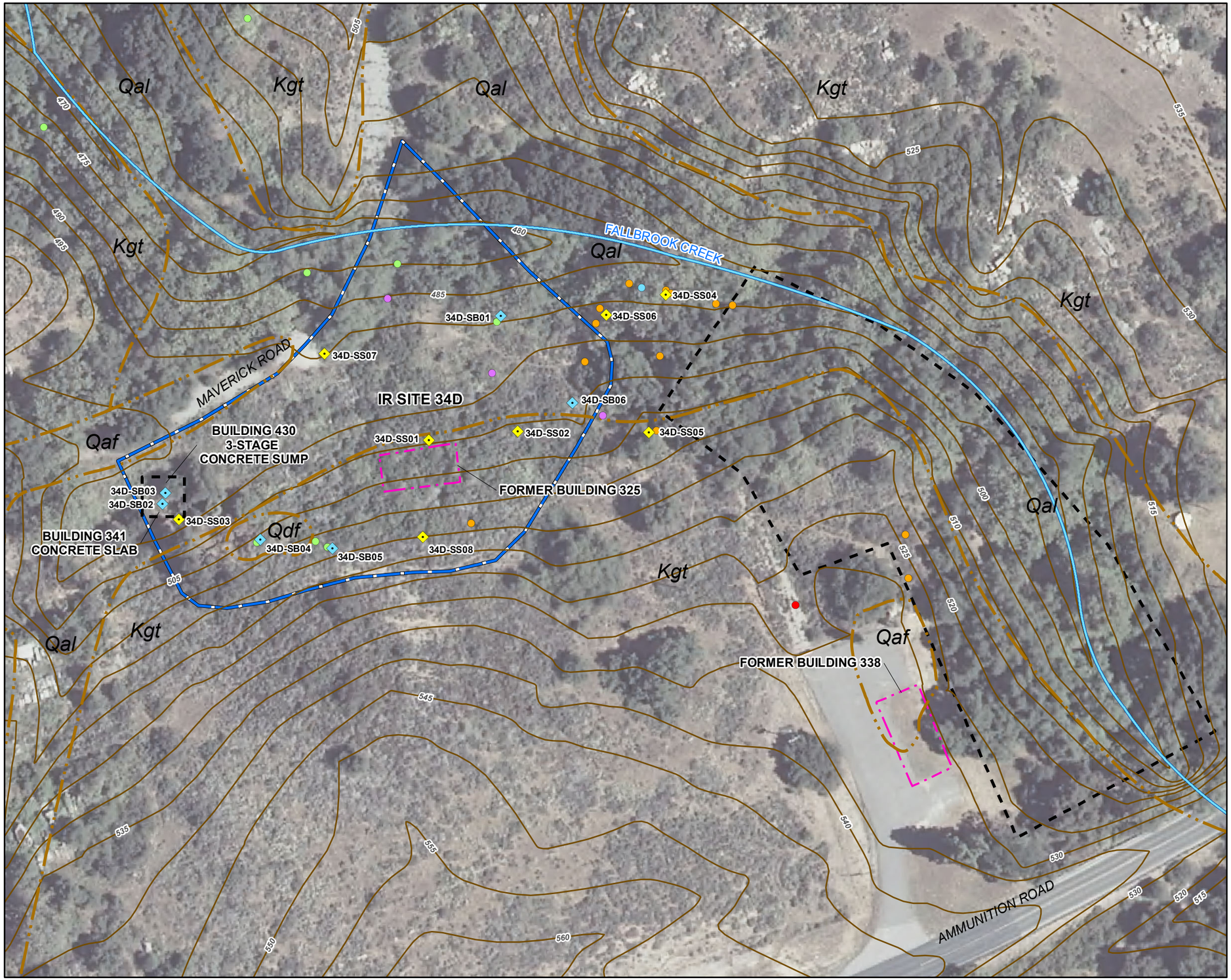

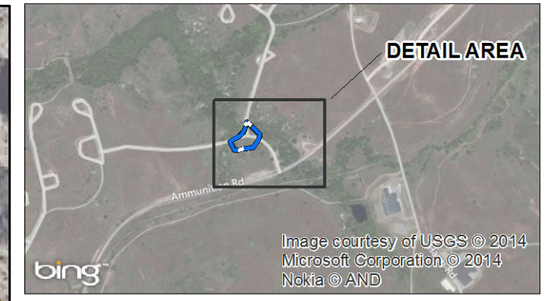

LEGEND

- MAGNETIC ANOMALIES
- 5.56-MM BLANK CASING
- METAL DEBRIS
- CONSTRUCTION DEBRIS
- OTHER DEBRIS
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- GEOLOGIC CONTACT (CHADUXTT 2010)
- TOPOGRAPHIC CONTOUR
- FORMER BUILDING
- GEOPHYSICAL INVESTIGATION AREA
- IR SITE34D BOUNDARY

NOTES:
Qdf - DEBRIS FILL
Qaf - ARTIFICIAL FILL
Qal - ALLUVIUM
Kgt - TONALITE

SOURCE:
GOOGLE MAPS AERIAL IMAGE

N

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA
NAVFAC Naval Facilities Engineering Command NAVFAC SOUTHWEST

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 3

IR SITE 34D SITE PLAN

TREVET

DATE: JULY 2014

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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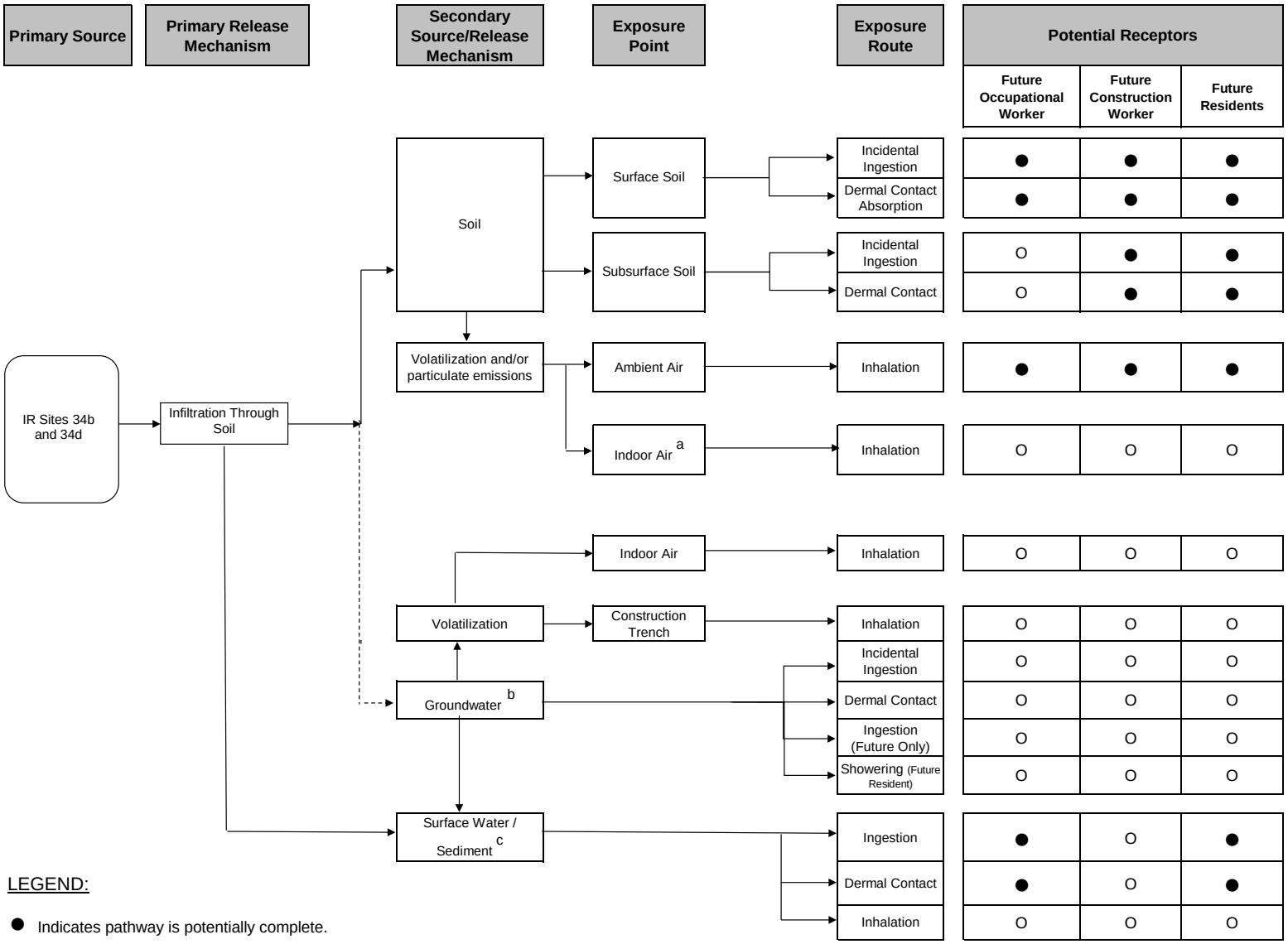
FIGURE 4
HUMAN HEALTH CONCEPTUAL SITE EXPOSURE MODEL
IR SITES 34b and 34d, NWS Fallbrook, California



LEGEND:

● Indicates pathway is potentially complete.

O Indicates pathway is incomplete.

- - - ▸ indicates transport pathway possible, however, see footnote "b"

Footnotes and Notes:

[a] No soil gas or indoor air sampling planned (no existing buildings at Sites).
[b] Groundwater sampling not planned (see text).
[c] IR Site 34d only (adjacent to Fallbrook Creek).
Surface Soil is 0-0.5 foot bgs soil interval; Subsurface Soil is vadose zone from 0.5 feet bgs to 10 feet.

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Tables

Table C1. **Human Health Risk Assessment Screening Levels for Soil, Surface Water, and Sediment**

Table C2. **Selection of Exposure Pathways**

Table C3. **Values Used for Daily Intake and Exposure Calculations – Future Exposures to Surface Soil – Occupational Worker**

Table C4. **Values Used for Daily Intake and Exposure Calculations – Future Exposures to Total Soil – Construction Worker**

Table C5. **Values Used for Daily Intake and Exposure Calculations – Future Exposures to Total Soil – Residential Adult**

Table C6. **Values used for Daily Intake and Exposure Calculations – Future Exposures to Total Soil – Residential Child**

Table C7. **Values used for Daily Intake and Exposure Calculations – Future Exposures to On-Site Surface Water – Occupational Worker**

Table C8. **Values used for Daily Intake and Exposure Calculations – Future Exposures to On-Site Surface Water – Residential Adult**

Table C9. **Values used for Daily Intake and Exposure Calculations – Future Exposures to On-Site Surface Water – Residential Child**

Table C10. **Values used for Daily Intake and Exposure Calculations – Future Exposures to On-Site Sediment– Occupational Worker**

Table C11. **Values used for Daily Intake and Exposure Calculations – Future Exposures to On-Site Sediment – Residential Adult**

Table C12. **Values used for Daily Intake and Exposure Calculations – Future Exposures to On-Site Sediment – Residential Child**

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Table C1.
Human Health Risk Assessment Screening Levels for Soil, Surface Water, and Sediment
NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Analyte	CAS	Tap-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes	Soil r-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes
		RSL	Cancer / Non-cancer			RSL	Cancer / Non-cancer		
1,1,1-Trichloroethane	71-55-6	8000	N	ug/L		8100	N	mg/kg	
1,1,2,2-Tetrachloroethane	79-34-5	0.076	C	ug/L		0.6	C	mg/kg	
1,1,2-Trichloroethane	79-00-5	0.28	C	ug/L		1.1	C	mg/kg	
1,1-Dichloroethane	75-34-3	2.7	C	ug/L		3.6	C	mg/kg	
1,1-Dichloroethene	75-35-4	280	N	ug/L		230	N	mg/kg	
1,2,4-Trimethylbenzene	95-63-6	15	N	ug/L		58	N	mg/kg	
1,2-Dichloropropane	78-87-5	0.44	C	ug/L		1	C	mg/kg	
1,3,5-Trimethylbenzene	108-67-8	12.3	N	ug/L	Cal Modified PRG	21.3	N	mg/kg	Cal Modified PRG
2-Butanone	78-93-3	5600	N	ug/L		27000	N	mg/kg	
2-Hexanone	591-78-6	38	N	ug/L		200	N	mg/kg	
Methyl Isobutyl Ketone	108-10-1	1200	N	ug/L		5300	N	mg/kg	
Acetone	67-64-1	14000	N	ug/L		61000	N	mg/kg	
Benzene	71-43-2	0.45	C	ug/L		1.2	C	mg/kg	
Bromodichloromethane	75-27-4	0.13	C	ug/L		0.29	C	mg/kg	
Bromoform	75-25-2	9.2	C	ug/L		67	C	mg/kg	
Bromomethane	74-83-9	7.5	N	ug/L		6.8	N	mg/kg	
Carbon disulfide	75-15-0	810	N	ug/L		770	N	mg/kg	
Carbon tetrachloride	56-23-5	0.45	C	ug/L		0.65	C	mg/kg	
Chlorobenzene	108-90-7	78	N	ug/L		280	N	mg/kg	
Dibromochloromethane	124-48-1	0.17	C	ug/L		0.73	C	mg/kg	
Chloroethane	75-00-3	21000	N	ug/L		14000	N	mg/kg	
Chloroform	67-66-3	0.22	C	ug/L		0.32	C	mg/kg	
Chloromethane	74-87-3	190	N	ug/L		110	N	mg/kg	
cis-1,2-Dichloroethene	156-59-2	36	N	ug/L		160	N	mg/kg	
cis-1,3-Dichloropropene	10061-01-5	0.47	C	ug/L	use 1,3-Dichloropropene	1.8	C	mg/kg	use 1,3-Dichloropropene
Ethylbenzene	100-41-4	1.5	C	ug/L		5.8	C	mg/kg	
Isopropyl benzene	98-82-8	450	N	ug/L		1900	N	mg/kg	
m/p-Xylenes	136777-61-2	190	N	ug/L	use xylenes	550	N	mg/kg	use m-xylene
Methylene chloride	75-09-2	4.3	C	ug/L	Cal Modified PRG	9.1	C	mg/kg	Cal Modified PRG
n-Butylbenzene	104-51-8	1000	N	ug/L		580	N	mg/kg	Cal Modified PRG
n-Propylbenzene	103-65-1	660	N	ug/L		3300	N	mg/kg	
o-Xylene	95-47-6	190	N	ug/L		650	N	mg/kg	
p-Isopropyltoluene	99-87-6	NVA				NVA			
sec-Butylbenzene	135-98-8	240	N	ug/L	Cal Modified PRG	450	N	mg/kg	Cal Modified PRG
Styrene	100-42-5	1200	N	ug/L		6000	N	mg/kg	
tert-Butylbenzene	98-06-6	240	N	ug/L	Cal Modified PRG	530	N	mg/kg	Cal Modified PRG
Tetrachloroethylene	127-18-4	0.1	C	ug/L	Cal Modified PRG	0.48	C	mg/kg	Cal Modified PRG
Toluene	108-88-3	1100	N	ug/L		4900	N	mg/kg	
trans-1,2-Dichloroethene	156-60-5	360	N	ug/L		1600	N	mg/kg	
trans-1,3-Dichloropropene	10061-02-6	0.47	C	ug/L	use 1,3-Dichloropropene	1.8	C	mg/kg	use 1,3-Dichloropropene
Trichloroethene	79-01-6	0.49	C	ug/L		0.94	C	mg/kg	
Vinyl chloride	75-01-4	0.019	C	ug/L		0.059	C	mg/kg	

1,2,4,5-Tetrachlorobenzene	95-94-3	1.7	N	ug/L		18	N	mg/kg	
1,2,4-Trichlorobenzene	120-82-1	1.1	C	ug/L		24	C	mg/kg	
1,2-Dichlorobenzene	95-50-1	300	N	ug/L		1800	N	mg/kg	

Table C1.
Human Health Risk Assessment Screening Levels for Soil, Surface Water, and Sediment
NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Analyte	CAS	Tap-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes	Soil r-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes
		RSL	Cancer / Non-cancer			RSL	Cancer / Non-cancer		
1,3-Dichlorobenzene	541-73-1	180	N	ug/L	Cal Modified PRG	530	N	mg/kg	Cal Modified PRG
1,4-Dichlorobenzene	106-46-7	0.48	C	ug/L		2.6	C	mg/kg	
2,2-Oxybis (1-Chloropropane)	108-60-1	0.36	C	ug/L		4.9	C	mg/kg	
2,4,5-Trichlorophenol	95-95-4	1200	N	ug/L		6200	N	mg/kg	
2,4,6-Trichlorophenol	88-06-2	4	C	ug/L		48	C	mg/kg	
2,4-Dichlorophenol	120-83-2	46	N	ug/L		180	N	mg/kg	
2,4-Dimethylphenol	105-67-9	360	N	ug/L		1200	N	mg/kg	
2,4-Dinitrophenol	51-28-5	39	N	ug/L		120	N	mg/kg	
2,4-Dinitrotoluene	121-14-2	0.24	C	ug/L		1.7	C	mg/kg	
2,6-Dichlorophenol	87-65-0	46	N	ug/L	use 2,4-Dichlorophenol	180	N	mg/kg	use 2,4-Dichlorophenol
2-Chloronaphthalene	91-58-7	750	N	ug/L		6300	N	mg/kg	
2-Chlorophenol	95-57-8	91	N	ug/L		63	N	mg/kg	Cal Modified PRG
2-Methylphenol	95-48-7	930	N	ug/L		3100	N	mg/kg	
2-Nitroaniline	88-74-4	190	N	ug/L		610	N	mg/kg	
2-Nitrophenol	88-75-5	NVA				NVA			
3,3'-Dichlorobenzidine	91-94-1	0.12	C	ug/L		1.2	C	mg/kg	
3,3'-Dimethylbenzibine	119-93-7	0.0065	C	ug/L		0.048	C	mg/kg	
3.4-Methylphenol	106-44-5	1900	N	ug/L		6200	N	mg/kg	
3-Nitroaniline	99-09-2	3.2	C	ug/L	Cal Modified PRG	18	N	mg/kg	Cal Modified PRG
4,6-Dinitro-2-methylphenol	534-52-1	1.5	N	ug/L		4.9	N	mg/kg	
4-Bromophenyl-phenyl ether	101-55-3	NVA				NVA			
4-Chloro-3-methylphenol	59-50-7	1400	N	ug/L		6200	N	mg/kg	
4-Chloroaniline	106-47-8	0.36	C	ug/L		2.7	C	mg/kg	
4-Chlorophenyl-phenyl ether	7005-72-3	NVA				NVA			
4-Nitroaniline	100-01-6	3.8	C	ug/L		27	C	mg/kg	
4-Nitrophenol	100-02-7	NVA				NVA			
5-Nitro-o-toluidine	99-55-8	8.1	C	ug/L		59	C	mg/kg	
A,A-Dimethylphenethylamine	122-09-8	NVA				NVA			
Acenaphthene	83-32-9	530	N	ug/L		3500	N	mg/kg	
Acetophenone	98-86-2	1900	N	ug/L		7800	N	mg/kg	
Aniline	62-53-3	13	C	ug/L		93	C	mg/kg	
Aramite	140-57-8	1.3	C	ug/L		21	C	mg/kg	
Benzo(a)anthracene	56-55-3	0.034	C	ug/L		0.15	C	mg/kg	
Benzo(a)pyrene	50-32-8	0.0034	C	ug/L		0.015	C	mg/kg	
Benzo(b)fluoranthene	205-99-2	0.034	C	ug/L		0.15	C	mg/kg	
Benzo(g,h,i)perylene	191-24-2	120	N	ug/L	use pyrene	1700	N	mg/kg	use pyrene
Benzo(k)fluoranthene	207-08-9	0.056	C	ug/L	Cal Modified PRG	0.38	C	mg/kg	Cal Modified PRG
Benzyl alcohol	100-51-6	2000	N	ug/L		6200	N	mg/kg	
bis(2-Chloroethoxy)methane	111-91-1	59	N	ug/L		180	N	mg/kg	
bis(2-Chloroethyl)ether	111-44-4	0.014	C	ug/L		0.23	C	mg/kg	
Bis(2-ethylhexyl)phthalate	117-81-7	5.6	C	ug/L		38	C	mg/kg	
Butylbenzylphthalate	85-68-7	16	C	ug/L		280	C	mg/kg	
Chlorobenzilate	510-15-6	0.31	C	ug/L		4.8	C	mg/kg	
Chrysene	218-01-9	0.56	C	ug/L	Cal Modified PRG	3.8	C	mg/kg	Cal Modified PRG
Diallate	2303-16-4	0.52	C	ug/L		8.7	C	mg/kg	

Table C1.
Human Health Risk Assessment Screening Levels for Soil, Surface Water, and Sediment
NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Analyte	CAS	Tap-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes	Soil r-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes
		RSL	Cancer / Non-cancer			RSL	Cancer / Non-cancer		
Dibenzo(a,h)anthracene	53-70-3	0.0034	C	ug/L		0.015	C	mg/kg	
Dibenzofuran	132-64-9	7.9	N	ug/L		72	N	mg/kg	
Diethylphthalate	84-66-2	15000	N	ug/L		49000	N	mg/kg	
Dimethylphthalate	131-11-3	360000	N	ug/L	Cal Modified PRG	150000	N	mg/kg	Cal Modified PRG
Di-n-butylphthalate	84-74-2	900	N	ug/L		6200	N	mg/kg	
Di-n-octylphthalate	117-84-0	200	N	ug/L		620	N	mg/kg	
Fluoranthene	206-44-0	800	N	ug/L		2300	N	mg/kg	
Fluorene	86-73-7	290	N	ug/L		2300	N	mg/kg	
Hexachlorobenzene	118-74-1	0.049	C	ug/L		0.33	C	mg/kg	
Hexachlorobutadiene	87-68-3	0.3	C	ug/L		6.8	C	mg/kg	
Hexachlorocyclopentadiene	77-47-4	31	N	ug/L		370	N	mg/kg	
Hexachloroethane	67-72-1	0.9	C	ug/L		13	C	mg/kg	
Indeno(1,2,3-cd)pyrene	193-39-5	0.034	C	ug/L		0.15	C	mg/kg	
Isophorone	78-59-1	78	C	ug/L		560	C	mg/kg	
Kepone	143-50-0	0.0035	C	ug/L		0.053	C	mg/kg	
Naphthalene	91-20-3	0.17	C	ug/L		3.8	C	mg/kg	
N-Nitroso-di-n-butylamine	924-16-3	0.0027	C	ug/L		0.094	C	mg/kg	
N-Nitrosodimethylamine	62-75-9	0.00049	C	ug/L		0.0023	C	mg/kg	
N-Nitroso-di-n-propylamine	621-64-7	0.011	C	ug/L		0.076	C	mg/kg	
N-Nitrosomethylethylamine	10595-95-6	0.0035	C	ug/L		0.024	C	mg/kg	
N-Nitrosopyrrolidine	930-55-2	0.037	C	ug/L		0.25	C	mg/kg	
O-toluidine	95-53-4	2.5	C	ug/L	use p-toluidine	18	C	mg/kg	use p-toluidine
Pentachlorobenzene	608-93-5	3.2	N	ug/L		49	N	mg/kg	
Pentachloroethane	76-01-7	0.64	C	ug/L		5.9	C	mg/kg	
Pentachloronitrobenzene	82-68-8	0.12	C	ug/L		2	C	mg/kg	
Pentachlorophenol	87-86-5	0.04	C	ug/L		0.99	C	mg/kg	
Phenanthrene	85-01-8	120	N	ug/L	use pyrene	1700	N	mg/kg	use pyrene
Phenol	108-95-2	5800	N	ug/L		18000	N	mg/kg	
Pronamide	23950-58-5	1200	N	ug/L		4600	N	mg/kg	
Pyrene	129-00-0	120	N	ug/L		1700	N	mg/kg	
Pyridine	110-86-1	20	N	ug/L		78	N	mg/kg	
Aluminum	7429-90-5	20000	N	ug/L		77000	N	mg/kg	
Antimony	7440-36-0	7.8	N	ug/L		31	N	mg/kg	
Arsenic	7440-38-2	0.0071	C	ug/L	Cal Modified PRG	0.062	C	mg/kg	Cal Modified PRG
Barium	7440-39-3	3800	N	ug/L		15000	N	mg/kg	
Beryllium	7440-41-7	25	N	ug/L		16	N	mg/kg	Cal Modified PRG
Boron	7440-42-8	4000	N	ug/L		16000	N	mg/kg	
Cadmium	7440-43-9	9.2	N	ug/L		4	N	mg/kg	Cal Modified PRG
Calcium	7440-70-2	NVA			Nutrient	NVA			Nutrient
Chromium	7440-47-3	22000	N	ug/L	use Chromium(III), Insoluble Salts	120000	N	mg/kg	use Chromium(III), Insoluble Salts
Cobalt	7440-48-4	6	N	ug/L		23	N	mg/kg	
Copper	7440-50-8	800	N	ug/L		3100	N	mg/kg	
Iron	7439-89-6	14000	N	ug/L		55000	N	mg/kg	
Lead	7439-92-1	15		ug/L	Action Level at Tap	80		mg/kg	Cal DTSC

Table C1.
Human Health Risk Assessment Screening Levels for Soil, Surface Water, and Sediment
NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Analyte	CAS	Tap-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes	Soil r-RSL (EPA May 2014 [CR=1E-6; HQ=1])		Units	Notes
		RSL	Cancer / Non-cancer			RSL	Cancer / Non-cancer		
Magnesium	7439-95-4	NVA			Nutrient	NVA			Nutrient
Manganese	7439-96-5	430	N	ug/L		1800	N	mg/kg	
Molybdenum	7439-98-7	100	N	ug/L		390	N	mg/kg	
Nickel	7440-02-0	390	N	ug/L		1500	N	mg/kg	
Potassium	7440-09-7	NVA			Nutrient	NVA			Nutrient
Selenium	7782-49-2	100	N	ug/L		390	N	mg/kg	
Silica		NVA				NVA			
Silver	7440-22-4	94	N	ug/L		390	N	mg/kg	
Sodium	7440-23-5	NVA			Nutrient	NVA			Nutrient
Thallium	7440-28-0	0.2	N	ug/L		0.78	N	mg/kg	
Vanadium	7440-62-2	86	N	ug/L		390	N	mg/kg	
Zinc	7440-66-6	6000	N	ug/L		23000	N	mg/kg	
Mercury	7439-97-6	0.63	N	ug/L	use Mercury (elemental)	9.4	N	mg/kg	use Mercury (elemental) [note: use methyl mercury value of 7.8 mg/kg for sediment screening]
Hexavalent Chromium	18540-29-9	0.035	C	ug/L		0.3	C	mg/kg	
2378-TCDD	1746-01-6	0.0000006	C	ug/L		4.90E-06	C	mg/kg	N/A
12378-PeCDD	40321-76-4	N/A				4.90E-06	C	mg/kg	TCDD-TEQ
123478-HxCDD	39227-28-6	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
123678-HxCDD	57653-85-7	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
123789-HxCDD	19408-74-3	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
1234678-HpCDD	35822-46-9	N/A				4.90E-04	C	mg/kg	TCDD-TEQ
OCDD	3268-87-9	N/A				1.63E-02	C	mg/kg	TCDD-TEQ
2378-TCDF	51207-31-9	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
12378-PeCDF	57117-41-6	N/A				1.63E-04	C	mg/kg	TCDD-TEQ
23478-PeCDF	57117-31-4	N/A				1.63E-05	C	mg/kg	TCDD-TEQ
123478-HxCDF	70648-26-9	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
123678-HxCDF	57117-44-9	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
123789-HxCDF	72918-21-9	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
234678-HxCDF	60851-34-5	N/A				4.90E-05	C	mg/kg	TCDD-TEQ
1234678-HpCDF	67562-39-4	N/A				4.90E-04	C	mg/kg	TCDD-TEQ
1234789-HpCDF	55673-89-7	N/A				4.90E-04	C	mg/kg	TCDD-TEQ
OCDF	39001-02-0	N/A				1.63E-02	C	mg/kg	TCDD-TEQ

RSL = EPA Regional Screening Level (Human Health)
CR = Cancer Risk; HQ = Hazard Quotient
Soil r = Residential Scenario; Tap = Tap water scenario (conservatively used for surface water)
Soil screening levels conservatively used for sediment exposure (except for mercury).
Cal = California; PRG = Preliminary Remediation Goal; DTSC = Cal Dept of Toxic Substances Control (HHRA Note No. 3, 2013)
TEQ = Toxicity Equivalent (individual congener values estimated using TEFs for 2,3,7,8-TCDD)
TEF = toxicity equivalency factor
N/A = not applicable (D/F not recommended for analysis in surface water due to low solubility)
NVA = No value available.

Table C2
Selection of Exposure Pathways
IR Sites 34b and 34d - NWS Seal Beach Detachment Fallbrook, Fallbrook California

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	All	All	IR Sites 34b and 34d	All	Adult, Child	All	None	There are no structures at the Sites, the area is fenced, and the land is not used; therefore, no current receptors exist.
Future	Surface Soil	Surface Soil	IR Sites 34b and 34d	Occupational Worker	Adult	Incidental ingestion	Quantitative	Workers could contact surface soil at IR Sites 34b and 34d and be exposed to COPCs via incidental ingestion.
						Dermal	Quantitative	Workers could contact surface soil at IR Sites 34b and 34d and be exposed to COPCs via dermal absorption.
				Trespassers	Adult or Child	Incidental ingestion	None	Trespassers would be expected to have lower exposure than occupational worker
						Dermal	None	Trespassers would be expected to have lower exposure than occupational worker
				Maintenance Worker	Adult	Incidental ingestion	None	Maintenance workers would be expected to have lower exposure than occupational worker
						Dermal	None	Maintenance workers would be expected to have lower exposure than occupational worker
		Air	Particulates/volatiles released from surface soil at IR Sites 34b and 34d to ambient air	Occupational Worker	Adult	Inhalation	Quantitative	Workers could be exposed to particulate COPCs released from surface soil at IR Sites 34b and 34d, or to volatile compounds released from total soil.
				Trespasser	Adult or Child	Inhalation	None	Trespassers would be expected to have lower exposure than occupational worker
				Maintenance Worker	Adult	Inhalation	None	Maintenance workers would be expected to have lower exposure than occupational worker
			Indoor Air	Occupational Worker	Adult	Inhalation	None	There are currently no structures on IR Sites 34b and 34d, and no soil gas sampling is planned.
	Groundwater	Groundwater	IR Sites 34b and 34d	Occupational Worker	Adult	Ingestion, Dermal	None	Groundwater sampling is not planned.
	Subsurface Soil	Subsurface Soil	IR Sites 34b and 34d	Occupational Worker	Adult	Ingestion, Dermal	None	Workers do not have direct exposure to subsurface soil
	Total Soil (Surface and Subsurface soil)	Total Soil	IR Sites 34b and 34d	Construction Worker	Adult	Incidental ingestion	Quantitative	Construction workers could contact total soil at IR Sites 34b and 34d and be exposed to COPCs via incidental ingestion.
						Dermal	Quantitative	Construction workers could contact total soil at IR Sites 34b and 34d and be exposed to COPCs via dermal absorption.
		Air	Particulates/volatiles released from total soil at IR Sites 34b and 34d	Construction Worker	Adult	Inhalation	Quantitative	Construction workers could be exposed to particulate COPCs or to volatile compounds released from total soil.
			Volatiles from total soil migrating into indoor air	Occupational Worker	Adult	Inhalation	None	There are currently no structures on IR Sites 34b and 34d, and no soil gas sampling is planned.
				Construction Worker	Adult	Inhalation	None	Construction workers are not expected indoors.
	Groundwater	Groundwater	IR Sites 34b and 34d	Construction Worker	Adult	Incidental ingestion	None	Due to the depth of the groundwater at the site, potential future construction/utility workers would not contact the water table during excavation, construction, or utility-related activities in a trench or pit. Therefore, exposures to COPCs in groundwater via incidental ingestion from splashing and hand-to-mouth contact are not expected. Also, groundwater sampling is not planned.

Table C2
Selection of Exposure Pathways
IR Sites 34b and 34d - NWS Seal Beach Detachment Fallbrook, Fallbrook California

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	IR Sites 34b and 34d	Construction Worker	Adult	Dermal	None	Due to the depth of the groundwater at the site, potential future construction/utility workers would not contact the water table during excavation, construction, or utility-related activities in a trench or pit. Therefore, exposures to COPCs in groundwater by dermal absorption are not expected. Also, groundwater sampling is not planned.
		Groundwater	IR Sites 34b and 34d	Residential	Adults and Children	Inhalation	None	Groundwater sampling is not planned.
		Air	Indoor Air	Construction Worker	Adult	Inhalation	None	Construction work is outdoors and workers would not spend a significant amount of work time in future hypothetical structures on IR Sites 34b and 34d. Also, groundwater sampling is not planned.
			Trench Vapors	Construction Worker	Adult	Inhalation	None	Groundwater sampling is not planned.
	Surface Water	Fallbrook Creek	IR Sites 34d	Occupational Worker	Adult	Incidental ingestion	Quantitative	Workers could contact surface water in Creek adjacent to IR Site 34d.
						Dermal	Quantitative	Workers could contact surface water in Creek adjacent to IR Site 34d.
	Sediment	Fallbrook Creek	IR Sites 34d	Occupational Worker	Adult	Incidental ingestion	Quantitative	Workers could contact sediment in Creek adjacent to IR Site 34d.
						Dermal	Quantitative	Workers could contact sediment in Creek adjacent to IR Site 34d.
	Total Soil (Surface and Subsurface soil)	Total Soil	IR Sites 34b and 34d	Residential	Adult	Incidental ingestion	Quantitative	Residents could be exposed to COPCs in total soil at IR Sites 34b and 34d via incidental ingestion.
						Dermal	Quantitative	Residents could be exposed to COPCs in total soil at IR Sites 34b and 34d via dermal contact.
					Child	Incidental ingestion	Quantitative	Residents could be exposed to COPCs in total soil at IR Sites 34b and 34d via incidental ingestion.
						Dermal	Quantitative	Residents could contact total soil at IR Sites 34b and 34d and be exposed to COPCs via dermal contact.
		Air	Particulates/volatiles released from total soil at IR Sites 34b and 34d	Residential	Adult	Inhalation	Quantitative	Residents could be exposed to particulate COPCs released from total soil at IR Sites 34b and 34d, or volatile compounds released from total soil.
					Child	Inhalation	Quantitative	Residents could be exposed to particulate COPCs released from total soil at IR Sites 34b and 34d, or volatile compounds released from total soil.
			Volatiles from total soil migrating into indoor air	Residential	Adult	Inhalation	None	There are currently no structures on IR Sites 34b and 34d, and no soil gas sampling is planned.
					Child	Inhalation	None	There are currently no structures on IR Sites 34b and 34d, and no soil gas sampling is planned.

Table C2
Selection of Exposure Pathways
IR Sites 34b and 34d - NWS Seal Beach Detachment Fallbrook, Fallbrook California

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	IR Sites 34b and 34d	Residential	Adult	Incidental ingestion	None	Groundwater sampling is not planned.
						Dermal	None	Groundwater sampling is not planned.
					Child	Incidental ingestion	None	Groundwater sampling is not planned.
						Dermal	None	Groundwater sampling is not planned.
		Air	Indoor Vapors	Occupational Worker	Adult	Inhalation	None	Groundwater sampling is not planned.
				Residential	Adult	Inhalation	None	Groundwater sampling is not planned.
					Child	Inhalation	None	Groundwater sampling is not planned.
			Household Use of	Residential	Adult	Inhalation	None	Groundwater sampling is not planned.
					Child	Inhalation	None	Groundwater sampling is not planned.
	Surface Water	Fallbrook Creek	IR Sites 34d	Residential	Adult	Incidental ingestion	Quantitative	Residents could contact surface water in Creek adjacent to IR Site 34d.
						Dermal	Quantitative	Residents could contact surface water in Creek adjacent to IR Site 34d.
					Child	Incidental ingestion	Quantitative	Residents could contact surface water in Creek adjacent to IR Site 34d.
						Dermal	Quantitative	Residents could contact surface water in Creek adjacent to IR Site 34d.
	Sediment	Fallbrook Creek	IR Sites 34d	Residential	Adult	Incidental ingestion	Quantitative	Residents could contact sediment in Creek adjacent to IR Site 34d.
						Dermal	Quantitative	Residents could contact sediment in Creek adjacent to IR Site 34d.
					Child	Incidental ingestion	Quantitative	Residents could contact sediment in Creek adjacent to IR Site 34d.
						Dermal	Quantitative	Residents could contact sediment in Creek adjacent to IR Site 34d.

Note: HHRA risk and hazards will be assessed separately for each Site.

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Table C3
Values Used for Daily Intake and Exposure Calculations - Future Exposures to Surface Soil - Occupational Worker
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, CA

Scenario Timeframe:	Future
Medium:	Surface Soi
Exposure Medium:	Surface Soi
Exposure Point:	Surface Soil
Receptor Population:	Occupational Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	100	USEPA, 2002	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	5,700	DTSC (2011)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2	0.2	DTSC (2011)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2004	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(1)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	0.33	8 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	250	USEPA, 2002	AT
	ED	Exposure Duration	years	25	USEPA, 2002	(2)
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED	

Notes:

(1) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).

Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3).

(2) RAGS-F (USEPA, 2009).

Sources:

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C4
Values Used for Daily Intake and Exposure Calculations - Future Exposures to Total Soil - Construction Worker
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Total Soil
Exposure Medium:	Total Soil
Exposure Point:	Total Soil
Receptor Population:	Construction Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	330	USEPA, 2002	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	125	Assumed	
	ED	Exposure Duration	years	1	(1)	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	365	Based on ED	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	5,700	DTSC (2011)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2	0.8	DTSC (2011)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	125	Assumed	
	ED	Exposure Duration	years	1	(1)	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	365	Based on ED	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(2)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	0.33	8 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	125	Assumed	AT
	ED	Exposure Duration	years	1	(1)	(3)
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	365	Based on ED	

Notes:

(1) Based on assumed one-time construction project lasting 125 days.

(2) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).

Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3)

(3) RAGS-F (USEPA, 2009).

Sources:

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24

USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final

USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.

USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.

California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C5
Values Used for Daily Intake and Exposure Calculations - Future Exposures to Total Soil - Residential Adult
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Total Soil
Exposure Medium:	Total Soil
Exposure Point:	Total Soil
Receptor Population:	Residential Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	100	USEPA, 1997	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED_c	Exposure Duration (Cancer)	years	20	USEPA, 2014 (1)	
	ED	Exposure Duration (Noncancer)	years	26	USEPA, 2014	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,490	Based on ED (2)	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	5,700	DTSC (2011)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2	0.07	DTSC (2011)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA 2004	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED_c	Exposure Duration (Cancer)	years	20	USEPA, 2014 (1)	
	ED	Exposure Duration (Noncancer)	years	26	USEPA, 2014	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,490	Based on ED (2)	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(3)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	1.0	24 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	350	USEPA, 2002	AT
	ED_c	Exposure Duration (Cancer)	years	20	USEPA, 2014 (1)	(4)
	ED	Exposure Duration (Noncancer)	years	26	USEPA, 2014	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,490	Based on ED (2)	

Notes:
(1) For carcinogens, risks for adults and children are averaged over a lifetime.
(2) AT for chronic exposures = 26 years x 365 days/year.
(3) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).
Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3).
(4) RAGS-F (USEPA, 2009).
Sources:
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C6
Values Used for Daily Intake and Exposure Calculations - Future Exposures to Total Soil - Residential Child
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Total Soil
Exposure Medium:	Total Soil
Exposure Point:	Total Soil
Receptor Population:	Residential Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	200	USEPA, 2011	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	2,900	DTSC (2011)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2	0.2	DTSC (2011)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	
Inhalation	CA	Chemical Concentration in Air	mg/m^3	Chemical Specific	(1)	Exposure concentration (mg/m^3) =
	FI	Fraction Inhaled	unitless	1.00	24 hours/24 hours	CA*FI*EF*ED
	EF	Exposure Frequency	days/year	350	USEPA, 2002	AT
	ED	Exposure Duration	years	6	USEPA, 2002	(2)
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	

Notes:
(1) Chemical concentration for particulates in air (mg/m^3) = Concentration in soil (mg/kg) x 1/PEF (kg/m^3).
Chemical concentration of volatiles in air (mg/m^3) = Concentration in soil (mg/kg) x 1/VF (kg/m^3).
(2) RAGS-F (USEPA, 2009).
Sources:
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2009. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C7
Values Used for Daily Intake and Exposure Calculations - Future Exposures to On-Site Surface Water - Occupational Worker
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Surface Water
Exposure Medium:	Surface Water
Exposure Point:	On-Site Surface Water
Receptor Population:	Occupational Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical concentration in Surface Water	ug/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-SW	Ingestion Rate of Surface Water	L/day	0.1	(1)	CSW*IR-SW*ED*EF*CF
	CF	Conversion Factor	mg/ug	0.001	--	BW*AT
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (2)	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(3)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	3,610	USEPA, 1997 (4)	DAevent*EV*ED*EF*SA
	EV	Event Frequency	events/day	1	Assumed	BW*AT
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (2)	

Notes:
(1) Conservatively derived from the exposure parameters for the swimming (wading) scenario (USEPA, 1989) based on ingestion of 0.05 L/hour for two hours.
(2) AT for chronic exposures = 25 years x 365 days/year
(3) Value based on chemical concentration in surface water and equations presented in USEPA, 2004.
(4) Hands, forearms, and feet assumed exposed to surface water (USEPA, 1997). This assumes water penetrates non-waterproof shoes.
Sources:
USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A). EPA/540/1-89/002.
USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.
USEPA, 2002. Supplemental Soil Screening Level Guidance. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C8
Values Used for Daily Intake and Exposure Calculations - Future Exposures to On-Site Surface Water - Residential Adult
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Surface Water
Exposure Medium:	Surface Water
Exposure Point:	On-Site Surface Water
Receptor Population:	Residential Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical concentration in Surface Water	ug/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-SW	Ingestion Rate of Surface Water	L/day	0.1	(1)	CSW*IR-SW*ED*EF*CF
	CF	Conversion Factor	mg/ug	0.001	--	BW*AT
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED_c	Exposure Duration	years	20	USEPA, 2014 (2)	
	ED	Exposure Duration	years	26	USEPA, 2014	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,490	Based on ED (3)	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(4)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	3,610	USEPA, 1997 (5)	DAevent*EV*ED*EF*SA
	EV	Event Frequency	events/day	1	Assumed	BW*AT
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED_c	Exposure Duration	years	20	USEPA, 2014 (2)	
	ED	Exposure Duration	years	26	USEPA, 2014	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,490	Based on ED (3)	

Notes:
(1) Derived from the exposure parameters for the swimming (wading) scenario (USEPA, 1989) based on ingestion of 0.05 L/hour for two hours.
(2) For carcinogens, risks for adults and children are averaged over a lifetime.
(3) AT for chronic exposures = 26 years x 365 days/year
(4) Value based on chemical concentration in surface water and equations presented in USEPA, 2004.
(5) Value based on hands, feet, forearms exposure.
Sources:
USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A). EPA/540/1-89/002.
USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.
USEPA, 2002. Supplemental Soil Screening Level Guidance. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C9
Values Used for Daily Intake and Exposure Calculations - Future Exposures to On-Site Surface Water - Residential Child
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Surface Water
Exposure Medium:	Surface Water
Exposure Point:	On-Site Surface Water
Receptor Population:	Residential Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical concentration in Surface Water	ug/L	Chemical Specific	--	Chronic Daily Intake (CDI) (mg/kg/day) =
	IR-GW	Ingestion Rate of Surface Water	L/day	0.1	(1)	CSW*IR-SW*ED*EF*CF
	CF	Conversion Factor	mg/ug	0.001	--	BW*AT
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Noncancer)	days	2,190	Based on ED	
Dermal	DAevent	Absorbed dose per event	mg/cm^2-event	(2)	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
	SA	Skin Surface Available for Contact	cm^2	3,700	USEPA, 1997 (3)	DAevent*EV*ED*EF*SA
	EV	Event Frequency	events/day	1	Assumed	BW*AT
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Noncancer)	days	2,190	Based on ED	

Notes:
(1) Derived from the exposure parameters for swimming (wading) scenario (USEPA, 1989) based on ingestion of 0.05 L/hour for two hours.
(2) Value based on chemical concentration in surface water and equations presented in USEPA, 2004.
(3) Value based on arms, hands, legs, and feet exposure.

Sources:
USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A). EPA/540/1-89-002.
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C10
Values Used for Daily Intake and Exposure Calculations - Future Exposures to On-Site Sediment - Occupational Worker
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment
Exposure Point:	On-Site Sediment
Receptor Population:	Occupational Worker

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	50	USEPA, 2002	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (1)	
Dermal	CS	Chemical concentration in soil	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	1900	USEPA, 1997 (2)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.2	USEPA, 2004 (3)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	250	USEPA, 2002	
	ED	Exposure Duration	years	25	USEPA, 2002	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	Based on ED (1)	

Notes:
(1) AT for chronic exposures = 25 years x 365 days/year.
(2) Assumes forearms and hands contact sediment (USEPA, 1997).
(3) Value is based on the geometric mean soil adherence factor for "children playing (wet soil)" from Exhibit C-3 in USEPA, 2004.
Sources:

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24

USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final

USEPA, 1997. Exposure Factor Handbook. EPA/600/P-95/002Fa.

USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.

USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.

California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C11
Values Used for Daily Intake and Exposure Calculations - Future Exposures to On-Site Sediment - Resident Adult
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment
Exposure Point:	On-Site Sediment
Receptor Population:	Residential Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	100	USEPA, 1997	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	EDc	Exposure Duration	years	20	USEPA, 2014 (1)	
	ED	Exposure Duration	years	26	USEPA, 2014	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,490	Based on ED	
Dermal	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	1900	USEPA, 1997 (2)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.2	USEPA, 2004 (3)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	EDc	Exposure Duration	years	20	USEPA, 2014 (1)	
	ED	Exposure Duration	years	26	USEPA, 2014	
	BW	Body Weight	kg	80	USEPA, 2011	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	9,490	Based on ED	

Notes:
(1) For carcinogens, risks for adults and children are averaged over a lifetime.
(2) Assumes forearms and hands contact sediment (USEPA, 1997).
(3) Value is based on the geometric mean soil adherence factor for "children playing (wet soil)" from Exhibit C-3 in USEPA, 2004
Sources:
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Table C12
Values Used for Daily Intake and Exposure Calculations - Future Exposures to On-Site Sediment - Residential Child
IR Sites 34b and 34d, NAVWPNSTA Seal Beach Detachment Fallbrook, Fallbrook, California

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment
Exposure Point:	On-Site Sediment
Receptor Population:	Residential Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Intake (mg/kg/day) =
	IR-S	Ingestion Rate	mg/day	200	USEPA, 1997	CS*IR-S*CF3*ED*EF*FI
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	BW*AT
	FI	Fraction Ingested	unitless	1.00	--	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	
Dermal	CS	Chemical concentration in sediment	mg/kg	Chemical Specific	--	Dermally Absorbed Dose (mg/kg/day) =
	CF3	Conversion Factor 3	kg/mg	1.0E-06	--	CS*SSAF*DABS*SA*CF3*ED*EF
	SA	Skin Surface Available for Contact	cm^2/day	3,200	(1)	BW*AT
	SSAF	Soil to Skin Adherence Factor	mg/cm^2/event	0.2	USEPA, 1997 (2)	
	DABS	Absorption Factor	unitless	Chemical Specific	USEPA, 2004	
	EF	Exposure Frequency	days/year	350	USEPA, 2002	
	ED	Exposure Duration	years	6	USEPA, 2002	
	BW	Body Weight	kg	15	USEPA, 2002	
	AT-C	Averaging Time (Cancer)	days	28,470	USEPA, 2011	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	Based on ED	

Notes:
(1) Assumes arms, hands, and legs contact sediment (USEPA, 1997).
(2) Value is based on the geometric mean soil adherence factor for "children playing (wet soil)" from Exhibit C-3 in USEPA, 2004
Sources:
USEPA, 1997. Exposure Factors Handbook. EPA/600/P-95/002 Fa.
USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment). Final
USEPA, 2011. Exposure Factors Handbook. EPA/600/R-090/052 F, Sept.
USEPA, 2014, HHEM, Supplemental Guidance, Update of Standard Default Exposure Factors, OSWER 9200.1-120.
California DTSC, 2011, HERO HHRA Note Number 1, Recommended Default Exposure Factors

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Appendix D: Screening Level Ecological Risk Assessment Work Plan

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FINAL

Appendix D

Screening Level Ecological Risk Assessment Work Plan, IR Sites 34b and 34d, Dunnage Disposal Areas 2 and 4

Naval Weapons Station Seal Beach Detachment Fallbrook
Fallbrook, California

May 2015

Prepared for:

Naval Facilities Engineering Command Southwest

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San Diego, CA 92132-5190

Prepared by:

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Prepared under:

Contract Number: N62473-10-D-4009
Task Order Number: 0096
DCN: CBI-4009-0096-2146

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Attachment

Attachment A LANL (2012) Ecological Screening Levels

Acronyms and Abbreviations

AUF	area use factor
BERA	baseline ecological risk assessment
bgs	below ground surface
CAGC	Coastal California gnatcatcher
CDFG	California Department of Fish and Game
COC	chemical of concern
COPEC	constituent of potential ecological concern
CSM	conceptual site model
Det.	Detachment
DON	U.S. Department of the Navy
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EcoSSL	Ecological Soil Screening Level
EPC	exposure point concentration
ERA	ecological risk assessment
ESL	ecological screening level
HI	hazard index
HQ	hazard quotient
HR	home range
IR	Installation Restoration
kg	kilogram
LANL	Los Alamos National Laboratory
LBV	Least Bell's vireo
LD_{50}	median lethal dose
LOAEL	lowest-observed-adverse-effect level
LOEC	lowest-observed-effect concentration
MEC	munitions explosives constituent
mg/kg	milligrams per kilogram
NAVFAC SW	Naval Facilities Engineering Command Southwest
NAVWPNSTA	Naval Weapons Station
NOAEL	no-observed adverse-effect level
NOEC	no-observed-effect concentration

PA	Preliminary Assessment
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
RI	remedial investigation
SAP	sampling and analysis plan
SI	site inspection
SKR	Stephens' kangaroo rat
SLERA	screening level ecological risk assessment
SVOC	semi-volatile organic compound
SWFC	Southwestern willow flycatcher
TCDD	tetrachloro-dibenzo-*p*-dioxin
TEF	toxicity equivalency factor
TEQ	Toxicity Equivalents
TRV	toxicity reference value
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
UXO	unexploded ordnance
VOC	volatile organic compound

Section 1 Ecological Risk Assessment

This Screening Level Ecological Risk Assessment (SLERA) work plan has been prepared for the Remedial Investigation (RI) of Installation Restoration (IR) Sites 34b and 34d (Dunnage Disposal Sites 2 and 4) at Naval Weapons Station (NAVWPNSTA) Seal Beach Detachment (Det.) Fallbrook, California (Figure 1). The RI is being performed under the Department of the Navy (DON), Naval Facilities Engineering Command Southwest (NAVFAC SW), Contract Number N62473-10-D-4009, Task Order Number 0096.

1.1 Objective and Background

The primary objective of the SLERA is to evaluate whether unacceptable adverse risks are or may be posed to ecological receptors as a result of hazardous substance releases (volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and/or dioxins and furans) at IR Sites 34b and 34d. A report presenting the results of this evaluation will be prepared and submitted as part of the RI report.

1.2 Approach

The assessment objective will be met by characterizing the general plant and animal communities in the vicinity of IR Sites 34b and 34d, defining the particular hazardous substances affecting environmental media at the Sites, identifying pathways for receptor exposure, estimating the potential for adverse impacts on ecological receptors, and determining the extent to which response actions are necessary. The three principal steps of SLERAs as defined by the USEPA (1997 and 1998) will be followed, and are described in detail in the SLERA Work Plan sections referenced:

- Problem formulation (Section 1.3);
- Analysis (Section 1.4); and
- Risk characterization (Section 1.5).

A tiered-analysis approach, based on USEPA guidelines (USEPA 1997 and 1998), will be used to perform the ecological risk assessment for the Sites. Analysis and risk characterization results from each tier will be used as the basis for scientific/management decisions for No Further Action, immediate corrective measures, and/or to determine the need for implementation of more detailed evaluations of ecological risk (i.e., the next tier, such as a baseline ecological risk assessment [BERA]). The SLERA approach is included herein as requested in the Performance Work Statement (DON 2012). A BERA, however, is currently outside the current scope, and if considered, would require a separate BERA Work Plan.

The results of the SLERA are hazard quotients (HQs) and cumulative hazard indices (HIs), which will be used to evaluate potential site-related risks to receptor populations and, if necessary, to be incorporated into additional levels of ecological risk assessment (ERA) evaluation, as mentioned previously.

It should be noted that HQs and HIs will be estimated using ecological screening levels (ESLs) as published by Los Alamos National Laboratory (LANL 2012) for a variety of wildlife species, as well as plant and soil invertebrate receptors, and aquatic receptors. The use of these ESLs is explained in more detail in the following sections of the SLERA Work Plan.

Available LANL (2012) ESLs for metals, VOCs, SVOCs, and dioxin/furans are presented in Attachment A. LANL (2012) is recommended as the source of ESLs for the SLERA because screening levels are available for many of these chemical constituents, several of the receptors used by LANL are suitable to the Fallbrook, California arid environment, values are available for surface water and sediment, in addition to soil, and both no effect and low effect ESLs are available. A comparison was performed between toxicity reference values (TRVs) used in the development of LANL ESLs and TRVs used in the Ecological Soil Screening Levels (EcoSSLs) from USEPA (2007) and it was determined that for the fifteen metals common to both publications, wildlife TRVs are identical. Therefore, differences in LANL ESLs and EcoSSLs for wildlife (for the no effect endpoint) are primarily due to differences in receptor-specific factors such as intake rate per body weight, not TRVs. In addition, LANL ESLs are available for two additional metals (molybdenum and thallium), as well as an avian ESL for barium, compared with the EcoSSL data base.

1.3 Problem Formation

Problem formulation is the first step in the SLERA and includes developing the conceptual site model (CSM) and defining the assessment endpoints, ecological receptors, and constituents to be evaluated at IR Sites 34b and 34d.

IR Site 34b

IR Site 34b is located in the north-central portion of the installation, east of Walleye Road; it encompasses 9 acres of shallow north-sloping natural topography covered with native vegetation. Potable groundwater is anticipated to be located at a depth greater than 100 feet in this area (ChaduxTt 2010).

Historical information obtained during preparation of the Preliminary Assessment (PA) (Malcolm Pirnie 2006) indicated that IR Site 34b was reportedly used as a disposal or burial area for dunnage from 1942 until 1978. The dunnage disposal area was initially considered a possible munitions burial site because of evidence of munitions explosives compounds (MEC) and

munitions scrap found at two similar dunnage disposal sites at NAVWPNSTA Seal Beach Det. Fallbrook. However, a detailed review of historical installation records, reconnaissance surveys, and follow-up interviews found no evidence that munitions were disposed of at the site. A supplemental review of historical photographs of the period from 1953 to 1978 indicated that the southeastern portion of the site and south adjoining area was used as a borrow pit for sand and gravel. The borrow area appeared to be in heavy use before and during the 1950s. By the late 1970s, activity in this area appears to have been curtailed or eliminated.

IR Site 34d

IR Site 34d is located in the central portion of the installation, immediately north of Ammunition Road and along the south side of Fallbrook Creek. The irregular-shaped site encompasses 1.8 acres. Old asphalt paving associated with Maverick Road and improvements related to the former crossing over Fallbrook Creek are located in the northwestern portion of the Site. Fallbrook Creek flows westward through the northern portion of the Site as well, north of Maverick Road (ChaduxTt 2010).

A portion of the Site was reported to be used as a burial area for dunnage from 1942 until 1978. The Site was also initially considered a possible munitions burial site based on evidence of MEC and munitions scrap found at other dunnage disposal sites. Further investigation of the Site (installation record reviews, visual surveys, and interviews) during the PA (Malcolm Pirnie 2006) concluded that IR Site 34d had not been a munitions burial site.

1.3.1 Conceptual Site Model Development

The CSM is used to describe Site dynamics, identify data gaps, and define hypotheses to be tested in the SLERA, streamline the risk evaluation, and develop appropriate response actions, if necessary. The CSM identifies potentially complete exposure pathways between physical media affected by site-related contamination and potential receptors. Only exposure pathways that are potentially complete and for which adequate data are available will be quantitatively evaluated in the SLERA. If, under current and expected future land use scenarios, there are no potential exposure pathways for ecological receptors at IR Sites 34b and 34d, there is no potential for risk, and a SLERA is not necessary.

IR Sites 34b and 34d are not paved and vegetation is present. Therefore, a SLERA is being conducted for the RI to provide information for use in risk management decisions. A CSM has been developed based on the assumption that potential exposure pathways and ecological receptors exist at IR Sites 34b and 34d (Figure 2). In addition, simplified terrestrial and aquatic food web models are presented in Figures 3 and 4.

1.3.2 Ecological Characterization

The first step in developing ecological characterization for a site is to characterize the area with respect to operational, physical, chemical, and ecological characteristics, and their current and anticipated future land uses. Understanding site conditions and land uses aids in the identification of potential receptors under current and likely future scenarios. The composition of biological resources in an area generally is influenced by climate, topography, and the degree to which land management activities have altered the natural environment.

1.3.2.1 Ecological Communities

More than 80 percent of NAVWPNSTA Seal Beach Det. Fallbrook lands exist as natural open space because of the low-intensity land use of the military installation. The area around NAVWPNSTA Seal Beach Det. Fallbrook and MCB Camp Pendleton provides the largest remaining wildlife habitat area in coastal southern California. A collaborative effort among federal, state, and private agencies called the South Coast Missing Linkages Project, which aims to identify and prioritize linkages that conserve essential biological and ecological processes, has identified fifteen linkages for the South Coast Ecoregion. The project is intended to prevent populations of plants and wildlife inhabiting the largest remaining wildland tracts from becoming isolated by creating dispersal corridors between important lands. MCB Camp Pendleton and NAVWPNSTA Seal Beach Det. Fallbrook make up the primary parcel of land at the Santa Ana–Palomar Mountains Linkage's western end; the linkage connects the coastal Santa Ana Mountains with the inland Palomar Mountains. In particular, the northern boundary of NAVWPNSTA Seal Beach Det. Fallbrook, the Santa Margarita River corridor, is a key component of this linkage. The corridors are considered essential to maintaining ecological processes in an increasingly fragmented landscape.

1.3.2.2 Vegetation

Several native plant communities at NAVWPNSTA Seal Beach Det. Fallbrook provide habitat for wildlife, including perennial grassland, coastal sage scrub, chamise chaparral, coast live oak riparian woodland, willow riparian woodland, fresh emergent wetlands, and eucalyptus.

1.3.2.3 Wildlife

Fauna common to the installation include many mammals (kangaroo rats, voles, deer, mice, bats, ground squirrels, opossum, rabbits, and coyotes), reptiles (orange-throated whiptails, rattlesnakes, and horned lizards), and birds (owls, kites, quails, sparrows, kingbirds, and hawks).

1.3.2.4 Threatened and Endangered Species

Many species have been documented or have the potential to occur at the installation, including the following federally threatened or endangered species (Tierra Data Inc. 2006):

- Coastal California gnatcatcher (CAGC) (*Polioptila californica californica*); threatened
- Least Bell's vireo (LBV) (*Vireo bellii pusillus*); endangered
- Southwestern willow flycatcher (SWFC) (*Empidonax trailli extimus*); endangered
- Stephens' kangaroo rat (SKR) (*Dipodomys stephensi*); endangered
- Arroyo toad (*Bufo californicus*); endangered
- California red-legged frog (*Rana aurora draytonii*), threatened

CAGC is a non-migratory species that nests in coastal sage scrub and adjacent chaparral, as well as baccharis scrub. The LBV usually arrives in southern California in mid-March through August or September and nests in riparian as well as coastal sage vegetation with patches of Mexican elderberry (*Sambucus mexicanus*). The SWFC also nests in riparian areas and occurs in southern California between mid-May through September or October. The SKR burrows in areas with low-lying perennial cover and bare ground, including coastal sage scrub, grassland, and chaparral. The arroyo toad uses wetland and upland areas during various parts of its life cycle; they are known to occur along the Santa Margarita River and may occur in suitable habitat at NAVWPNSTA Seal Beach Det. Fallbrook. The California red-legged frog inhabits freshwater marshes, ponds, streams, lakes, and other quiet water bodies and is known to have persisted on the Santa Rosa Plateau, which is located 11 miles north of the installation, until at least the late 1990s, where they inhabited deep pools associated with arroyos.

Sensitive wildlife species that have been seen at Fallbrook are the coastal cactus wren (last record 1995), San Diego horned lizard (last record 2001), orange throated whiptail (last record 2003) and the southwestern pond turtle (last record 2003). Coastal cactus wrens have not been surveyed since 1995, and at that time were not recorded at IR Sites 34b or 34d. The pond turtle was observed in the creek adjacent to IR Site 32 in 2003 (but not at Sites 34b or 34d). The orange throated whiptail was recorded near unexploded ordnance (UXO) 1 in 1995 (but not at Sites 34b or 34d).

Suitable habitat for one or more protected species was found at each Site during the SI (ChaduxTt 2010). The results are summarized below for IR Sites 34b and 34d:

- IR Site 34b — Vegetation in the area is considered mostly coastal sage scrub and provides suitable habitat for the CAGC and SKR, with some burrows observed at the Site; therefore, both species could occur at the Site.

- IR Site 34d — Vegetation in the area is a mix of oak woodland, riparian woodland, and coastal sage scrub. The Site provides suitable habitat for the CAGC, SKR, LBV, and SWFC; therefore, these species could occur at the Site.

1.3.3 Sources, Release Mechanisms, and Affected Media

Sources of potential environmental contamination at IR Sites 34b and 34d result from potential releases associated burning and/or suspected disposal activities. Therefore, constituents of potential ecological concern (COPECs) may include metals, VOCs, SVOCs, and dioxin/furans.

Media affected at both Sites by constituent releases includes soils and potential bioaccumulation in biota as illustrated in Figure 2. Release mechanisms generally involve deposition to surface soil, leaching, and overland runoff, although leaching is deemed minor (due to the considerable depth to groundwater). Surface water and sediment sampling is planned for IR Site 34d, as it is adjacent to Fallbrook Creek; therefore, exposure pathways associated with these media are also shown in Figure 2. The SLERA will thus quantitatively assess representative receptor exposures to contaminated soil and biota, and for Site 34d, contaminated surface water and sediment.

Direct groundwater exposure pathways are considered incomplete for terrestrial wildlife receptors.

1.3.4 Selection of Assessment Endpoints

Ecological risks are expressed in terms of a definite endpoint, which is defined as an environmental value to be protected. Assessment endpoints are "explicit expressions of the actual environmental value that is to be protected" (USEPA 1998). The assessment endpoints provide a transition between broad management or policy goals and the specific endpoints used in the assessment. In this SLERA approach, the general assessment endpoint is the potential reduction in the receptor species due to exposure to site-related chemicals in affected media. The assessment endpoints are addressed through the assessment of the potential reduction in the survival, growth, and reproduction of receptor populations at IR Sites 34b and 34d. The assessment endpoints are evaluated using measures of effect (i.e., measurement endpoints) (Section 1.3.7.1) intended to reflect constituent concentrations in environmental media that do not threaten the survival, growth, and reproduction of receptor populations at the Sites. The ecological assessment endpoints and indicators and measures of effect are summarized in Table 1.

1.3.5 Selection of Receptor Species

Representative receptor species were identified for each of the assessment endpoints as shown in Tables 1 and 2. This list of non-domesticated terrestrial wildlife receptors is contained in the LANL database (LANL 2012), for a typical arid environmental proximate to LANL. These

listed species may reasonably be expected to reside or regularly forage at IR Sites 34b and 34d, given current Site conditions. There are no current plans for future development of the Sites; therefore, continued use by wildlife species is expected.

While there may be some concern as to the adequacy and appropriateness of the proposed representative receptor species for an ecological risk assessment of IR Sites 34b and 34d where threatened and/or endangered receptor species may occur, the proposed eight wildlife receptor species and the aquatic community receptor include species with life histories and feeding strategies similar to the potential threatened and/or endangered species, as shown as follows:

Threatened or Endangered Species	**Trophic Level**	**Representative Species Proposed for SLERA**	**Trophic Level**	**Comment**
Coastal California gnatcatcher	Insectivore	American robin as insectivore; violet-green swallow	Insectivore	As the American robin has a home range of 1.2 acres, its potential exposure to site COPECs will be maximized, compared with the T&E species that have larger home ranges
Least Bell's vireo				
Southwestern willow flycatcher				
Stephens' kangaroo rat	Omnivore	Deer mouse	Omnivore	As the deer mouse has a home range of 0.06 acres, its potential exposure to site COPECs will be similar to the SKR that has a home range of approximately 0.02 acres[1]
Arroyo toad	Omnivore	Surface water and sediment aquatic communities	Various (omnivore, carnivore, herbivore)	SLERA will use water quality criteria and sediment benchmarks for the protection of aquatic life
California red-legged frog	Omnivore			

In general, the selection of representative receptor species followed EPA (1996a).

Therefore, the selected wildlife species and the aquatic community selected as representative surrogates for use in the SLERA are deemed adequate for purposes of assessing potential COPEC exposures and hazards by threatened and endangered species that may be in the general area. During preparation of the SLERA, the potential toxicity of detected COPECs in surface water and/or sediment will be further researched for possible toxicity to amphibians (e.g., toads and frogs) using Bleiler et al. (2004; 2009) and Sparling et al. (2000), as LANL (2012) ESLs may not contain amphibian-specific benchmarks. Vegetation and Invertebrates

[1] http://www.iucnredlist.org/details/6682/0

Limited surveys have been conducted to characterize vegetation communities at the Sites (Section 1.3.2.4). Federally-listed plant species have not been identified at IR Sites 34b and 34d; therefore, plants generally will be evaluated as an exposure medium (i.e., a food source) for wildlife receptors. Federal- and state-listings of threatened and endangered species proximate to the Site will be updated during the SLERA, based on a review of information available in on-line databases (such as the California Department of Fish and Game [CDFG] 2008 Wildlife Habitat Relationship System). Because there is limited phytotoxicity information in the available technical literature for many chemicals, quantitatively assessing risk to plants from constituent concentrations has high uncertainty. Where appropriate toxicity data are available, soil concentrations of COPECs will be screened against these benchmarks to assess risks to plants. However, some plants can accumulate high quantities of constituents in their tissues, without harm to the plant. The uncertainties associated with the lack of available toxicity data for the direct assessment of plants will be discussed in the SLERA report. Because herbivores and omnivores will be evaluated directly in the SLERA, it can be inferred that the success of these receptors reflects the overall health of the plant communities that support them. Similarly, soil invertebrates (i.e., insects) will be evaluated as potential indirect exposure media for higher-trophic level consumers (insectivore and omnivores). Therefore, no primary producer or detritivore receptor species are identified; rather, the plant assemblages representing the dominant cover types present at IR Sites 34b and 34d and a general terrestrial invertebrate group will be evaluated as biotransfer media, assuming that all plants and soil invertebrates have the capacity to bioaccumulate constituents from soils. Such plants and invertebrates then may serve as food for higher order consumers.

As shown in Table 1, the terrestrial plant and invertebrate communities are selected as Measurement Receptors, and potential impacts to upper trophic level receptors (such as birds and/or mammals) will be assessed via the potential reduction in this base of the food chain resource (i.e., loss of food source for higher feeding guilds). Similarly, aquatic invertebrates are also selected as a Measurement Receptor, and potential impacts to upper trophic level receptors (such as semi-aquatic birds and/or mammals) will be assessed via the potential reduction in this base of the food chain resource (i.e., loss of food source for higher feeding guilds).

1.3.5.1 Wildlife

Only limited surveys have been conducted at IR Sites 34b and 34d to characterize terrestrial and semi-aquatic wildlife species. Based on current and expected future Site conditions (i.e., vacant land, with vegetation typical of the region), fauna at IR Sites 34b and 34d could include terrestrial invertebrates (i.e., insects), aquatic invertebrates at IR Site 34d (i.e., water column and sediment invertebrates), reptiles, birds, small mammals (i.e., rodents, bats), and larger carnivorous or omnivorous mammals (i.e., red fox). The representative receptor species selected for evaluation in the SLERA were based on those receptors in the LANL database that may be

present in a typical arid environment and therefore may reside or forage at IR Sites 34b and/or 34d based on current conditions. Guidelines considered in selecting receptors from the potentially exposed community generally include the following (EPA, 1996a):

- Representativeness of assessment endpoints;
- Limited home range relative to a site or area of interest;
- Role in food chains;
- Potential presence at a site;
- Sufficient toxicological information available in the literature for comparative and interpretive purposes; and
- Sensitivity to COPECs.

Wildlife receptors were selected to represent the trophic levels and habitat characteristics of the area being assessed. Based on available ecological information, species were selected for use as assessment endpoints in the SLERA, representative of terrestrial and aquatic ecological receptors potentially exposed to constituents in soil, surface water, sediment and/or biota. Aquatic receptors potentially exposed to surface water and sediment have been identified for Site 34d, as aquatic exposure pathways only exist at this Site.

The selected wildlife species are intended to represent the dominant trophic levels related to the vegetative communities present at IR Sites 34b and 34d. A general terrestrial food web model has been developed (Figure 3) to illustrate these trophic levels, while a general aquatic food web is presented in Figure 4. While the ecological communities at IR Sites 34b and 34d may have multiple species with desirable characteristics for use as receptor species, most of these species have not been used for toxicological testing. The overall representativeness (i.e., protectiveness) of the selected representative receptors presents a source of uncertainty in the risk assessment. This uncertainty will be documented in the uncertainty section of the SLERA.

The representative terrestrial wildlife species identified for IR Sites 34b and 34d are the montane shrew, American robin, American kestrel, deer mouse, desert cottontail, and red fox, based on those terrestrial species contained in the LANL (2012) database, as previously discussed in Section 1.3.5. The representative semi-aquatic wildlife species identified for IR Site 34d are the Occult little brown bat and violet-green swallow, based on those semi-aquatic species contained in the LANL (2012) database for potential COPEC sediment exposure (based on transfer of chemicals from sediment to aerial aquatic insects). In addition, these terrestrial and semi-aquatic wildlife species are all assumed to ingest surface water. The representative receptor species are shown within the CSM (Figure 2), and the terrestrial and aquatic food web models in Figures 3 and 4, respectively. The selected species are considered to be representative of current and potential future ecological receptors at IR Sites 34b and/or 34d. In addition, when coupled with

plants and invertebrates as biotransfer media, the species selected represent important components of the food chain, as demonstrated in Figures 3 and 4.

A lack of toxicity data precludes adequate quantitative evaluation of risks to lizards, tortoises, and snakes; therefore they are not included as receptors for quantitative evaluation in the SLERA. The uncertainties associated with eliminating ecological receptors from quantitative evaluation due to a lack of toxicity (or other) data will be discussed in the SLERA.

1.3.6 Exposure Areas

IR Sites 34b and 34d are approximately 9 and 1.8 acres in size. These areas will be used to define exposure areas for incidental ingestion of soil and/or, ingestion of surface water from IR Site 34d, and ingestion of plant and prey species. Area use factors (AUFs) will be calculated by dividing the IR Sites 34b and 34d areas (affected by past Site activities) by the representative receptor's average home range (also referred to as foraging range) (obtained from literature, as shown in Table 2). In cases where the average reported home range is less than the size of IR Sites 34b and 34d, the AUF will be assigned a default value of 1.0.

As the estimated area of IR Site 34b is approximately 9 acres, AUFs for the Montane shrew, American robin, deer mouse, and desert cottontail will be set to 1.0, as these four species have home ranges less than or equal to 9 acres (Table 2). As the estimated area of IR Site 34d is approximately 1.8 acres, AUFs for the Montane shrew, American robin, and deer mouse, will be set to 1.0, as these three species have home ranges less than 1.8 acres (Table 2).

1.3.7 Analysis Plan

The analysis plan consists of a summary of the hypotheses to be tested in the SLERA and a summary of how the measures of effect (i.e., measurement endpoints) will be assessed. The measures of effect for the SLERA are described below.

1.3.7.1 Selection of Measures of Effect

Measures of effect, or measurement endpoints, are measurable responses to a chemical stressor that are related to the valued characteristics chosen as assessment endpoints (USEPA 1998). Assessment endpoints generally refer to characteristics of populations and ecosystems, however, it is usually impractical to measure changes in these characteristics as part of an assessment (Suter 1993). Consequently, measurement endpoints are selected that can be measured and extrapolated to predict effects on assessment endpoints (USEPA 1992 and 1996b). Examples of measurement endpoints include no-observed adverse-effect levels (NOAELs), no-observed-effect concentrations (NOECs), and median lethal doses (LD_{50}s); however, LD_{50}s are not appropriate for use as measurement endpoints in ERAs. Other measure endpoints include

species diversity and relative abundance indices, however, these endpoints are not proposed for the SLERA, as these measurement endpoints are more appropriate for a BERA.

Effects relative to the assessment endpoints are extrapolated from the measurement endpoints (Table 1). The wildlife measurement endpoints selected for the SLERA are chronic NOAELs derived from controlled toxicity studies, which reflect protection of individual organisms. The measurement endpoints for terrestrial plants and invertebrates will be NOECs (receptor-specific benchmark concentrations) in soil. The measurement endpoints for aquatic invertebrates will be NOECs (receptor-specific benchmark concentrations) in surface water and sediment. The NOAEL is a dose of each preliminary COPEC that will produce no known adverse effects on the test species. The NOAEL is an appropriate toxicological endpoint for a SLERA because it provides the greatest degree of protection to the receptor species at the individual organism level. For the SLERA, TRV will be used as NOAELs, as represented by the wildlife-specific NOAEL-based ESLs published by LANL (2012).

There is no specific guidance available for determining the threshold significance level for population-level impacts. It typically is assumed that most populations or communities (excluding threatened or endangered species) can suffer some depletion or adverse effect while remaining viable. This is because the reproductive potential of most wildlife populations exceeds what is needed to maintain a stable population, and a degree of higher mortality or a lowering of reproductive potential can be sustained without harm to the population. Also, populations over large areas are structured in "metapopulations" and usually have "source" and "sink" areas determined by habitat quality. In source areas, reproductive success is high, creating a surplus of individuals, while in sink areas where habitat quality is poor, reproductive success is low, and often mortality is high. Sink areas typically do not have a self-sustaining population, and are often populated by excess individuals that have emigrated from the source areas. Small areas of disturbance or contamination (i.e., IR Sites 34b and 34d) may function within the metapopulation as sink areas. In the literature, a 20% effect level is often used in assessing the significance of toxicity on sample populations, particularly for receptors in aquatic environments where exposure is certain (Suter et al. 2000). There is considerably more uncertainty associated with exposure of receptors to constituents in terrestrial environments, where constituent distributions are not uniform throughout affected media, and chemical bioavailability and species mobility factors allow for reductions in or avoidance of exposure. Therefore, a specific number of individuals that could be lost or reproductively impaired for any given representative species population cannot realistically be applied in terrestrial risk assessments. Rather it is conservatively assumed that the lowest-observed-adverse-effect level (LOAEL) or lowest-observed-effect concentration (LOEC) for reproductive, growth, or mortality endpoints is indicative of a threshold impact beyond which population viability could be impaired. In summary, a NOAEL-based HQ of 1 or below is deemed protective of an individual, while a

result above a NOAEL-based HQ of 1 and below or equal to a LOAEL-based HQ of 1 is deemed protective of a population.

The LOAEL/LOEC is the lowest dose/exposure concentration of a COPEC at which an adverse effect is observed in the test organisms, and is often considered a more appropriate measure of population-level effects than the NOAEL (Suter 1993; DTSC 1999). Therefore, the SLERA measures of effect will include both chronic NOAELs/NOECs and LOAELs/LOECs, as represented by the wildlife-specific LOAEL-based ESL published by LANL (2011).

Hazards will be quantified in the SLERA risk characterization using both types of endpoints to provide a range of HQs (and HIs) for use in the risk-management process.

The preferred toxicological endpoints used are growth, reproduction, and survival, as incorporated into the wildlife-specific NOAEL- and LOAEL-based ESLs published by LANL (2012). It is assumed that these endpoints are reflective of significant effects at either the individual organism or population level. Adverse effects on an individual organism do not necessarily constitute an adverse effect on the population.

Reliable measures of effect are not available for each exposure route for each COPEC. Effects from exposures through air exposure routes (inhalation) and dermal contact with soil are not well developed for ecological receptors; consequently, these exposure routes will be analyzed qualitatively.

1.3.7.2 Identification of Chemical Stressors

COPECs in soil, surface water, and sediment will be identified for IR Sites 34b and/or 34d via a screening process where all detected chemicals will be selected for further evaluation, with the exception of inorganic chemicals determined to be related to background (as recommended by DTSC 1997).

To support the sampling and analysis plan (SAP) and project data quality objectives (DQOs) for soil, surface water, and sediment, and to ensure analytical detection limits are appropriately low, ecological screening levels are presented in Attachment A of the SLERA Work Plan, based on ESLs from LANL (2012).

The statistical approach recommended for the comparison of chemical concentrations in affected media sampled at IR Sites 34b and 34d with site-specific background chemical data is described in detail in this subsection, including a geochemical background evaluation.

Background distributions for 23 Target Analyte List metals, strontium, and tin in soil at the installation have been determined as part of the site-specific background study (SES-Tech 2012). Statistical descriptions of these background data, by parent rock type, include a 95th upper

tolerance limit (UTL) for each element along with other parameters (minimum, maximum, frequency of detection, data distribution, etc.). The 95th UTL provides an upper bound on the true the 95th percentile of the background population, and will be used as a background screening value. Concentrations in samples from IR Sites 34b and 34d (that have a parent rock type of tonalite, will be compared to the background distributions[2] by comparing the maximum detected Site concentration to the 95th UTL background screening value, and by directly comparing the IR Sites 34b and 34d and background data distributions using ProUCL (USEPA 2013) via the Wilcoxon rank sum test performed at a 95 percent confidence level.

Metals that fail either of these two tests will then be subject to a geochemical evaluation using the methods of Myers and Thorbjornsen (2004) and Thorbjornsen and Myers (2007) to determine if the statistical exceedances are due to naturally high concentrations or due to Site contamination. Metals identified by this process as contaminants will be considered as being site related (i.e., not related to background).

For surface water and sediment data to be collected from IR Site 34d, a simple comparison of the three proposed site samples with the one upstream sample will be used to assess whether or not a detected chemical is potentially site related. If the maximum detected site sample result exceeds the upstream concentration, then the chemical will be considered to be site related. As the DTSC (1997) background guidance only addresses inorganics, organic compounds detected in surface water and/or sediment that are potentially background related will be conservatively carried though the SLERA. However, at the conclusion of the SLERA, those non-site-related organics that may be found to be hazard-drivers in surface water and/or sediment will be identified and discussed in detail.

1.4 Analysis Methods

The analysis step identifies and discusses potential pathways of receptor exposure to COPECs and assesses the toxicity of COPECs to receptors. The exposure assessment is conducted by characterizing the magnitude (concentration) and distribution (locations) of the constituents detected in the media sampled during the characterization efforts, evaluating pathways by which chemicals may be transported through the environment, and determining the points at which organisms at IR Sites 34b and 34d may contact constituents. The effects assessment includes compiling available chemical- and receptor-specific toxicity information, as represented by ESLs published by LANL (2012). General food web models have been adopted for IR Sites 34b and 34d (Figures 3 and 4, respectively). It will be assumed representative species are exposed to sampled environmental media at IR Sites 34b and 34d (i.e., soils, surface water, and/or sediment). Exposure pathways for ecological receptors may be direct or through the food web

[2] The combined parent rock type of gabbro/granodiorite/tonalite from the Background Study will be used, as the 14 soil samples from each of these three soil types were determined to be statistically similar (SES-Tech 2012).

via consumption of contaminated biota. Direct exposure pathways include dermal contact, inhalation, and ingestion. Examples of direct exposure include animals ingesting surface water, incidentally ingesting contaminated soil and/or sediment, plants or invertebrates absorbing constituents by uptake from contaminated soil, and aquatic invertebrates (i.e., flying insects) absorbing constituents by uptake from contaminated sediment. Because there are few toxicological data on dermal and inhalation exposure, these exposure routes will be addressed qualitatively for wildlife.

1.4.1 Characterization of Ecological Receptor Exposure Pathways

Potentially complete pathways for the SLERA are generalized and assume that terrestrial wildlife receptors may be associated with the following pathways: ingestion of soils, ingestion of vegetation, and ingestion of prey items. Semi-aquatic wildlife receptors may be associated with the following pathways: ingestion of surface water and ingestion of prey items (i.e., flying insects) that have absorbed constituents from contaminated sediments. In addition, terrestrial wildlife are also assumed to ingest surface water.

1.4.1.1 Soil Exposure Pathways

The soil exposure interval 0 to 2 feet below ground surface (bgs) will be used in the SLERA to evaluate ecological receptor exposures to this medium. A depth interval of 0 to 2 feet bgs is considered appropriate for evaluation of soil COPEC exposures for surface foraging and shallow-burrowing wildlife, as well as for many forage plants (i.e., grasses and forbs) and invertebrates expected at IR Sites 34b and 34d. Although USEPA (1997) does not have a recommended ecological depth interval of interest, the use of the 0 to 2 foot depth interval is generally consistent with the root zone of plants where the greatest absorption of soluble COPECs would be expected to occur. It should be noted that DTSC (1998) recommends a soil exposure interval of up to 6 feet bgs; although a shallower depth is allowed when soil contamination is expected to be shallower than 6 feet. Based on information in the SI (ChaduxTt 2010), most soil contamination occurred within the top two feet, although some elevated concentrations were found from 2 to 4 feet bgs at IR Site 34b and from 2 to 6 feet bgs at IR Site 34d. As soil samples collected from 3 to 4 feet and 5 to 6 feet bgs, (based on potential visual evidence of debris or stained soil at the bottom of a trench or soil boring) are discussed in Sections 3.7 and 3.8 of the main Work Plan, sample results from this depth interval (2 to 6 feet bgs) will be used to assess potential exposure to burrowing wildlife and deep-rooted plants (assuming samples from this depth interval are actually collected).

Soil data from the SI for IR Sites 34b and 34d (ChaduxTt 2010) will be merged with the soil data to be collected as part of the RI, in order to generate a more complete and robust data set for use in the SLERA.

1.4.1.2 Groundwater Exposure Pathways

Groundwater exposure pathways for ecological receptors are incomplete and will not be evaluated for IR Sites 34b and 34d.

1.4.1.3 Surface Water and Sediment Exposure Pathways

Surface water and sediment exposure pathways at IR Site 34b are incomplete and will not be evaluated, as there is no surface water or sediment at or near this Site. However, surface water and sediment exposure pathways at IR Site 34d are potentially complete and will be evaluated, as this Site is adjacent to Fallbrook Creek.

1.4.1.4 Biota Exposure Pathways

Animals may be exposed indirectly to site-related constituents through ingestion of plants and animals that have bioaccumulated constituents in their tissues. Because analysis of biological tissue will not be performed for the SLERA, the potential for exposure via ingestion of biota will be inferred based on estimated constituent uptake and assimilation by vegetation and prey species, and on the bioaccumulation properties of the constituents. These exposure pathways are incorporated into the wildlife-specific ESLs from LANL (2012).

1.4.2 Quantification of Receptor Exposures

Quantification of exposure requires the consideration of numerous variables, including determination of a chemical exposure point concentration, the calculation of food intake rates for site receptors (on a body weight basis), surface water ingestion, incidental soil ingestion, and bioaccumulation in food items. However, rather than calculate intake for each recommended wildlife receptor, wildlife-specific ESLs from LANL (2012) will be used to estimate hazards. This approach is recommended because the LANL ESLs were generally developed to assess arid ecological receptors (as may exist at IR Sites 34b and 34d).

Realistic exposure for terrestrial plants, invertebrates, surface water and sediment invertebrates, and wildlife receptors will be assessed using exposure point concentration (EPC) for soil, surface water, and sediment COPECs based on the 95% upper confidence limit (UCL) on the mean or the maximum detection concentration, whichever is lower. For example, if the 95% UCL is calculated to exceed the maximum detected concentration (such as due to high data variability), the maximum detected concentration will be used as the EPC. The 95% UCLs will be estimated using USEPA's ProUCL statistical software (USEPA 2013).

For dioxin/furan soil and sediment data, a specific approach will be followed, as discussed as follows. There are 210 individual compounds or "congeners" of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofuran (PCDFs). USEPA has developed procedures

for assessing the risks associated with exposure to the many PCDDs and PCDFs. These procedures are used to assess risk on the basis of the relative toxicity of 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD), which is the most toxic dioxin. Each congener has been assigned a value, referred to as a toxicity equivalency factor (TEF), which corresponds to its toxicity in relation to 2,3,7,8-TCDD. For example, 2,3,7,8-TCDD has a TEF of 1.0, and other PCDDs and PCDFs have TEFs between 0.0 and 1.0. USEPA's protocol guidance and other USEPA guidance recommend that risk assessments include all PCDDs or PCDFs with chlorine molecules substituted in the 2,3,7, and 8 positions. There are seventeen of these dioxin-like PCDDs and PCDFs that are considered in the analysis. Mammalian TEF values for these seventeen congeners from Van den Berg et al. (2006) will be used in the SLERA. For avian receptor, TEFs from Van den Berg et al. (1998) will be used.

The combined hazards resulting from exposure to a mixture of the seventeen dioxin-like congeners will be computed using the TEFs with the assumption that the hazards are cumulative. Results for 2,3,7,8-TCDD Toxicity Equivalents (TEQs), for mammals and birds separately, will be determined by multiplying the congener-specific TEF by the detected congener concentration(s) in each sample. Hazards on a 2,3,7,8-TCDD TEQ basis will be assessed using 2,3,7,8-TCDD ESLs for mammalian and avian wildlife

1.5 Risk Characterization

Risk characterization involves risk estimation and risk description. Risk estimation consists of integration of exposure and toxicity, and results in numerical measurements referred to as HQs and HIs. Risk description consists of summarizing conclusions of the risk estimates, presenting a weight-of-evidence analysis of the risk estimates, and addressing the uncertainty, assumptions, and limitations of the risk estimates.

1.5.1 Risk Estimation

The SLERA will estimate potential adverse effects occurring as a result of exposure of the selected Site receptors to COPECs. This will be done separately for terrestrial wildlife vs. plants and soil invertebrates, and semi-aquatic wildlife vs. surface water and sediment invertebrates.

For wildlife, chemical-specific EPCs will be divided by NOAEL- and LOAEL-based LANL ESLs, and then multiplied by the IR Sites 34b and 34d AUF, to estimate an HQ as follows:

$$HQ_{wildlife} = \frac{EPC_{(mg/kg)\ chemical}}{ESL_{(mg/kg)\ chemical}} \times AUF_{\text{wildlife receptor}}$$

For example, if the lead EPC in soil is 17 mg/kg, the NOAEL-based HQ for the American robin (as an insectivore) would be:

$$HQ_{Pb,\ robin,\ NOAEL\ TRV} = \frac{17}{14} \times (AUF = 1\ acre\ site\ area/1.2\ acre\ home\ range) = 1.0$$

Similarly, the LOAEL-based HQ for the American robin (as an insectivore) would be:

$$HQ_{Pb,\ robin,\ LOAEL\ TRV} = \frac{17}{28} \times (AUF = 1\ acre\ site\ area/1.2\ acre\ home\ range) = 0.5$$

For plants and soil invertebrates, the chemical-specific EPCs will be divided by NOAEL- and LOAEL-based LANL ESLs, to estimate an HQ, as follows:

$$HQ_{plant\ or\ invertebrate} = \frac{EPC_{(mg/kg)\ chemical}}{ESL_{(mg/kg)\ chemical}}$$

For example, given a lead EPC in soil of 17 mg/kg, the NOAEL-based HQ for plants would be:

$$HQ_{Pb,\ plant,\ NOAEL} = \frac{17}{120} = 0.14$$

Similarly, the LOAEL-based HQ for plants would be:

$$HQ_{Pb,\ plant,\ LOAEL} = \frac{17}{570} = 0.03$$

For invertebrates, the NOAEL- and LOAEL-based HQs for lead would be:

$$HQ_{Pb,\ invert,\ NOAEL} = \frac{17}{1700} = 0.01$$

$$HQ_{Pb,\ invert,\ LOAEL} = \frac{17}{8400} = 0.002$$

For plants and soil invertebrates, and for surface water and sediment aquatic invertebrates, the use of a site-wide EPC, rather than a maximum concentration, assumes that exposure is considered at the population level, not the individual level. This is appropriate because there are no known federal-listed threatened or endangered plant or invertebrate species at IR Sites 34b and 34d. The plant and invertebrate HQs will be used to assess potential food supply concerns for the selected wildlife receptors (Table 2).

While individual constituents may affect distinct target organs or systems within an organism, some chemicals may act in similar ways, thus being additive in effect. HQs will be summed for each receptor at IR Sites 34b and 34d for COPECs that exhibit similar modes of toxicity or effects endpoints. The resulting HI will be evaluated as an indication of the additive potential for the COPECs to result in adverse effects on the assessment endpoints.

As mentioned in Section 1.3.7.2, the SLERA will be performed by presenting the hazards excluding any background inorganic chemicals. The results of the SLERA, as well as upstream organic concentrations at IR Site 34d, will be used in conjunction with the risk description to recommend IR Sites 34b and 34d for no further ERA evaluation, immediate remedial action, or additional levels of ERA. The Navy, in conjunction with the regulatory agencies, will use the results of the SLERA to make a risk management decision regarding the path forward. The decision criteria used to assist in making this recommendation are discussed in Section 1.5.2.

1.5.2 Risk Description

Risk description allows for interpretation of the risks estimated for the assessment endpoints. It includes an "evaluation of the lines of evidence supporting or refuting the risk estimate(s) and an interpretation of the significance of the adverse effects on the assessment endpoints (USEPA 1998b).

NOAEL-based HQs or HIs that are greater than or equal to 1.0 indicate that the associated COPECs qualify as preliminary constituents of concern (COCs). Preliminary COCs will be further evaluated to determine the actual likelihood of harm to ecological receptors using LOAEL-based LANL (2012) ESLs (Section 1.5.1), assuming there is no direct evidence of threatened or endangered species at either of the sites. The final COCs are determined only after an additional weight-of-evidence evaluation of the conservatism of the exposure assumptions, toxicity values, and uncertainties is conducted as part of the risk description. This evaluation allows for review of the HQs and HIs and discussion among risk managers, risk assessors, and other stakeholders.

The risk description step of the assessment will assist in potentially classifying IR Sites 34b and 34d for potential further evaluation or action.

Additional lines of evidence to be evaluated (as appropriate) include:

- Relevance of evidence to the measurement and assessment endpoints;
- Sufficiency and quality of literature toxicity data and experimental designs;
- Potential for bioaccumulation of constituents;
- Site risk relative to background and/or upstream risk;
- Spatial distribution of contamination at the Sites;
- Size of Site relative to foraging area of receptors;
- Quality of habitat for receptors;
- Presence of threatened or endangered species;
- Strength of cause/effect relationships; and

- Relative uncertainties of each line of evidence.

The lines of evidence will be used to supplement the quantitative results to determine if there are any COCs at IR Sites 34b and 34d. USEPA's (1998) *Guidelines for Ecological Risk Assessment* lists five criteria for evaluating adverse changes in assessment endpoints:

- Nature of effects;
- Intensity of effects;
- Spatial scale;
- Temporal scale; and
- Potential for recovery.

These criteria will be considered in the final determination of whether a given chemical at IR Sites 34b and/or 34d is a COC (likely to cause adverse effects), not a COC (unlikely to cause adverse effects), or requires further analysis or data collection to reduce uncertainty (i.e., a BERA).

1.5.3 Uncertainties in the Process

The uncertainty analysis is an important component of the SLERA process. Uncertainties associated with the SLERA will be evaluated qualitatively. The uncertainty analysis will evaluate the potential magnitude of underestimating or overestimating the potential for adverse effects to organisms. Uncertainties may bias SLERA results in a conservative or non-conservative manner. In addition, comparisons between LANL (2012) ESLs and EcoSSLs (USEPA 2007) will be performed, and significant differences will be discussed.

A lack of toxicity data precludes adequate quantitative evaluation of risks to lizards, tortoises, and snakes; therefore they are not included as receptors for quantitative evaluation in the SLERA. The uncertainties associated with not including some ecological receptors (such as reptiles) from quantitative evaluation due to a lack of toxicity (or other) data will be discussed in the SLERA.

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Figures

Figure 1. Site Location Map
Figure 2. Ecological Conceptual Site Model
Figure 3. Terrestrial Food Web Model
Figure 4. Aquatic Food Web Model

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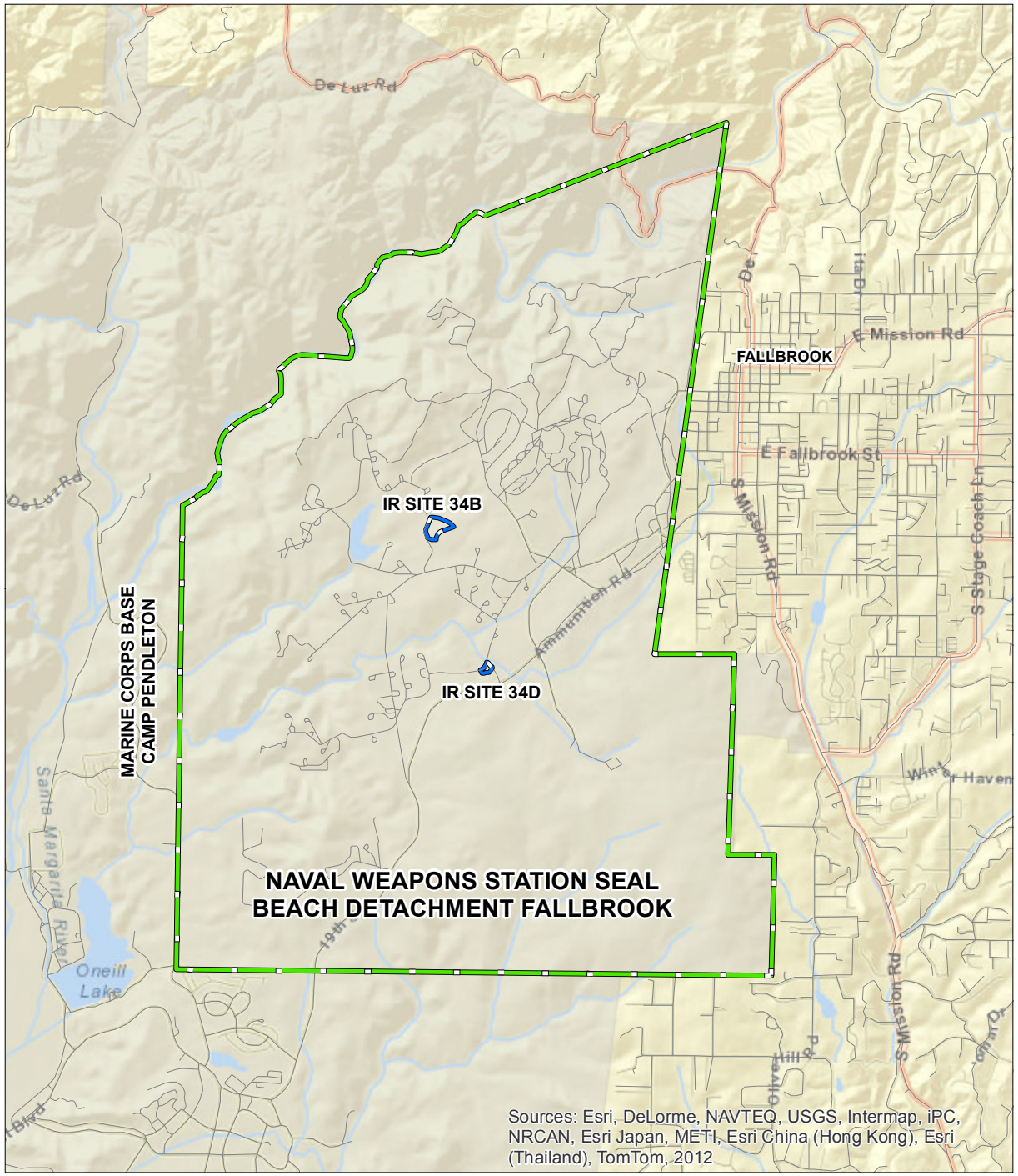
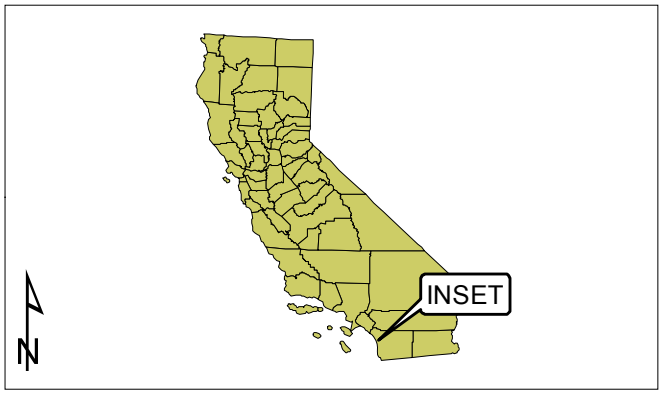
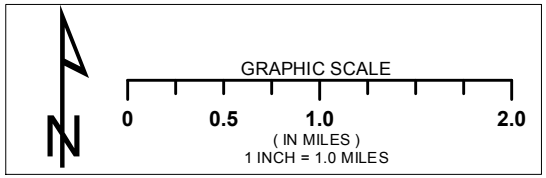




LEGEND

IR SITE BOUNDARY

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT FALLBROOK



DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 1

SITE LOCATION MAP

TREVET

DATE: JULY 2014

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

Path: N:\GIS_Projects\Fallbrook\Figs_WorkPlan_34bd-7-14\Fig1_ir34_7-14.mxd

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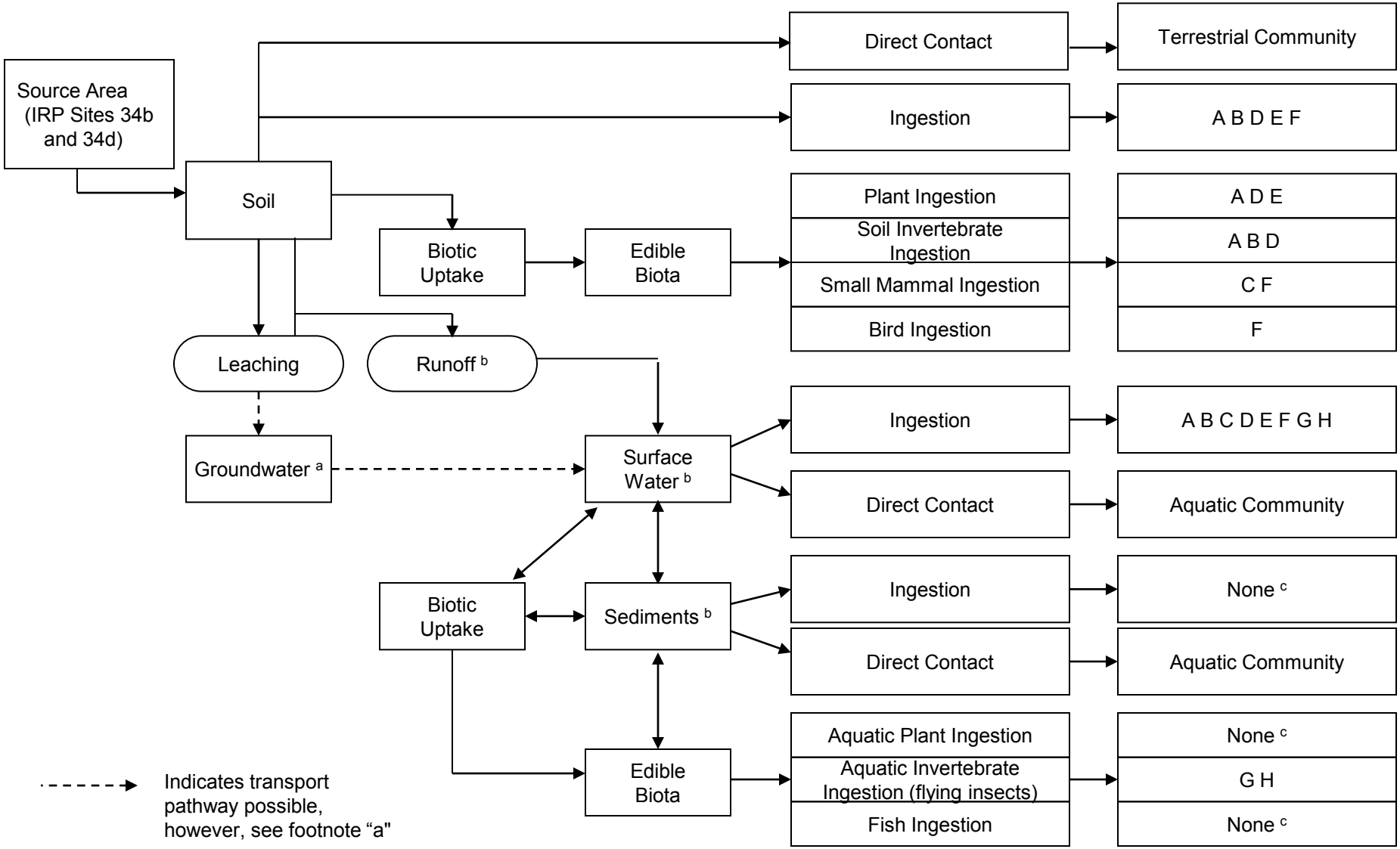

Indicates transport pathway possible, however, see footnote "a"

[a] Groundwater sampling not planned (see text)

[b] IRP Site 34d only (near Fallbrook Creek)

[C] As available and derived in LANL (2012) ESL data base. Exposure pathways are limited to those quantified by LANL for each receptor.

WILDLIFE RECEPTORS [c]

A. Deer Mouse
B. Montane Shrew
C. American Kestrel
D. American Robin
E. Desert Cottontail
F. Red Fox
G. Occult little brown bat
H. Violet-green swallow

Figure 2

Ecological Conceptual Site Model

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Figure 3

Terrestrial Food Web Model

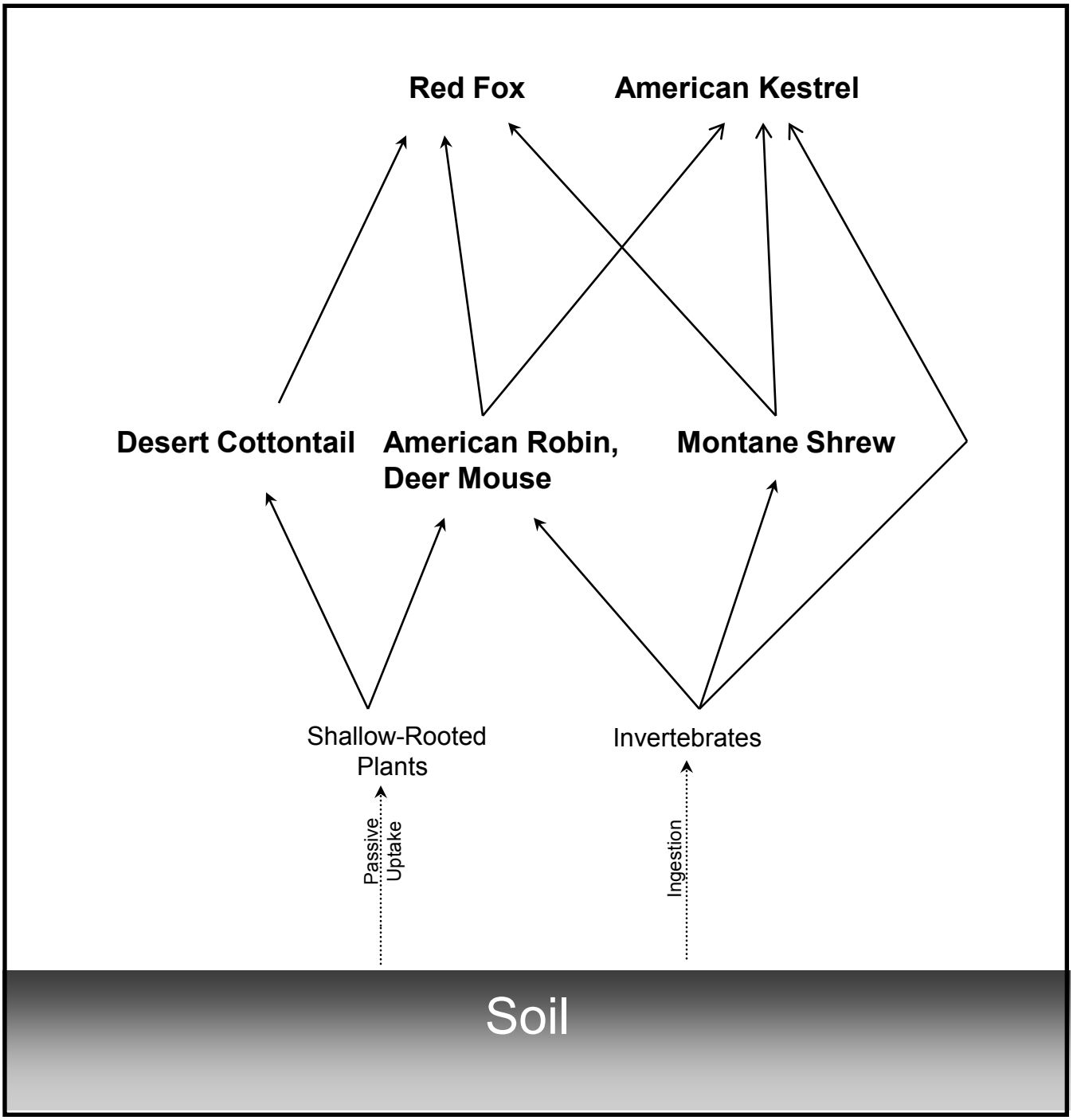

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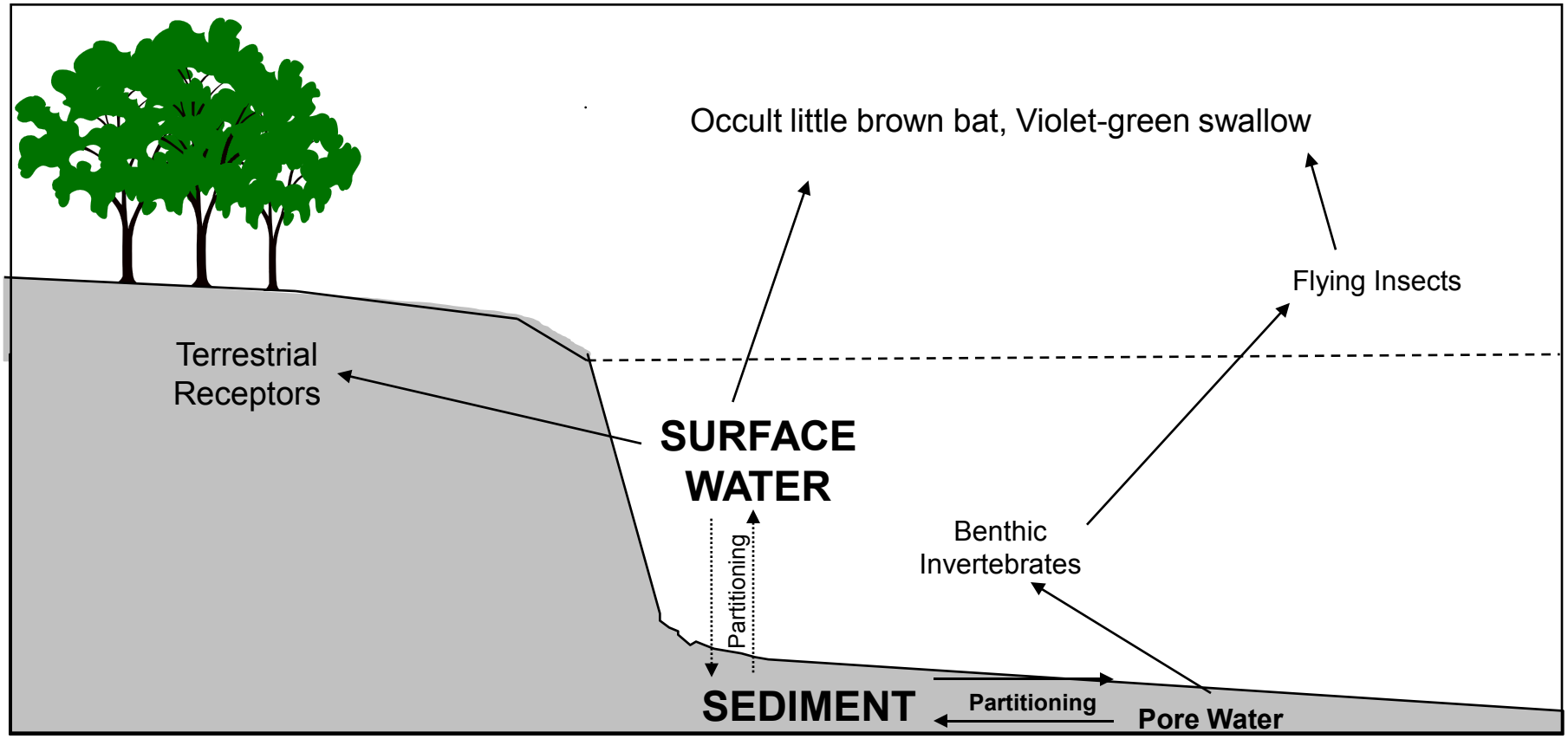
Figure 4
Aquatic Food Web Model



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Tables

Table D1. Assessment and Measurement Endpoints

Table D2. Measurement Receptor Information

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Table D1
Assessment and Measurement Endpoints

Assessment Endpoints	Measurement Endpoints	Measurement Receptor	Information Provided
Terrestrial Habitats			
Protection of trophic level 2 herbivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Desert cottontail; American robin (as herbivore)	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 3 omnivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Deer mouse; American robin (as omnivore)	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 3 insectivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Montane shrew; American robin (as insectivore)	Impacts resulting from direct exposure and indirect exposure via food chains
Protection of trophic level 4 carnivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Red fox (as top carnivore); American kestrel (as top carnivore and as intermediate carnivore)	Impacts resulting from direct exposure and indirect exposure via food chains
Preservation of the viability of upper trophic level receptors utilizing the plant community as habitat and/or food source.	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Terrestrial plant community	Impacts resulting from potential loss of food source.
Preservation of the viability of upper trophic level receptors utilizing the invertebrate community as a food source.	Mortality; reproduction, growth as measured by receptor-specific benchmark concentrations	Terrestrial invertebrate community	Impacts resulting from potential loss of food source.
Aquatic Habitats			
Protection of trophic level 3 insectivore populations	Mortality; reproduction, growth as measured by NOAEL and LOAEL based TRVs	Occult little brown bat, green-violet swallow (as insectivore)	Impacts resulting from direct exposure and indirect exposure via food chains

Table D1
Assessment and Measurement Endpoints

Assessment Endpoints	Measurement Endpoints	Measurement Receptor	Information Provided
Preservation of the viability of upper trophic level receptors utilizing the surface water aquatic community as a food source.	Mortality; reproduction, growth as measured by receptor-specific surface water benchmark concentrations, as well as state and federal ambient water quality criteria	Surface water aquatic community	Impacts resulting from potential loss of food source.
Preservation of the viability of upper trophic level receptors utilizing the sediment aquatic community as a food source.	Mortality; reproduction, growth as measured by receptor-specific sediment benchmark concentrations	Sediment aquatic community	Impacts resulting from potential loss of food source.

Notes:
COPEC constituent of potential ecological concern
LOAEL lowest-observed-adverse-effect level
NOAEL no-observed-adverse-effect level
TRV toxicity reference value

Table D2
Measurement Receptor Information [a]

Indicator Species	Average Home Range (acres)	Trophic Level	Dietary Composition
Montane shrew (*Sorex monticolus*)	0.1 [b]	Insectivore	Terrestrial invertebrates: 100%
American robin (*Turdus migratorius*)	1.2	Herbivore Insectivore Omnivore	Plants: 100% Terrestrial invertebrates: 100% 50% Plants, 50% Invertebrates
American kestrel (*Falco sparverius*)	314	Top Carnivore Intermediate Carnivore	Small mammals and birds: 100% 50% Small mammals and birds, 50% Invertebrates
Deer mouse (*Peromyscus maniculatus*)	0.06	Omnivore	50% Plants, 50% Invertebrates
Desert cottontail (*Sylvilagus audubonii*)	9.0 [c]	Herbivore	Plants: 100%
Red fox (*Vulpes vulpes*)	2204	Top Carnivore	Small mammals and birds: 100%
Occult little brown bat (*Myotis occultus*)	741 [d]	Insectivore	Flying insects: 100%
Violet-green swallow (*Tachycineta thalassina*)	464 [e]	Insectivore	Flying insects: 100%

NOTES

[a] Home range From USEPA (1993), except as noted. Trophic level and dietary composition from Los Alamos National Laboratory (2011).
[b] Smith, M.E. and M.C. Belk, 1996, *Sorex monticolus*, Mammalian Species, No. 528, pp. 1-5.
[c] Fitch (1947) in http://digital-desert.com/wildlife/cottontail.html
[d] California Wildlife Habitat Relationship System, 2005 states that *M. occultus* has HR up to several km; therefore 3 km conservatively assumed (= 741 acres).
[e] Birds of North America, Cornell Laboratory of Ornithology on-line data base, 2014, as no HR data available for *T. thalassina*, HR of similar species (*T. bicolor*, tree swallow) used: HR of 2 -3 km = 494 acres (conservative minimum).

All wildlife assumed to ingest surface water.

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Attachment

Attachment A. LANL (2012) Ecological Screening Levels for Ecological Receptors

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Attachment A
Ecological Screening Levels for Soil, Surface Water, and Sediment

Analyte	CAS	LANL Oct 2012 (Minimum Water ESL)		Units	Notes	LANL Oct 2012 (Minimum Soil ESL)			Notes	LANL Oct 2012 (Minimum Sediment ESL)		Units	Notes
		No Effect ESL	Low Effect ESL			No Effect ESL	Low Effect ESL	Units		No Effect ESL	Low Effect ESL		
1,1,1-Trichloroethane	71-55-6	11	110	ug/L		260	2600	mg/kg		0.07	0.7	mg/kg	
1,1,2,2-Tetrachloroethane	79-34-5	NVA	NVA			NVA	NVA			NVA	NVA		
1,1,2-Trichloroethane	79-00-5	11	110	ug/L	use 1,1,1-Trichloroethane	260	2600	mg/kg	use 1,1,1-Trichloroethane	0.07	0.7	mg/kg	use 1,1,1-Trichloroethane
1,1-Dichloroethane	75-34-3	47	470	ug/L		210	2100	mg/kg		0.02	0.2	mg/kg	
1,2-Dichloroethane	107-06-2	100	1000	ug/L		0.85	1.6	mg/kg		6.3	12	mg/kg	
1,1-Dichloroethene	75-35-4	25	250	ug/L		11	110	mg/kg		0.1	1	mg/kg	
1,2,4-Trimethylbenzene	95-63-6	NVA	NVA			NVA	NVA			NVA	NVA		
1,2-Dichloropropane	78-87-5	NVA	NVA			NVA	NVA			NVA	NVA		
1,3,5-Trimethylbenzene	108-67-8	NVA	NVA			NVA	NVA			NVA	NVA		
2-Butanone	78-93-3	7200	71000	ug/L		360	930	mg/kg		3300	8700	mg/kg	
2-Hexanone	591-78-6	NVA	NVA			0.36	3.6	mg/kg		NVA	NVA		
Methyl Isobutyl Ketone	108-10-1	NVA	NVA			9.8	98	mg/kg		NVA	NVA		
Acetone	67-64-1	1500	15000	ug/L		1.2	6.3	mg/kg		0.065	0.65	mg/kg	
Benzene	71-43-2	46	460	ug/L		24	240	mg/kg		0.01	0.1	mg/kg	
Bromodichloromethane	75-27-4	NVA	NVA			NVA	NVA			NVA	NVA		
Bromoform	75-25-2	NVA	NVA			NVA	NVA			NVA	NVA		
Bromomethane	74-83-9	NVA	NVA			NVA	NVA			NVA	NVA		
Carbon disulfide	75-15-0	NVA	NVA			0.82	8.2	mg/kg		NVA	NVA		
Carbon tetrachloride	56-23-5	NVA	NVA			NVA	NVA			NVA	NVA		
Chlorobenzene	108-90-7	130	1300	ug/L		2.4	24	mg/kg		0.03	0.3	mg/kg	
Dibromochloromethane	124-48-1	NVA	NVA			NVA	NVA			NVA	NVA		
Chloroethane	75-00-3	NVA	NVA			NVA	NVA			NVA	NVA		
Chloroform	67-66-3	1.8	18	ug/L		8	22	mg/kg		10	28	mg/kg	
Chloromethane	74-87-3	NVA	NVA			NVA	NVA			NVA	NVA		
cis-1,2-Dichloroethene	156-59-2	590	1100	ug/L	use Dichloroethene[cis/trans-1,2-]	23	230	mg/kg	use Dichloroethene[cis/trans-1,2-]	0.2	2	mg/kg	use Dichloroethene[cis/trans-1,2-]
cis-1,3-Dichloropropene	10061-01-5	NVA	NVA			NVA	NVA			NVA	NVA		
Ethylbenzene	100-41-4	NVA	NVA			NVA	NVA			NVA	NVA		
Isopropyl benzene	98-82-8	NVA	NVA			NVA	NVA			NVA	NVA		
m/p-Xylenes	136777-61-2	13	130	ug/L	use Xylene (Total)	1.4	1.7	mg/kg	use Xylene (Total)	0.13	1.3	mg/kg	use Xylene (Total)
Methylene chloride	75-09-2	210	2100	ug/L		2.6	22	mg/kg		0.018	0.18	mg/kg	
n-Butylbenzene	104-51-8	NVA	NVA			NVA	NVA			NVA	NVA		
n-Propylbenzene	103-65-1	NVA	NVA			NVA	NVA			NVA	NVA		
o-Xylene	95-47-6	13	130	ug/L	use Xylene (Total)	1.4	1.7	mg/kg	use Xylene (Total)	0.13	1.3	mg/kg	use Xylene (Total)
p-Isopropyltoluene	99-87-6	NVA	NVA			NVA	NVA			NVA	NVA		
sec-Butylbenzene	135-98-8	NVA	NVA			NVA	NVA			NVA	NVA		
Styrene	100-42-5	NVA	NVA			1.2	12	mg/kg		NVA	NVA		
tert-Butylbenzene	98-06-6	NVA	NVA			NVA	NVA			NVA	NVA		
Tetrachloroethylene	127-18-4	98	830	ug/L		0.18	0.94	mg/kg		0.002	0.02	mg/kg	
Toluene	108-88-3	9.8	98	ug/L		23	230	mg/kg		0.01	0.1	mg/kg	
trans-1,2-Dichloroethene	156-60-5	590	1100	ug/L	use Dichloroethene[cis/trans-1,2-]	23	230	mg/kg	use Dichloroethene[cis/trans-1,2-]	0.2	2	mg/kg	use Dichloroethene[cis/trans-1,2-]
trans-1,3-Dichloropropene	10061-02-6	NVA	NVA			NVA	NVA			NVA	NVA		
Trichloroethene	79-01-6	21	210	ug/L		42	420	mg/kg		0.078	0.78	mg/kg	
Vinyl chloride	75-01-4	NVA	NVA			0.12	1.2	mg/kg		NVA	NVA		
1,2,4,5-Tetrachlorobenzene	95-94-3	NVA	NVA			NVA	NVA			NVA	NVA		
1,2,4-Trichlorobenzene	120-82-1	24	240	ug/L		0.27	2.7	mg/kg		0.011	0.11	mg/kg	
1,2-Dichlorobenzene	95-50-1	NVA	NVA			0.92	9.2	mg/kg		NVA	NVA		
1,3-Dichlorobenzene	541-73-1	NVA	NVA			0.73	7.3	mg/kg		NVA	NVA		
1,4-Dichlorobenzene	106-46-7	15	150	ug/L		0.88	3.5	mg/kg		0.03	0.3	mg/kg	
2,2-Oxybis (1-Chloropropane)	108-60-1	NVA	NVA			NVA	NVA			NVA	NVA		
2,4,5-Trichlorophenol	95-95-4	NVA	NVA			NVA	NVA			NVA	NVA		
2,4,6-Trichlorophenol	88-06-2	NVA	NVA			NVA	NVA			NVA	NVA		
2,4-Dichlorophenol	120-83-2	NVA	NVA			NVA	NVA			NVA	NVA		
2,4-Dimethylphenol	105-67-9	NVA	NVA			NVA	NVA			NVA	NVA		
2,4-Dinitrophenol	51-28-5	NVA	NVA			NVA	NVA			NVA	NVA		
2,4-Dinitrotoluene	121-14-2	65	330	ug/L		2.5	25	mg/kg		0.29	2.9	mg/kg	
2,6-Dichlorophenol	87-65-0	NVA	NVA			NVA	NVA			NVA	NVA		
2-Chloronaphthalene	91-58-7	NVA	NVA			NVA	NVA			NVA	NVA		
2-Chlorophenol	95-57-8	490	4300	ug/L		0.39	3.9	mg/kg		0.055	0.55	mg/kg	
2-Methylphenol	95-48-7	NVA	NVA			0.67	6.7	mg/kg		NVA	NVA		

Attachment A
Ecological Screening Levels for Soil, Surface Water, and Sediment

Analyte	CAS	LANL Oct 2012 (Minimum Water ESL)		Units	Notes	LANL Oct 2012 (Minimum Soil ESL)			Notes	LANL Oct 2012 (Minimum Sediment ESL)		Units	Notes
		No Effect ESL	Low Effect ESL			No Effect ESL	Low Effect ESL	Units		No Effect ESL	Low Effect ESL		
2-Nitroaniline	88-74-4	NVA	NVA			5.4	1500	mg/kg		NVA	NVA		
2-Nitrophenol	88-75-5	NVA	NVA			NVA	NVA			NVA	NVA		
3,3'-Dichlorobenzidine	91-94-1	NVA	NVA			NVA	NVA			NVA	NVA		
3,3'-Dimethylbenzibine	119-93-7	NVA	NVA			NVA	NVA			NVA	NVA		
3.4-Methylphenol	106-44-5	NVA	NVA			NVA	NVA			NVA	NVA		
3-Nitroaniline	99-09-2	NVA	NVA			NVA	NVA			NVA	NVA		
4,6-Dinitro-2-methylphenol	534-52-1	NVA	NVA			NVA	NVA			NVA	NVA		
4-Bromophenyl-phenyl ether	101-55-3	NVA	NVA			NVA	NVA			NVA	NVA		
4-Chloro-3-methylphenol	59-50-7	NVA	NVA			NVA	NVA			NVA	NVA		
4-Chloroaniline	106-47-8	NVA	NVA			1	10	mg/kg		NVA	NVA		
4-Chlorophenyl-phenyl ether	7005-72-3	NVA	NVA			NVA	NVA			NVA	NVA		
4-Nitroaniline	100-01-6	NVA	NVA			NVA	NVA			NVA	NVA		
4-Nitrophenol	100-02-7	NVA	NVA			NVA	NVA			NVA	NVA		
5-Nitro-o-toluidine	99-55-8	NVA	NVA			NVA	NVA			NVA	NVA		
A,A-Dimethylphenethylamine	122-09-8	NVA	NVA			NVA	NVA			NVA	NVA		
Acenaphthene	83-32-9	5.8	58	ug/L		0.25	2.5	mg/kg		0.076	0.76	mg/kg	
Acetophenone	98-86-2	NVA	NVA			NVA	NVA			NVA	NVA		
Aniline	62-53-3	NVA	NVA			NVA	NVA			NVA	NVA		
Aramite	140-57-8	NVA	NVA			NVA	NVA			NVA	NVA		
Benzo(a)anthracene	56-55-3	0.027	0.27	ug/L		0.8	8	mg/kg		0.1	1	mg/kg	
Benzo(a)pyrene	50-32-8	0.014	0.14	ug/L		53	170	mg/kg		0.15	1.4	mg/kg	
Benzo(b)fluoranthene	205-99-2	9	90	ug/L		18	180	mg/kg		0.19	1.9	mg/kg	
Benzo(g,h,i)perylene	191-24-2	7.6	76	ug/L		24	240	mg/kg		0.17	1.7	mg/kg	
Benzo(k)fluoranthene	207-08-9	0.0041	0.041	ug/L		62	620	mg/kg		0.24	2.4	mg/kg	
Benzyl alcohol	100-51-6	NVA	NVA			120	360000	mg/kg		330	3300	mg/kg	
bis(2-Chloroethoxy)methane	111-91-1	NVA	NVA			NVA	NVA			NVA	NVA		
bis(2-Chloroethyl)ether	111-44-4	NVA	NVA			NVA	NVA			NVA	NVA		
Bis(2-ethylhexyl)phthalate	117-81-7	32	320	ug/L		0.02	0.2	mg/kg		0.026	0.26	mg/kg	
Butylbenzylphthalate	85-68-7	19	190	ug/L		90	900	mg/kg		0.1	1	mg/kg	
Chlorobenzilate	510-15-6	NVA	NVA			NVA	NVA			NVA	NVA		
Chrysene	218-01-9	0.0018	0.018	ug/L		2.4	24	mg/kg		0.16	1.2	mg/kg	
Diallate	2303-16-4	NVA	NVA			NVA	NVA			NVA	NVA		
Dibenzo(a,h)anthracene	53-70-3	0.0034	0.034	ug/L		12	120	mg/kg		0.033	0.33	mg/kg	
Dibenzofuran	132-64-9	3.7	37	ug/L		6.1	61	mg/kg		0.51	5.1	mg/kg	
Diethylphthalate	84-66-2	NVA	NVA			100	1000	mg/kg		NVA	NVA		
Dimethylphthalate	131-11-3	3	30	ug/L		10	100	mg/kg		100	1000	mg/kg	
Di-n-butylphthalate	84-74-2	19	190	ug/L		0.011	0.11	mg/kg		0.011	0.11	mg/kg	
Di-n-octylphthalate	117-84-0	3	30	ug/L		0.91	9.1	mg/kg		1.1	11	mg/kg	
Diphenylamine	122-39-4	NVA	NVA			10	17	mg/kg		13	22	mg/kg	
Fluoranthene	206-44-0	0.04	0.4	ug/L		10	23	mg/kg		0.42	2.2	mg/kg	
Fluorene	86-73-7	3.9	39	ug/L		3.7	19	mg/kg		0.077	0.53	mg/kg	
Hexachlorobenzene	118-74-1	NVA	NVA			0.079	0.79	mg/kg		NVA	NVA		
Hexachlorobutadiene	87-68-3	NVA	NVA			NVA	NVA			NVA	NVA		
Hexachlorocyclopentadiene	77-47-4	NVA	NVA			NVA	NVA			NVA	NVA		
Hexachloroethane	67-72-1	NVA	NVA			NVA	NVA			NVA	NVA		
Indeno(1,2,3-cd)pyrene	193-39-5	4.3	43	ug/L		62	620	mg/kg		0.2	2	mg/kg	
Isophorone	78-59-1	NVA	NVA			NVA	NVA			NVA	NVA		
Kepone	143-50-0	350	1700	ug/L		0.021	0.1	mg/kg		0.027	0.13	mg/kg	
Naphthalene	91-20-3	1.1	11	ug/L		1	10	mg/kg		0.17	0.56	mg/kg	
N-Nitroso-di-n-butylamine	924-16-3	NVA	NVA			NVA	NVA			NVA	NVA		
N-Nitrosodimethylamine	62-75-9	NVA	NVA			NVA	NVA			NVA	NVA		
N-Nitroso-di-n-propylamine	621-64-7	NVA	NVA			NVA	NVA			NVA	NVA		
N-Nitrosomethylethylamine	10595-95-6	NVA	NVA			NVA	NVA			NVA	NVA		
N-Nitrosopyrrolidine	930-55-2	NVA	NVA			NVA	NVA			NVA	NVA		
O-toluidine	95-53-4	NVA	NVA			NVA	NVA			NVA	NVA		
Pentachlorobenzene	608-93-5	NVA	NVA			NVA	NVA			NVA	NVA		
Pentachloroethane	76-01-7	NVA	NVA			NVA	NVA			NVA	NVA		
Pentachloronitrobenzene	82-68-8	10	100	ug/L		0.7	41	mg/kg		0.92	9.2	mg/kg	
Pentachlorophenol	87-86-5	15	19	ug/L		0.36	3.6	mg/kg		0.01	0.1	mg/kg	

Attachment A
Ecological Screening Levels for Soil, Surface Water, and Sediment

Analyte	CAS	LANL Oct 2012 (Minimum Water ESL)		Units	Notes	LANL Oct 2012 (Minimum Soil ESL)			Notes	LANL Oct 2012 (Minimum Sediment ESL)		Units	Notes
		No Effect ESL	Low Effect ESL			No Effect ESL	Low Effect ESL	Units		No Effect ESL	Low Effect ESL		
Phenanthrene	85-01-8	6.3	30	ug/L		5.5	12	mg/kg		0.2	1.1	mg/kg	
Phenol	108-95-2	320	3200	ug/L		0.79	7.9	mg/kg		840	8400	mg/kg	
Pronamide	23950-58-5	NVA	NVA			NVA	NVA			NVA	NVA		
Pyrene	129-00-0	0.025	0.25	ug/L		10	20	mg/kg		0.19	1.5	mg/kg	
Pyridine	110-86-1	NVA	NVA			NVA	NVA			NVA	NVA		
Aluminum	7429-90-5	530	1300	ug/L		pH dependent	pH dependent	mg/kg		25000	58000	mg/kg	also pH dependent
Antimony	7440-36-0	30	88	ug/L		0.05	0.5	mg/kg		0.36	3.6	mg/kg	
Arsenic	7440-38-2	150	340	ug/L		6.8	68	mg/kg		9.7	33	mg/kg	
Barium	7440-39-3	3.9	39	ug/L		110	260	mg/kg		150	300	mg/kg	
Beryllium	7440-41-7	0.66	6.6	ug/L		2.5	25	mg/kg		73	730	mg/kg	
Boron	7440-42-8	1.6	16	ug/L		2	10	mg/kg		10	54	mg/kg	
Cadmium	7440-43-9	0.28	0.91	ug/L		0.27	2.7	mg/kg		0.33	3.3	mg/kg	
Calcium	7440-70-2	NVA	NVA		Nutrient	NVA	NVA		Nutrient	NVA	NVA		Nutrient
Chromium	7440-47-3	11	16	ug/L	use Chromium (total)	28	280	mg/kg	use Chromium (total)	43	110	mg/kg	use Chromium (total)
Cobalt	7440-48-4	3	30	ug/L		13	130	mg/kg		230	2300	mg/kg	
Copper	7440-50-8	5	7	ug/L		15	46	mg/kg		23	70	mg/kg	
Iron	7439-89-6	1000	10000	ug/L		NVA	NVA			20000	40000	mg/kg	
Lead	7439-92-1	1	10	ug/L		14	28	mg/kg		27	54	mg/kg	
Magnesium	7439-95-4	NVA	NVA		Nutrient	NVA	NVA		Nutrient	NVA	NVA		Nutrient
Manganese	7439-96-5	1300	2300	ug/L		220	1100	mg/kg		460	1100	mg/kg	
Molybdenum	7439-98-7	1800	7900	ug/L		17	170	mg/kg		27	270	mg/kg	
Nickel	7440-02-0	29	260	ug/L		9.7	19	mg/kg		13	27	mg/kg	
Potassium	7440-09-7	NVA	NVA		Nutrient	NVA	NVA		Nutrient	NVA	NVA		Nutrient
Selenium	7782-49-2	5	20	ug/L		0.52	3.4	mg/kg		0.72	2.9	mg/kg	
Silica		NVA	NVA			NVA	NVA			NVA	NVA		
Silver	7440-22-4	0.1	1	ug/L		2.6	26	mg/kg		0.5	5	mg/kg	
Sodium	7440-23-5	NVA	NVA		Nutrient	NVA	NVA		Nutrient	NVA	NVA		Nutrient
Thallium	7440-28-0	0.03	0.3	ug/L		0.032	0.32	mg/kg		0.044	0.44	mg/kg	
Vanadium	7440-62-2	19	190	ug/L		0.025	0.25	mg/kg		30	61	mg/kg	
Zinc	7440-66-6	65	85	ug/L		48	480	mg/kg		65	650	mg/kg	
Mercury	7439-97-6	0.77	1.4	ug/L	use inorganic mercury	0.013	0.13	mg/kg	use inorganic mercury for soil screening	0.00046	0.0046	mg/kg	use methyl mercury value for sediment screening
Hexavalent Chromium	18540-29-9	11	16	ug/L		0.34	3.4	mg/kg		680	6800	mg/kg	
2378-TCDD	1746-01-6	0.000002	0.00002	ug/L	N/A	2.90E-07	1.90E-06	mg/kg		3.60E-07	2.40E-06	mg/kg	
12378-PeCDD	40321-76-4	N/A	N/A			2.90E-07	1.90E-06	mg/kg	TCDD-TEQ	3.60E-07	2.40E-06	mg/kg	TCDD-TEQ
123478-HxCDD	39227-28-6	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
123678-HxCDD	57653-85-7	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
123789-HxCDD	19408-74-3	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
1234678-HpCDD	35822-46-9	N/A	N/A			2.90E-05	1.90E-04	mg/kg	TCDD-TEQ	3.60E-05	2.40E-04	mg/kg	TCDD-TEQ
OCDD	3268-87-9	N/A	N/A			9.67E-04	6.33E-03	mg/kg	TCDD-TEQ	1.20E-03	8.00E-03	mg/kg	TCDD-TEQ
2378-TCDF	51207-31-9	N/A	N/A			2.90E-07	1.90E-06	mg/kg	TCDD-TEQ	3.60E-07	2.40E-06	mg/kg	TCDD-TEQ
12378-PeCDF	57117-41-6	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
23478-PeCDF	57117-31-4	N/A	N/A			2.90E-07	1.90E-06	mg/kg	TCDD-TEQ	3.60E-07	2.40E-06	mg/kg	TCDD-TEQ
123478-HxCDF	70648-26-9	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
123678-HxCDF	57117-44-9	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
123789-HxCDF	72918-21-9	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
234678-HxCDF	60851-34-5	N/A	N/A			2.90E-06	1.90E-05	mg/kg	TCDD-TEQ	3.60E-06	2.40E-05	mg/kg	TCDD-TEQ
1234678-HpCDF	67562-39-4	N/A	N/A			2.90E-05	1.90E-04	mg/kg	TCDD-TEQ	3.60E-05	2.40E-04	mg/kg	TCDD-TEQ
1234789-HpCDF	55673-89-7	N/A	N/A			2.90E-05	1.90E-04	mg/kg	TCDD-TEQ	3.60E-05	2.40E-04	mg/kg	TCDD-TEQ
OCDF	39001-02-0	N/A	N/A			9.67E-04	6.33E-03	mg/kg	TCDD-TEQ	1.20E-03	8.00E-03	mg/kg	TCDD-TEQ

LANL = Los Alamos National Laboratory (for a full list of receptor-specific ELS that will be used, for each detected analyte, see: http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php)
ESL = Ecological Screening Level (minimum ESL presented for each medium [as example], for a variety of ecological receptors)
TEQ = Toxicity Equivalent (individual congener values estimated using TEFs for 2,3,7,8-TCDD)
TEF = toxicity equivalency factor
N/A = not applicable (D/F not recommended for anlaysis in surface water due to low solubility)

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Appendix E: Response to Agency Comments and Attachments

Attachment 1 – Proposed Test Pit Locations Technical Memorandum for IR Sites 34b and 34d
Attachment 2 – Aerial Photographs for IR Site 34b
Attachment 3 – Aerial Photographs for IR Site 34d

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Mr. Stephen Niou, Project Manager – Comments received by email December 4, 2014 **California Department of Toxic Substances Control (DTSC)** **5796 Corporate Avenue, Cypress, CA 90630**	
DTSC Comments	**Navy Responses**
General Comment 1: DTSC does not believe geophysical methods are effective in detecting non-metal material buried below ground surface (bgs). Also, we do not agree with Navy's response to DTSC's comments stating that geophysical surveys are able to detect metallic objects up to 15 feet bgs. Consequently, DTSC cannot agree with the application of geophysical survey data to delineate waste disposal areas and to determine the locations of test pits.	**Response to General Comment 1:** The geophysical surveys that were performed at the sites were just the first step that was used to help determine the best locations where test pits should be dug. Other site information including available site data and maps, aerial photographs (see General Comment 2), and a detailed visual evaluation of both surface contours and detected surface debris were evaluated. That cumulative information was used to best locate areas where waste possibly could have been disposed at each site, not just the collected geophysical data. Only one waste disposal area is known to exist at IR Sites 34b and 34d, and that is the waste disposal trench at the center of IR Site 34b. No other areas at those two sites were found through visual inspection or geophysical means to have positive indications of waste disposal at those sites. As a result, site test pits were selected based primarily on potential access and site topography at IR Site 34d and at identified linear features at IR Site 34b.
General Comment 2: DTSC recommends the examination of past aerial photos and ground surface elevation contours to identify potential disposal areas and to help in the determination of excavation/ soil sampling locations.	**Response to General Comment 2:** The Site Inspection (SI) Report (ChaduxTt 2010) documents the examination of aerial photographs in an effort to determine where past disposal activities may have taken place. It was this review of past aerial photographs that resulted in the identification of the two potential disposal trenches in the southwestern portion of IR Site 34b. No such areas of potential disposal were identified during the SI review of aerial photographs for IR Site 34d. In response to this comment and subsequent related comments, available aerial photographs for both sites are provided as an

	attachment to these RTCs. Historical elevation contours at the sites are not known to exist with a precision that would be useful for the identification of disposal areas. However, a visual evaluation of the present surface contours of the site has been done. That assessment was greatly enhanced by the devegetation resulting from the recent wildfires.
General Comment 3: As we do not know whether or not the site has impacts of pesticides, PAHs and PCBs, in addition to the analyses of VOCs, SVOCs, metals, TOCs, and dioxins/furans, DTSC recommends that pesticides, PAHs, and PCBs be analyzed for selected soil samples.	**Response to General Comment 3:** Because waste exists in the one known disposal trench at IR Site 34b, pesticide and PCB analyses has been added for the four waste samples planned to be collected from the Waste Test Pits at that site. At IR Site 34d, where waste disposal has not been identified, four of the test pit samples with the greatest overall detected contaminant concentrations will also be analyzed for pesticides and PCBs. The SVOC analytical suite planned for all soil samples at both IR sites includes PAHs, as shown on SAP WS#15.
General Comment 4: Because of the lacking of information on past disposal areas, DTSC recommends that the Navy take a phased approach to this RI. We believe the numbers of test pits and soil samples may have to be modified with new RI data.	**Response to General Comment 4:** The Navy acknowledges that if dunnage or waste encountered constitutes a larger release than expected, additional investigation of those areas may be needed. The technical approach presented in this Work Plan represents the approach agreed upon in the Preliminary Assessment and the follow up Site Investigation, as per the CERCLA process. Site Remedial Investigations can only cover suspected or known conditions. However, if the Investigation uncovers evidence of a larger environmental release or the results indicate data gaps, the Navy is obligated to continue with the studies until the nature and extent of the release is properly characterized. The geophysical assessment that was performed during the work plan development phase represents the Navy's current phased approach for this action. That survey was performed to assess if subsurface waste

	could be identified in other areas besides where waste is known to exist in the single drainage at IR Site 34b. The geophysical assessment did not indicate any additional areas where buried waste might exist at either IR site. As a result, the planned trenching and sampling is the next phase to attempt to determine if waste disposal has occurred at those sites.
General Comment 5: Section 1.2 - IR Sites 34b and 34d Summary- The text states that both IR Sites 34b and 34d were not used as munitions burials. Please provide supporting data to back up this statement that MEC/MC are not present at these sites.	**Response to General Comment 5:** As noted in the SI Report, the Preliminary Assessment (PA) Report (Malcolm Pirnie 2006) recommended NFA for MEC and MC for IR Sites 34b and 34d. For IR Site 34b, the SI notes in Section 8.1 that "a detailed review of historical installation records, reconnaissance surveys, and follow-up interviews found no evidence that munitions were disposed of at the site." Section 9.1 of the SI Report makes parallel observations for IR Site 34d. In response to this comment, additional text making reference to both the PA and the SI reports will be added to Section 1.2 of the Work Plan.
Comment 6: Section 3.7, Test Pit Excavations, page 3-3 a. Because 3 test pits will be excavated at past soil sampling locations, DTSC recommends that the Navy provide a table of past soil sampling data in this work plan. b. Please provide the rationale of limiting the number of test pits to seven. c. Please provide the rationale of the locations of test pits. d. Please explain the rationale of limited investigation at the	**Response to Comment 6:** a. In response to this comment copies of the soil data tables from the SI Report have been included as Appendix F of the Work Plan. b. Seven test pits were initially selected for IR Site 34b in order to provide sufficient information about the nature and extent of contamination in the known disposal trench, while allowing assessment on the two other possible trench areas in the southwest portion of the site. Based on the results of the geophysical evaluation, these comments, and the 1/16/15 site walk, the number of proposed test pits has been reduced to 6, and the sampling program has been altered to distinguish between exploratory test pits for locations where waste has not been identified, and waste test pits for locations where waste

other three potential waste disposal areas. DTSC believes four test pits may not be sufficient to delineate the nature and extent of contamination for the other areas. e. DTSC believes the number of soil samples should not be limited to 35. With DTSC's recommended phased RI approach, additional soil samples may have to be collected. f. DTSC believes that the collection of soil samples may not be limited to the bottom or walls of test pits. Soil sampling may be conducted at places at which field data/observation suggests the possibility of past disposal and where test pits are not proposed.	disposal has occurred. c. The rational for the locations of each of the test pits is detailed in the Proposed Test Pit Locations technical memorandum for IR Sites 34b and 34d, which accompanies these RTCs and will be included as an appendix in the next version of the Work Plan. In summary the test pits are based on a combination of the results of the geophysical investigation, visual observation of site topography, historical aerial photographs, and observable surface debris. d. At IR Site 34b, there is only one known area of buried debris disposal, identified on figures as the known disposal trench. Based on the geophysical survey, as well as consideration of visual observation of site topography, and observable surface debris, this appears to be the only area of waste disposal. Because two linear features that may have been trenches were identified in the SI based on review of aerial photographs, geophysical evaluation was performed for these two features. Following the 1/16/15 site walk, the Navy and regulators agreed that no further evaluation of these two linear features was needed, based on the geophysical data, the aerial photograph review, and the visual assessment of the site. The third site linear feature/potential waste disposal area identified in the northeast of IR Site 34b was initially identified for evaluation based on topography, when the site was still well vegetated. Based on the geophysical results and the increased ability to visually assess the feature following the recent wildfire devegetation, this feature is identified as a natural drainage with no visual or geophysical indication that might suggest any disposal activities. As a result, no further actions or sampling is planned for this feature. e. Please see the Navy response to General Comment 4 above. f. Noted. No such areas have been identified to date at IR Site 34b. If such areas are identified, contractual modification will be needed and associated planning required.

Comment 7:	**Response to Comment 7:**
Site 34d a. DTSC recommends the examination of past aerial photos and ground surface elevation contours to identify potential past disposal areas. b. Please provide the rationale of limiting the number of test pits to four and the number of soil samples to 10. c. Please provide the rationale of test pit location and depth.	Site 34d a. Please see the Navy response to General Comment 2 above. b. Four test pits were planned to evaluate areas of buried debris as identified by the geophysical investigation. No such areas were identified. As a result, the purpose of the test pits has been shifted slightly from the evaluation of identified areas of buried waste or debris, to exploration and confirmation of the results of the geophysical investigation. Accordingly, the number of test pits has been increased from four to eleven, while the number of samples planned in each test pit has been reduced from five to two. c. The rational for the locations of each of the test pits is detailed in the Proposed Test Pit Locations technical memorandum for IR Sites 34b and 34d, which accompanies these RTCs and will be included as an appendix in the next version of the Work Plan. In summary the locations of the test pits are based on a combination of the results of the geophysical investigation, visual observation of site topography, historical aerial photographs, and observable surface debris. The planned depth of the test pits (five feet) is based on a general expectation that the waste disposal at IR Site 34d (if any) will be similar to the depths identified for waste in the IR Site 34b SI investigation; stated as a maximum of 4 feet bgs (ChaduxTt 2010). In the event that buried waste is encountered at IR Site 34d that extends to a greater depth than expected, then the depth of the excavation will be increased as feasible based on the limitations of the excavation equipment or refusal.

Ms. Beatrice Griffey, Engineering Geologist, Northern Cleanup Unit **Received by Email December 8, 2014** **California Regional Water Quality Control Board, San Diego Region** **2375 Northside Drive, Suite 100, San Diego, CA 92108**	**RE:T10000004377:BGriffey for IR Site 34b** **RE:T10000004381:BGriffey for IR Site 34d**
Water Board General Comments	
General Comments: Introduction The "Draft Work Plan, Remedial Investigation IR Sites 34b and 34d, Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California" (Draft Work Plan) by Trevet, dated September 30, 2014, was received by the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) on October 13, 2014. The Draft Work Plan presents proposed remedial investigative activities for Naval Weapons Station Seal Beach Detachment Fallbrook Installation Restoration (IR) Sites 34b and 34d. The stated investigation objectives are to characterize the nature and extent of soil contamination, and characterize sediment and surface water contamination associated with historical activities conducted at the Sites, which involved the burning and disposal of waste for several decades. Investigation findings will be used in risk assessments to evaluate the potential threat site conditions may pose to human and ecological receptors.	**Response to Introduction:** The Navy would like it noted that while the period of time within which disposal may have taken place at the sites does cover decades, there is no indication that waste disposal occurred at the sites "for several decades". The only known waste disposal determined so far at IR Sites 34b and 34d is the one known disposal trench at IR Site 34b. Other than that single disposal trench, there has been no physical indication found that suggest that waste disposal has occurred at IR Site 34d or in the other areas of IR Site 34b.
General Comment 1: Proposed Utility Survey and Clearance The proposed use of spray paint during field activities has the potential to adversely affect the acquired analytical data and should be avoided if possible. The proposed field activities include the use of spray paint to demarcate test pit and boring locations (Draft Work Plan, Subsection 3.4, First Paragraph, Second Sentence). Typically environmental investigations of this nature do not include the use of such products during field activities due to the potential for the product to contaminate the collected and analyzed samples, and generate analytical data that is not representative of site conditions related to the historical Site activities. If possible, please revise the proposed activities to eliminate the use of spray paint and propose an alternative approach to demarcate pit and boring locations.	**Response to General Comment 1:** In response to this comment the Work Plan will be revised to indicate the use of stakes rather than spray paint to demarcate pit and boring locations.

General Comment 2: Proposed Soil and Sediment Sampling Plans	Response to General Comment 2:
The proposed soil and sediment sampling plans for IR Sites 34b and 34d do not seem adequate to achieve the stated investigation objectives and support defensible risk assessments. The stated investigation objectives include the characterization of the nature and extent of soil contamination, and characterization of sediment contamination within Fallbrook Creek (Draft Work Plan, Subsection 1.1). Investigation findings will be used to conduct a human health risk assessment (HHRA) and ecological risk assessment (ERA; Draft Work Plan, Section 4). The proposed soil sampling plan involves the advancement of up to seven 5 X 5 feet trenches to address a total of 1,600 feet of four disposal trenches, and the identification of sampling locations based on soil conditions encountered during the field activities. The sediment sampling plan involves the identification of four sampling locations collocated with surface water sample locations. Historical Site activities of environmental concern involved the disposal of waste from 1942 through 1978. Therefore, it seems probable the location of waste disposal activities and waste characteristics changed with time. Yet the proposed activities only address a very small portion of the identified disposal areas and do not address the extent of soil and sediment contamination identified during the investigation. If the field identified contaminated soil/sediment is sampled, then such findings are appropriate to support defensible conclusions regarding the nature of contamination, i.e. identify contaminant types and concentrations. However, such an approach is not appropriate to support defensible conclusions regarding the extent of identified soil/sediment contamination. Due to the known heterogeneity of soil/sediment contamination, the delineation of the lateral extent of contamination typically is achieved with multiple peripheral borings/trenches/sampling locations surrounding identified areas of contamination. The delineation of the vertical extent of contamination typically is achieved with two consecutive samples with contaminant concentrations below the established project screening levels. Such activities are not proposed in the Draft Work Plan. Therefore it seems unlikely that the findings of the proposed plan will support defensible conclusions regarding the nature and extent of contamination, which are fundamental components of defensible risk	This comment mirrors concerns expressed by DTSC over several of their comments, and therefore the responses below include paragraphs of text that are provided above in the responses to DTSC comments. The Navy would like to emphasize that other than the one known disposal trench at IR Site 34b, indications of waste disposal have not been found at IR Sites 34b and 34d. The observed limited scattered surface and detected subsurface debris found at IR Site 34d does not suggest so far that waste disposal has occurred at that site. The Navy acknowledges that it is possible that if dunnage disposal is encountered to a greater extent than expected, additional investigation of those areas may be needed, either as a field change or as a separate evaluation. The technical approach presented in this Work Plan represents the planned approach to evaluate the site based on the current available information. The geophysical assessment that was performed during the work plan development phase represents the Navy's current phased approach for this action. That survey was performed to assess if subsurface waste could be identified in other areas, besides where waste is known to exist at IR Site 34b. The geophysical survey and assessment did not indicate any additional areas where buried waste might exist at either IR site, other than the disposal trench identified in the SI at IR Site 34b. As a result, the planned trenching and sampling is the next phase to see if other waste disposal has occurred at those sites. The rational for the locations of each of the test pits is detailed in the Proposed Test Pit Locations technical memorandum for IR Sites 34b and 34d, which will be included in the next version of the Work Plan and is provided herein as an

assessments. Based on the stated investigation objectives, the desired performance of a HHRA and ERA, and current understanding of Site conditions, it seems that the implementation of a phased environmental investigation (a.k.a. triad approach) is warranted. In the RTC, please provide either the technical rationale that the proposed activities are adequate to achieve the stated investigation objectives and support a HHRA and ERA, including cited references, revised activities, or the proposed approach and time frame for characterizing the nature and extent of soil and sediment contamination identified during this investigation, whichever is appropriate.	attachment. In summary the locations of the test pits are based on a combination of the results of the geophysical investigation, visual observation of site topography, historical aerial photographs, and observable surface debris. The geophysical evaluation did not indicate areas of buried waste other than the known disposal trench at IR Site 34b. This is our only "identified area of contamination", and it is believed to be narrow enough a feature that the lateral extent on both sides at any point along its length is expected to be definable by a single test pit. Because no other identified areas of contamination are known to exist at the two sites, the planned exploratory test pits will be used to evaluate parts of the sites where buried waste might exist, which were not detected by the geophysical survey. The sediment sampling proposed in the Work Plan is not intended to delineate an area of known sediment contamination, but to evaluate whether site contaminants, if they exist, have impacted the creek.
General Comment 3a: Proposed Human Health Risk Assessment The proposed generation and designation of a "total soil" data set does not seem to consider natural environmental processes that are known to occur and conditions that likely will develop at the Sites, and is not adequately supported in the Draft Work Plan. According to Draft Work Plan, Appendix C, Subsection 3.2, the proposed activities include generating a total soil data set by combining the surface soil and subsurface soil data sets that will be used in a human health risk assessment. Such an approach does not seem to take into consideration the erosion and removal of surface soil related to overland flow of surface waters, and the exposure of subsurface soil with time. Also the reference of the environmental guidance document supporting the proposed approach is not cited in the Draft Work Plan. In the RTC, please provide a revised Draft Work Plan, Appendix C, Subsection 3.2 that either includes a detailed technical discussion supporting the proposed "total soil" data set including citing appropriate	**Response to General Comment 3:** The reference (DTSC, 2011) has been added to Section 5.2 of the HHRA Work Plan to support the use of surface soil (0-0.5 ft. bgs) and subsurface soil (0.5-10 ft. bgs) in the HHRA, for hypothetical future residential adult and children exposure to COPCs, as well as potential construction worker exposure to COPCs. The citation (EPA, 1989), already in Section 8 (References), has been added to Section 3.2 to support the combining of surface soil and subsurface soil in assessing potential receptor exposure to COPC in soil that may be disturbed (e.g., as a result of construction) in the future. A special consideration for potential exposure to subsurface COPCs only, due to erosion, has been added to the Work Plan;

references, or delete the proposed "total soil" data set, whichever is appropriate.	as the sites may be prone to this type of environmental disturbance for those portions of the sites situated on a hillside. However, as erosion of the top 0.5 ft of soil is considered unlikely, given an average annual precipitation at Fallbrook, California of approximately 16 inches, this evaluation will be performed in the HHRA uncertainty section. [1] *DTSC, 2011, HHRA Note Number 4, Screening Level Human Health Risk Assessments*, June 9
General Comment 3b: Proposed Human Health Risk Assessment The proposed generation and designation of a "total soil" data set does not seem to consider natural environmental processes that are known to occur and conditions that likely will develop at the Sites, and is not adequately supported in the Draft Work Plan. According to Draft Work Plan, Appendix C, Subsection 3.2, the proposed activities include generating a total soil data set by combining the surface soil and subsurface soil data sets that will be used in a human health risk assessment. Such an approach does not seem to take into consideration the erosion and removal of surface soil related to overland flow of surface waters, and the exposure of subsurface soil with time. Also the reference of the environmental guidance document supporting the proposed approach is not cited in the Draft Work Plan. In the RTC, please provide a revised Draft Work Plan, Appendix C, Subsection 3.2 that either includes a detailed technical discussion supporting the proposed "total soil" data set including citing appropriate references, or delete the proposed "total soil" data set, whichever is appropriate. The Human Health Conceptual Site Exposure Model (HHCSE Model) does not seem to address the potential future exposure pathways associated with excavation of site soil and sediment. The proposed HHCSE Model (Draft Work Plan, Appendix C, Figure 4) does not address exposure of construction workers to soil vapors during trenching activities, or Site surface water and sediment. In the RTC, please provide either the rationale supporting the proposed HHCSE Model regarding these potential exposure pathways, or a revised HHCSE Model,	**Response to General Comment 3b:** The HHCSE Model (Figure 4) does address potential future exposure associated with excavation of site soil, as complete exposure pathways are shown for hypothetical future residential adult and children and future construction worker exposure to subsurface soil. Hypothetical future residential adult and children and potential future occupational worker exposure to sediment is also shown in Figure 4. As future excavation of sediments is not a likely activity associated with expected site use, potential exposure to sediment by a construction worker is not a complete exposure pathway. Potential exposure to soil vapors by construction workers (and future occupational workers and residents) is a complete exposure pathway shown in Figure 4 (for the release of VOCs from soil to ambient air). As there is currently no readily-available transport model to estimate exposure to soil vapor in a trench, this pathway is shown as incomplete in Figure 4. It is believed potential future occupational worker exposure to soil vapors in ambient air (for 250 days a year for 25 years) may serve as a conservative surrogate for potential future construction worker exposure to soil vapors in trench air (for 125 days a year for 1 year), i.e., if occupational worker exposure to VOCs in ambient air is acceptable, then future

whichever is appropriate.	construction worker exposure to VOCs in a trench would also be expected to be acceptable. This will be discussed in the HHRA Uncertainty Section (and the Work Plan has been revised accordingly). Construction worker exposure to COPCs in surface water and/sediment is not expected because there is no obvious reason for this receptor to visit the part of the IR Site 34d near Fallbrook Creek. As hypothetical future residential adult and children and future occupational worker exposure to surface water and sediment is a potentially complete exposure pathway at IR Site 34d (Figure 4), exposures to COPCs in these media are being considered in the HHRA.

General Comment 4a: Proposed Ecological Risk Assessment

It is not apparent that the proposed use of ecological screening levels (ESLs) for "representative receptor species" is protective of site specific sensitive species. The proposed ecological risk assessment involves the use of ESLs for "representative receptor species" from a Los Alamos National Laboratory (LANL) Publication (2012), not site specific species. The rationale for using LANL "representative receptor species" is that the representative species may reasonably be expected to reside and forage in an environmental setting similar to that present at the subject Sites. Whereas such an approach may be acceptable for ecological receptor species that are thriving, it is not apparent that such an approach is acceptable for threatened and endangered receptor species. Based on the possible consequences and significance of underestimating the risk to threatened and endangered species populations, it seems that the proposed use of each "representative receptor species" requires a far more rigorous and robust analysis than that included in the Draft Work Plan. In the RTC, please provide a revised Draft Work Plan, Appendix D, Subsection 1.3.5 to include a detailed technical analysis of the adequacy and appropriateness of the proposed representative receptor species for an ecological risk assessment, including citing appropriate technical references, or revised approach, whichever is appropriate.

Response to General Comment 4a:

The following text has been added to the Work Plan, discussing the adequacy and appropriateness of the proposed representative receptor species for an ecological risk assessment at a site (or sites) where threatened and endangered receptor species may occur.

"While there may be some concern as to the adequacy and appropriateness of the proposed representative receptor species for an ecological risk assessment of IR Sites 34b and 34d where threatened and/or endangered receptor species may occur, the proposed eight wildlife receptor species and the aquatic community receptor include species with life histories and feeding strategies similar to the potential threatened and/or endangered species, as shown as follows:

Threatened or Endangered Species	**Trophic Level**	**Representative Species Proposed for SLERA**	**Trophic Level**	**Comment**
Coastal California gnatcatcher	Insectivore	American robin as insectivore; violet-green swallow	Insectivore	As the American robin has a home range of 1.2 acres, its potential exposure to site COPECs will be maximized, compared with the T&E species that have larger home ranges
Least Bell's vireo	Insectivore			
Southwestern willow flycatcher	Insectivore			
Stephens'	Omnivore	Deer mouse	Omnivore	As the deer mouse has a home range of 0.06 acres, its potential exposure to site COPECs will be similar to the SKR that has a home

kangaroo rat				range of approximately 0.02 acres[1]
Arroyo toad	Omnivore	Surface water and sediment aquatic communities	Various (omnivore, carnivore, herbivore)	SLERA will use water quality criteria and sediment benchmarks for the protection of aquatic life
California red-legged frog	Omnivore			

In general, the selection of representative receptor species followed EPA (1996[2]).

Therefore, the selected wildlife species and the aquatic community selected as representative surrogates for use in the SLERA are deemed adequate for purposes of assessing potential COPEC exposures and hazards by threatened and endangered species that may be in the general area. During preparation of the SLERA, the potential toxicity of detected COPECs in surface water and/or sediment will be further researched for possible toxicity to amphibians (e.g., toads and frogs) using Bleiler et al. (2004[3]; 2009[4]) and Sparling et al. (2000[5]), as LANL (2012) ESLs may not contain amphibian-specific benchmarks."

[1] http://www.iucnredlist.org/details/6682/0
[2] EPA, 1996, Ecological Significance and Selection of Candidate Assessment Endpoints, ECO Update, January, EPA 540/F-95/037.
[3] Bleiler, J., D. Pillard, D. Barclift, A. Hawkins, and J. Speicher, 2004, *Development of a Standardized Approach for Assessing Potential Risks to Amphibians Exposed to Sediment and Hydric Soils*, Naval Facilities Engineering Command, Technical Report TR-2245-ENV, Port Hueneme, California.
[4] Bleiler, J., D. Pillard, M. Johnson, C. Archer, M. Bazar, D. Anders, D. Barclift, J. Noles, P. Henry, K. Harvey, A. Hawkins, 2009, *Demonstration and Certification of Amphibian Ecological Risk Assessment Protocol Final Report*, ESTCP Project Number ER-0514, Naval Facilities Engineering Command, Port Hueneme, California.
[5] Sparling, D.W., G. Linder and C.A. Bishop, editors. 2000. *Ecotoxicology of Amphibians and Reptiles*. Pensacola, FL: Society of Environmental Toxicology and Chemistry (SETAC).

General Comment 4b: Proposed Ecological Risk Assessment The assumption that estimated avian or mammal hazards are considered indicative of hazards to reptilian receptors is not adequately supported in the Draft Work Plan. According to the proposed Ecological Risk Assessment (Draft Work Plan, Appendix D, Subsection 1.3.5.2, Page 1-9, Last Paragraph), avian or mammal hazards are assumed to be adequate indirect lines of evidence and correlate with hazards to reptiles. It is not apparent that such an assumption is appropriate for this investigation since a reptile identified at the Sites is an endangered species and therefore warrants more robust and thorough consideration. In the RTC, please provide either a technical discussion supporting the proposed assumption including citing appropriate technical references, or a revised Subsection 1.3.5.2 that includes a discussion of direct lines of evidence regarding the hazards to Sites' reptilian receptors.	**Response to General Comment 4b:** The last two sentences in Section 1.3.5.2 have been deleted. The following text has been added to Section 1.5.3: "A lack of toxicity data precludes adequate quantitative evaluation of risks to lizards, tortoises, and snakes; therefore they are not included as receptors for quantitative evaluation in the SLERA. The uncertainties associated with not including some ecological receptors (such as reptiles) from quantitative evaluation due to a lack of toxicity (or other) data will be discussed in the SLERA."
General Comment 4c: Proposed Ecological Risk Assessment The proposed soil exposure interval of 0-2 feet does not seem adequate to address all Site ecological receptors. According to Draft Work Plan, Subsection 4.2, Page 4-7, analytical data from the 0-2 feet soil interval will be used to evaluate ecological receptor exposure to soil. Typically the appropriate soil depth interval used is based on site-specific receptors and exposure pathways. Such a shallow soil interval does not address burrowing receptors, contaminant uptake by plant roots, and the surface soil erosion associated with overland flow of surface water. In the RTC, please provide the revised soil exposure interval that takes into consideration all the Site ecological receptors and the eventual exposure of currently subsurface soil. Also, note that there is a discrepancy in the proposed soil exposure interval in the Draft Work Plan and that in the Screening Level Ecological Risk Assessment Work Plan (Draft Work Plan, Appendix D).	**Response to General Comment 4c:** Section 1.4.1.1 of the SLERA Work Plan discusses in detail the depth intervals of potential concern, including the use of results from soil samples collected between 2 and 6 feet, if warranted. However, to be consistent with the main Work Plan that discusses the possible collection of soil samples from 3 to 4 feet and 5 to 6 feet, (based on potential visual evidence of debris or stained soil at the bottom of a trench or soil boring), sample collection at depths between 2 and 6 feet appear likely, and results would be used in the SLERA. Therefore, Section 1.4.1.1 has been revised to include this information.

General Comment 4d: Proposed Ecological Risk Assessment The conclusion that an adverse effect on an individual organism does not constitute an adverse effect on a population requires clarification and does seem appropriate for threatened and endangered species. The Proposed Ecological Risk Assessment (Draft Work Plan, Appendix D, Subsection 1.3.7.1, Page 1-11, Fourth Paragraph) notes that "Adverse effects on individual organisms do not necessarily constitute an adverse effect on the population." The proposed criteria for distinguishing potential adverse effect(s) to an individual receptor from a receptor population are not provided in the Draft Work Plan and such a statement does not seem appropriate for threatened and endangered species identified at the Sites. In the RTC, please provide either clarification regarding this matter, or a revised Draft Work Plan, Appendix D, Subsection 1.3.7.1, whichever is appropriate.	**Response to General Comment 4d:** Section 1.3.7.1 has been revised to clarify that a NOAEL-based HQ of 1 or below is deemed protective of an individual, while a result above a NOAEL-based HQ of 1 and below or equal to a LOAEL-based HQ of 1 is deemed protective of a population. The text already states "It typically is assumed that most populations or communities (excluding threatened or endangered species) can suffer some depletion or adverse effect while remaining viable." It should be noted that selection of the appropriate HQ for decision making is ultimately a combined stakeholder decision.
General Comment 4e: Proposed Ecological Risk Assessment The proposed risk description lines of evidence need to be expanded to include the presence of threatened and endangered species at and in the vicinity of the Sites. The proposed lines of evidence to be considered in the risk assessment (Draft Work Plan, Appendix D, Subsection 1.5.2) does not include consideration of the presence of several threatened and endangered species at the Sites. Based on the status and sensitivity of these species, it seems their presence warrants elevated consideration, concern, and efforts as part of the ecological risk assessment, which does not seem to be the case. In the RTC, please provide either a technical discussion that the proposed lines of evidence are adequately protective of identified threatened and endangered species or revised lines of evidence that include consideration of the status and sensitivity of the threatened and endangered species present at the Sites, whichever is appropriate.	**Response to General Comment 4e:** Section 1.5.2 has been revised to include the consideration of threatened or endangered species. Whether or not further action is ultimately recommended for either of the sites will depend on the estimated NOAEL- and LOAEL-HQs, specific details related to the HQ calculation and basis of the ESLs, and the weight of evidence that may or may not support the actual presence of threatened or endangered species at either of the two sites.

General Comment 4f: Proposed Ecological Risk Assessment	**Response to General Comment 4f:**
The proposed Ecological Conceptual Site Model (ECSM) seems to be deficient with regards to the identification of potential wildlife receptor exposure pathways. The proposed ECSM does not identify the following potential wildlife receptor exposure pathways and it is not apparent if this is an oversight or indeed the case: • Desert Cottontail ingesting soil, • Montane Shrew ingesting plants, • American Kestrel ingesting birds, • Deer Mouse, Montane Shrew, American Robin, Desert Cottontail, and Red Fox ingesting and coming into direct contact with sediments, and • American Robin ingesting aquatic invertebrates. In the RTC, please provide either an appropriately revised ECSM or the rationale as to why the identification of the above noted wildlife receptor exposure pathways in the ECSM is not appropriate, whichever is appropriate.	The ECSM is based on the exposure pathways quantified by LANL (2012) in their derivation of the ESLs that are proposed for use in the SLERA for HQ estimations. Footnote "c" in Figure 2 states the following for the proposed wildlife receptors: "As available and derived in LANL (2012) ESL data base." Additional text has been added to the Figure 2 footnote "c", as follows: "Exposure pathways are limited to those quantified by LANL for each receptor."

General Comment 5: Proposed Analytical Plan	**Response to General Comment 5:**
It is not apparent that the proposed analytical plan addresses the historical burning of polychlorinated phenol (PCP) preserved wood. The rationale for the proposed analytical plan does not appear to address PCP degradation and breakdown products associated with the presence and burning of PCP preserved wood at the Sites. As reported in other Naval Weapons Station Seal Beach Detachment Fallbrook (Base) environmental deliverables, wood preservation activities utilizing PCP was performed within Base boundaries. Therefore, it seems probable that waste associated with the Sites may contain PCP and PCP degradation/breakdown analytes associated with the presence and burning of PCP preserved wood. This matter is not discussed in the Draft Work Plan and it is not apparent if this is an oversight or not. In the RTC, please provide clarification regarding this matter, and if warranted the revised analytical plan to ensure that Site contamination is adequately characterized, a stated investigation objective.	Analysis for SVOCs by EPA Method 8270 is included for nearly every sample listed in the SAP, and includes polychlorinated phenols such as pentachlorophenol, 2-Chlorophenol, 2,4-Dichlorophenol, 2,6-Dichlorophenol, 2,4,5-Trichlorophenol, and 2,4,6-Trichlorophenol. In addition the SAP makes provision for the collection of a number of samples for analysis for dioxins/dibenzufurans, where burned waste is encountered below ground. The Navy believes that this analytical program will be adequate to characterize site contamination with respect to polychlorinated phenols.

Water Board IR Site 34b Comments	
Site 34b Comment 1: Historical Site Use	**Response to Site 34b Comment 1**
a. The discussion of historical site use needs to be expanded to include the findings of the review of appropriate historical aerial photographs. According to Draft Report, Subsection 1.2.1, existing structures or evidence of previously existing structures were not observed during the IR Site 34b site inspection. The temporal scope of the IR Site 34b historical structure evaluation needs to be expanded by conducting a review of appropriate aerial photographs dating back to the early 1940s, to the extent practicable, when the Department of Defense activities commenced at the Base. As part of the RTC generation, please conduct and report the findings of historical aerial photograph review with regards to the presence and location of historical site structures and associated activities to the extent practicable.	a. In response to this comment and previous comments, available aerial photographs for both sites are provided as an attachment to these RTCs. The Navy would like to note that the site was opened during the PA to address only the one known disposal area. During the SI a 1953 aerial photograph was uncovered that shows a surface disturbance at the other two areas at site 34B. Since these areas were unknown and not part of the original SI, they were never sampled nor has there been any indication that they were disposal areas. Since the origin of the disturbance is unknown it was recommended in the SI report that those areas be included in the RI. Since there is no record or evidence of disposal there, the purpose is only to determine if disposal had taken place at that feature. If evidence is uncovered through any of the investigative measures then the Navy will return to the area to determine nature and extent. Again, at this point there are no lines of evidence to support disposal practices. Lines of evidence include old aerial photographs that do not show evidence of backfilling, no surface debris, and no metallic waste was detected by the geophysical equipment.
b. The discussion of Site features needs to be expanded to include available information regarding the surface linear feature illustrated in Draft Work Plan, Figure 2. The Draft Work Plan fails to provide information regarding what appears to be a possible waste disposal trench located to the northeast of the identified "waste disposal trench." The approximately 300 feet long linear feature is not mentioned in the Draft Work Plan and does not appear to have been adequately investigated in the past. In the RTC, please provide either information regarding possible historical waste disposal activities and all historical environmental investigation findings for this subject Site feature, or the rationale as to why this feature is not relevant to this investigation, whichever is appropriate.	
c. The proposed conclusion regarding the two surface linear features located to the southwest of the "waste disposal trench" requires support and clarification. According to Draft Work Plan, Subsection 2.4.1, Third Paragraph, Last Sentence, the two surface linear features located in the southwestern portion of the Site (Draft Work Plan, Figure 2) are considered to be secondary areas of concern (AOC). Based on the extremely limited data acquired to date from these two features, it seems premature to derive any conclusions about these features. Additionally, it is not apparent as to how the designation of the features as a	b. As requested the work plan and figures will be updated to identify the surface feature discussed in this comment. The linear surface feature identified in this comment is a dirt road or path, which runs along the eastern side of the fence line at that location. A review of historical aerial photographs indicated that this feature was not present on aerial photographs from 2008 and

"secondary" AOC will ultimately be used to derive conclusions and recommendations regarding the environmental significance of these features. This investigation seems to be an excellent opportunity to address these features that should be taken advantage of. In the RTC, please provide either a revised Draft Work Plan, Subsection 2.4.1 that addresses these linear features, the proposed approach and time frame for addressing these features, or the rationale for identifying these features as secondary AOC and not investigating them, whichever is appropriate.	earlier, while it does appear on the 2009 aerial photograph. Those aerial photographs are provided as an attachment of these RTCs. c. The two "secondary AOCs" located southwest of the known disposal trench are identified as such because in contrast to the known disposal trench, no disposal or contamination has yet been identified at these locations. The designation as "secondary AOCs" was derived the SI report, in which those features were first identified (ChaduxTt 2010). The description of areas as secondary AOCs is intended to identify those areas as "potential or suspected" disposal areas. Whereas the primary AOC represents area where waste disposal is known to have occurred. The revised Work Plan will make clear that secondary AOCs are areas where contaminants "may" exist, but so far no direct evidence has been found to indicate waste is present.
Water Board IR Site 34d Comments	
Site 34d Comment 1: Historical Site Use	**Response to Site 34d Comment 1**
a. The discussion of IR Site 34d needs to be expanded to include the nature and duration of activities conducted in Former Building 338, to the maximum extent practicable. The discussion of IR Site 34d historical activities (Draft Work Plan, Subsection 2.4.2) does not contain information regarding activities conducted at Former Building 338, illustrated in Draft Work Plan, Figure 6. In the RTC, please provide environmentally relevant information regarding historical Building 338 or the rationale as to why Former Building 338 is not relevant to this investigation, whichever is appropriate. b. The discussion of former Building 430 needs to be expanded to include the historical location and source of power/fuel used to operate the former boiler, and	a. As requested, Section 2.4.2 has been expanded to include additional discussion of historical activities at IR Site 34d, including Building 338. Specifically, Building 338 (though falling outside the site boundary of IR Site 34d) has been identified as office space related to weapons testing (ChaduxTt 2010). The Navy would like to note that the site was created to address the dunnage disposal activities. The RI was not created to address the former building or former building activities, as these are not listed as part of the site as defined by the PA and subsequent SI. The Navy's interest in the historical activities at

the associated activities. The discussion of IR Site 34d historical activities (Draft Work Plan, Subsection 2.4.2) does not include the following environmentally significant information regarding activities conducted in Former Building 430, identified as a former boiler house: • type of fuel/power (petroleum, electrical, etc.) used to operate the former boiler, •location and nature of the system used to contain and convey fuel to the boiler, if appropriate, •status of fuel containment and conveyance systems, if appropriate, • historical activities conducted in Former Building 430 that required a boiler, and •historical environmental activities involving the closure of the fuel containment and conveyance systems, if appropriate. The above requested information is required to demonstrate that the proposed sampling and/or analytical plan are adequate to define the extent of site related contamination, an investigation objective. In the RTC, please provide either the requested information to the extent practicable, or the rationale as to why the requested information is not considered relevant to this investigation, whichever is appropriate.	the buildings is limited to their relationship, if any dunnage disposal. b. As requested, Section 2.4.2 has been expanded to include additional discussion of known activities at Building 430 (as well as the rest of the site). Little is known about the specific construction of Building 430, and a review of plans at the map room at NWS Fallbrook did not result in any plan sets for this building. The Geophysical Report did identify a pipeline running north from Building 430, as well as a buried feature at the end of that pipeline. Based on the geophysical investigation, potholing to investigate the nature of this feature is planned. Because the nature of the feature is unknown, no sampling program is proposed at this time for that location. Information resulting from the potholing will be used by the Navy to determine what, if anything needs to be done, and by what contractual mechanism any further actions would be implemented.
Site 34d Comment 2: Proposed Soil Sampling Plan The proposed soil sampling plan needs to be expanded to include the collection of samples adjacent to the existing concrete slab associated with former Building 341. The proposed soil sampling plan includes the collection of soil samples from beneath the existing Building 341 concrete slab. Whereas such a soil sampling plan may be appropriate for concrete slabs with compromised integrity when activities of potential environmental concern were being conducted on the slabs, it is not appropriate for concrete slabs that were intact during the activities of concern. Since it is unlikely that the concrete slab condition during the time period of concern is known, the collection of soil samples from beneath and adjacent to the concrete slab seems warranted to adequately address this Site area. In the RTC, please provide either the revised soil sampling plan or the rationale as to why the collection of soil samples adjacent to the concrete slab is not warranted to investigate this area of the Site, whichever is appropriate.	**Response to Site 34d Comment 2:** To address this comment, three soil borings have been added adjacent to the slab for Building 341, as shown Figure 2 of the attached Proposed Test Pit Locations technical memorandum for IR Sites 34b and 34d.

Water Board Editorial Comments and Conclusion	Navy Responses
Editorial Comment 1: The Draft Sampling and Analysis Plan (Draft SAP; Draft Work Plan, Appendix A, Subsection 14.12.4) mentions groundwater analytical data. Based on the San Diego Water Board's review of the Draft Work Plan it is our understanding that groundwater is not currently an environmental media of concern at these IR Sites. Please review the Draft SAP and make the necessary revisions or provide clarification, whichever is appropriate.	**Response to Editorial Comment 1:** Agreed. The following text change has been made to this section. *"The analytical data will be sent to a third-party data validation company."*
Editorial Comment 2: Draft Work Plan, Appendix D, Subsection 1.4.2, Third Paragraph needs to be expanded to include the citations for the USEPA publications referenced in the paragraph.	**Response to Editorial Comment 2:** Agreed. In response to this comment the reference to Van den Berg et al. 2006, and Van den Berg et al. 1998 will be formatted to include the primary author name within the parentheses, as for the other references.
Water Board Conclusion: The San Diego Water Board appreciates Department of the Navy's (Navy) time and efforts addressing environmental issues at IR Sites 34b and 34d, and looks forward to continuing to assist Navy with environmental issues at contaminated sites within Naval Weapons Station Seal Beach Detachment Fallbrook boundaries. In the subject line of any response pertaining to IR Site 34b, please include the reference number T10000004377:BGriffey and for IR Site 34d, please include the reference number T10000004381:BGriffey. For questions or comments, I may be reached by phone at (619) 521-3342, or by email at BGriffey@waterboards.ca.gov.	**Response to Water Board Conclusion:** Noted. The Navy appreciates the time and efforts of its Agency partners in the review of these documents.

***List of Attachments*:**

Attachment 1 – Proposed Test Pit Locations Technical Memorandum for IR Sites 34b and 34d
Attachment 2 – Aerial Photographs for IR Site 34b
Attachment 3 – Aerial Photographs for IR Site 34d

Attachment 1
Proposed Test Pit Locations Technical Memorandum

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TREVET

January 8, 2015

Ms. Ann Colt, RPM
Department of the Navy
NAVFAC Southwest
1220 Pacific Highway, Building 131
San Diego, CA 92123

Subject: Proposed Test Pit Locations
Remedial Investigations for Installation Restoration Sites 34b and 34d,
Naval Weapons Station (NWS) Seal Beach Detachment Fallbrook, Fallbrook, California
Contract No. N62473-10-D-4009

Dear Ms. Colt:

The purpose of this letter is to briefly describe the planned test pit locations for the remedial investigations (RIs) for Installation Restoration (IR) Sites 34b and 34d at Naval Weapons Station (NWS) Seal Beach Detachment Fallbrook. The proposed test pit locations are based on the results of the geophysical evaluation at the two sites, as described in the attached Geophysical Investigation Report, and on the analytical results from the Site Inspection (SI) Report, prepared by ChaduxTt in 2010. Table 1 describes the rationale for each of the proposed test pit locations.

Three types of proposed excavations are planned: (1) waste test pits where known or expected waste is believed to be buried, and five samples are planned for each waste test pit, (2) exploratory test pits to evaluate potential areas where waste might be buried, and two samples are planned for each exploratory test pit, and (3) exploratory potholes to evaluate subsurface objects identified during the geophysical survey that should be assessed, sampling is not planned for exploratory potholes. Table 1 describes the analytical program planned for each of the test pits. Table 2 describes the reasoning for the planned pothole locations. Table 3 notes several site features where investigation is not proposed, and the rationale for that decision.

Additional sampling other than the test pits described here is planned for IR Site 34d, and is described in the RI Work Plan for the site. If you have any questions about this submittal, please contact John Willis at (858) 578-8859, extension 104 or Bob Breglio at extension 103.

Sincerely,

John Willis
Trevet Project Manager

Bob Breglio
Trevet Technical Lead

cc: Dr. Margaret Wallerstein, Activity Point of Contact, NWS Seal Beach Det Fallbrook
Mr. Rich Wong, CB&I Federal Services

Enclosures (3)
1. Figure 1 – Proposed Test Pit Locations at IR Site 34b
2. Figure 2 – Proposed Test Pit Locations at IR Site 34d
3. SubSurface Surveys Geophysical Investigation Report

Table 1. Proposed Test Pits

Subarea	Proposed Location ID	Reason for Test Pit Location	Analytical Methods*	Sampling Program
IR Site 34b	Test Pit #1	Known disposal trench. Geophysical anomalies identified. Sampling to bound waste in trench laterally and vertically, and to assess the waste itself.	VOCs, SVOCs, and metals. Four waste samples will be additionally analyzed for pesticides and PCBs.	Waste Test Pits (5 samples each). Two sidewall samples in visually clean soil to laterally bound the disposal trench. One sidewall sample in the waste itself. Two floor samples in visually clean soil, one beneath the other, to vertically bound the contamination in the trench.
	Test Pit #2			
	Test Pit #3			
	Test Pit #4			
	Test Pit #5	Laterally bound the ends of the known disposal trench, outside of the identified geophysical anomalies.	VOCs, SVOCs, and metals.	Exploratory Test Pits (2 samples each). One shallow sidewall sample and one floor sample, unless debris or discoloration is encountered. If debris or discoloration is encountered, the sample will be collected at that location.
	Test Pit #6			
	Test Pit #7	Possible trenches identified in SI from aerial photographs. No geophysical or visual evidence was found to suggest debris or trenching.		
	Test Pit #8			
IR Site 34d	Test Pit #1	Confirm apparent wooden retaining wall visually identified above former location of Building 325. Near burned wood and glass shards identified in SI near SB04. This test pit will replace the five borings originally planned in this area.	VOCs, SVOCs, and metals. Four of the test pit samples, with the greatest overall detected contaminant concentrations, will be additionally analyzed for pesticides and PCBs.	Exploratory Test Pits. One shallow sidewall sample and one floor sample, unless debris or discoloration is encountered. If debris or discoloration is encountered, the sample will be collected at that location.
	Test Pit #2	Evaluate partially buried ammo cans that appear to be a small retaining wall structure that was visually identified during site reconnaissance.		
	Test Pit #3	Fill area where Building 325 was formerly located.		
	Test Pit #4	Flat area visually identified during site reconnaissance.		
	Test Pit #5	Flat area visually identified during site reconnaissance.		
	Test Pit #6	Small buried items identified by geophysics.		
	Test Pit #7	Downslope from the nearby former roadway.		
	Test Pit #8	Flat area next to former roadway.		
	Test Pit #9	Toe of slope downslope from Test Pit #8.		
	Test Pit #10	Toe of slope below parking area.		
	Test Pit #11	Slope below parking area.		

* Up to 10 of the Test Pit samples at each site may be additionally analyzed for dioxins/dibenzofurans, based on visual indications of historic burn activities.

Table 2. Proposed Exploratory Potholing, No Sampling Planned

Subarea	Location	Feature Description
IR Site 34d	Pothole #1	Position and geophysical signature suggest the identified subsurface structure might be the footing for former bridge over Fallbrook Creek. That bridge is no longer present.
	Pothole #2	Position and geophysical signature suggest a possible UST near Building 341.
	Pothole #3	Surface metal debris near stream embankment.
	Pothole #4	Surface metal debris and small metallic anomaly on slope near parking area.

Table 3. Site Features Where Investigation Is Not Proposed

Subarea	Geophysical Area	Feature Description	Reasoning for Not Sampling the Feature
IR Site 34b	Geophysical Area 3	Northeastern most Geophysical Area	No visual or geophysical indications of debris or contamination. Originally included because of topography, but following the fires it appears to be a natural drainage.
IR Site 34b	None	Dirt track along outside of the site fence line	No visual indications of debris or contamination observed. Feature not present on 2008 or earlier aerial photographs, but is present on the 2009 and later photographs. The dirt track is believed to be associated with the construction of the fence that now surrounds the western part of the site.
IR Site 34d	Geophysical Areas 3 and 4	Locations of magnetic anomalies identified in the SI Report	No buried anomaly identified in Area 3. Magnetic anomaly may have been one of the metal shards or pieces of wire that was moved to facilitate the subsurface evaluation. Anomaly in Area 4 identified in the SI Report appears to be a single piece of partially exposed metal strap or banding.
	Geophysical Area 5	Magnetic anomalies associated with corrugated sheeting	The corrugated sheeting is not itself a significant concern, and buried debris was not identified.
	Geophysical Area 5	Magnetic anomalies associated with riprap	Riprap placed to stabilize the stream channel. Not feasible to sample.

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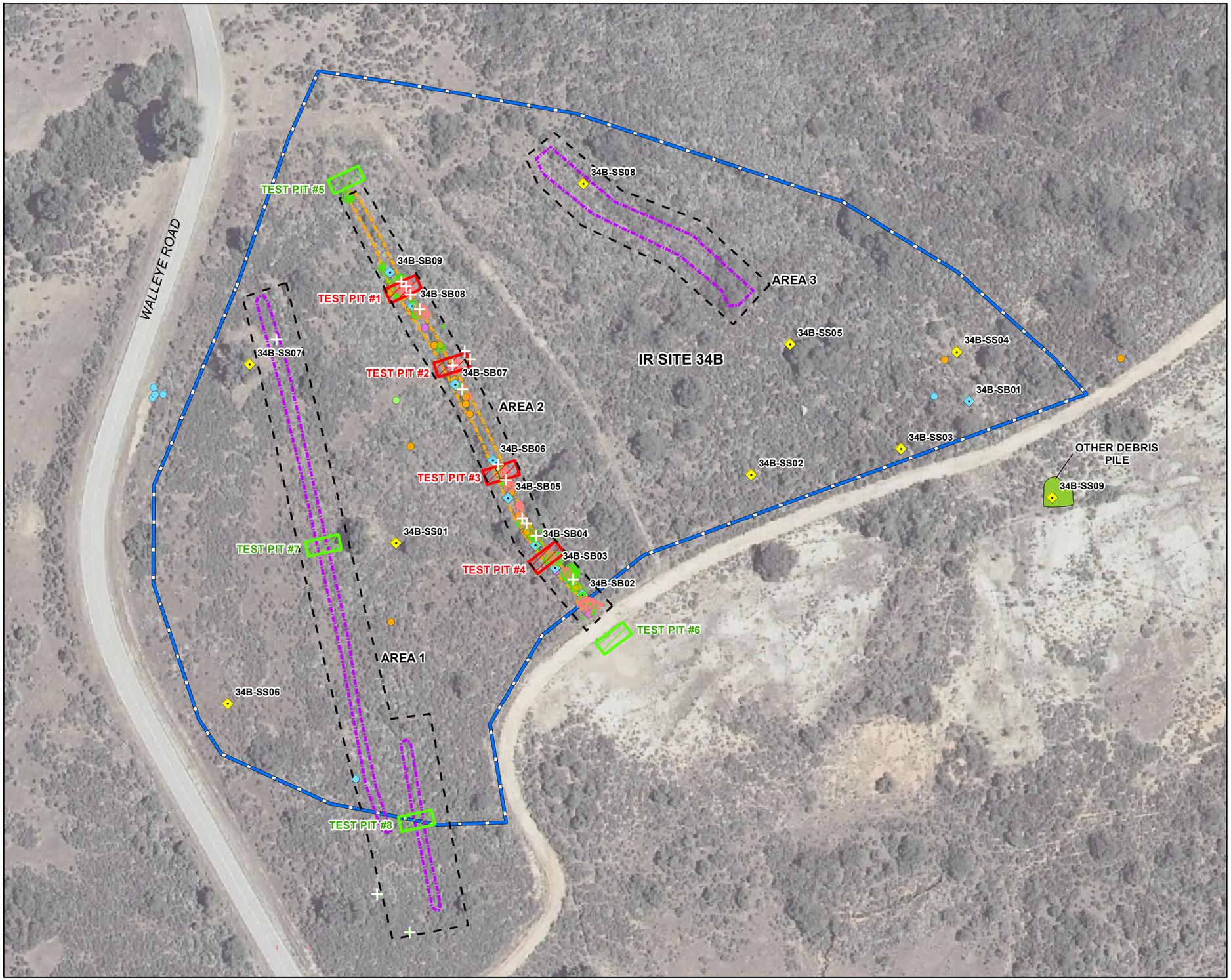

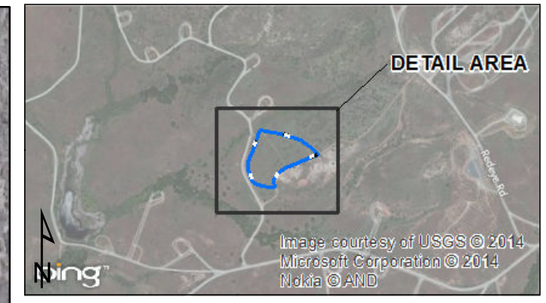

LEGEND

- METAL JUNK AT SURFACE (GEOPHYSICAL)
- MAGNETIC ANOMALIES (IDENTIFIED IN SI)
- METAL DEBRIS (IDENTIFIED IN SI)
- CONSTRUCTION DEBRIS (IDENTIFIED IN SI)
- OTHER DEBRIS (IDENTIFIED IN SI)
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PROPOSED WASTE TEST PIT
- PROPOSED EXPLORATORY TEST PIT
- WASTE DISPOSAL TRENCH
- MAGNETIC ANOMALIES (GEOPHYSICAL)
- EM ANOMALIES (GEOPHYSICAL)
- SUSPECTED WASTE DISPOSAL TRENCH
- GEOPHYSICAL INVESTIGATION AREA
- IR SITE 34B BOUNDARY

SOURCE:
GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE
0 50 100 200
(IN FEET)
1 INCH = 100 FEET

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 1

PROPOSED TEST PIT LOCATIONS AT IR SITE 34B

TREVET

DATE: JANUARY 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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LEGEND

- METAL JUNK SUBSURFACE (GEOPHYSICAL)
- METAL JUNK AT SURFACE (GEOPHYSICAL)
- MAGNETIC ANOMALIES (IDENTIFIED IN SI)
- 5.56-MM BLANK CASING (IDENTIFIED IN SI)
- METAL DEBRIS (IDENTIFIED IN SI)
- CONSTRUCTION DEBRIS (IDENTIFIED IN SI)
- OTHER DEBRIS (IDENTIFIED IN SI)
- PROPOSED HAND AUGER BORING
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATION
- PREVIOUS SURFACE SAMPLE LOCATION
- PREVIOUS SOIL SAMPLE LOCATION
- PROPOSED EXPLORATORY TEST PIT
- PROPOSED POTHOLE TEST PIT
- MAGNETIC ANOMALIES (GEOPHYSICAL)
- EM ANOMALIES (GEOPHYSICAL)
- GEOPHYSICAL SURVEY AREA
- FORMER BUILDING
- OFFSITE INVESTIGATION AREA
- IR SITE34D BOUNDARY

SOURCE: GOOGLE MAPS AERIAL IMAGE

GRAPHIC SCALE

0 50 100 200

(IN FEET)
1 INCH = 100 FEET

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

SAN DIEGO, CALIFORNIA

NAVAL WEAPONS STATION SEAL BEACH
DETACHMENT FALLBROOK
FALLBROOK, CALIFORNIA

FIGURE 2

PROPOSED TEST PIT LOCATIONS AT IR SITE 34D

TREVET

DATE: JANUARY 2015

CONTRACT NO.: N62473-10-D-4009
DELIVERY ORDER: 0096

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SubSurface Surveys
& Associates, Inc.
An Applied Geophysical Company

2075 Corte Del Nogal, Suite W
Carlsbad, CA 92011

Office: (760) 476-0492
Fax: (760) 476-0493

November 12, 2014

Project/Invoice No. 14-417

CB&I Federal Services LLC
1230 Columbia Street, Suite 1200
San Diego, California 92101

Attn: Brian White

Re: Geophysical Investigation Report, IR Sites 34B & 34D, Fallbrook Detachment NWS, Fallbrook, California

This report is to present the results of our geophysical survey carried out over designated portions of Installation Restoration (IR) Sites 34B and 34D within the Fallbrook Detachment of the Seal Beach Naval Weapons Station located immediately west of Fallbrook, California (Figure 1). This survey was performed on October 15-17, 22, 2014, and its purpose was to detect and delineate, insofar as possible, buried anomalous junk and debris within the client's areas of interest.

A combination of electromagnetic induction (EM) and magnetometry were applied to the search, both with differentially-corrected integrated global positioning systems (DGPS). A utility locator with line tracing capabilities was also brought to the field and used where risers existed onto which a signal could be impressed and traced.

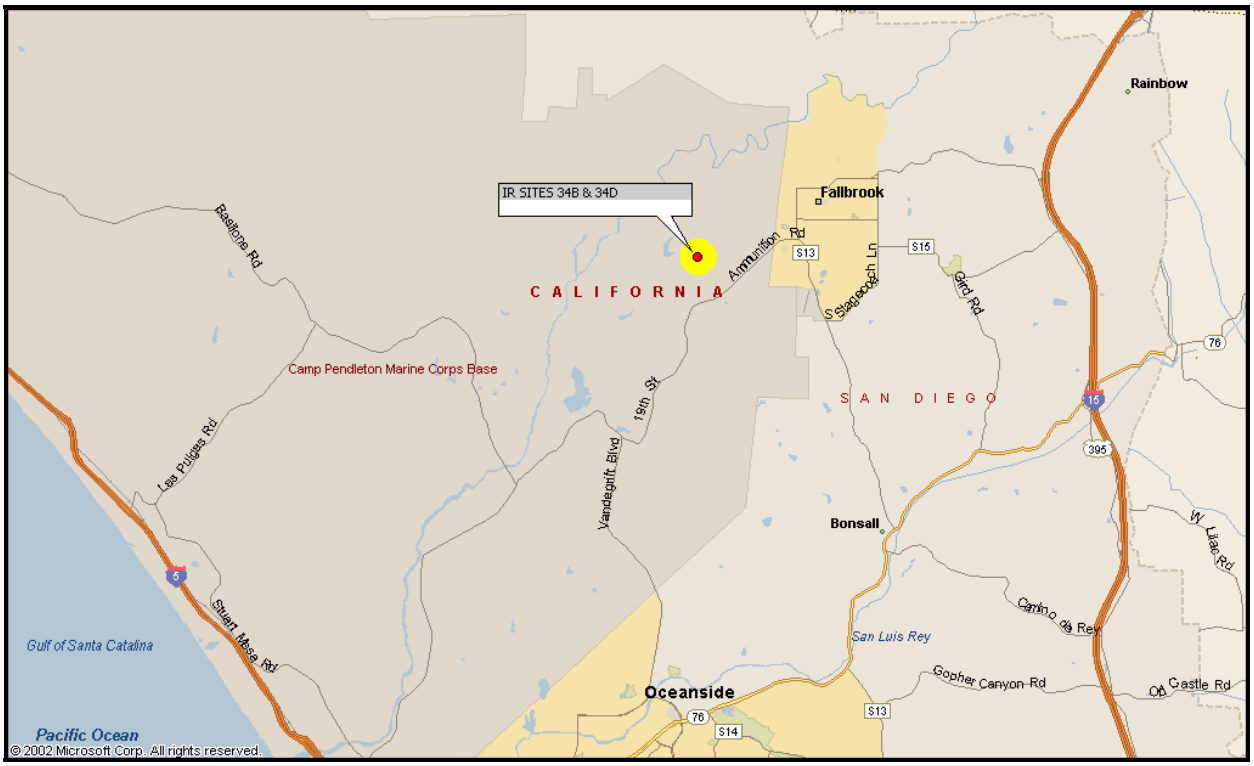


FIGURE 1. Site location map.

Survey Design – IR Sites 34B and 34D were located in the areas shown in Figure 2. Within IR Site 34B there were three specific investigation areas clustered closely together, and there were five similar investigation areas within IR Site 34D. Note that the boundaries shown in Figure 2 indicate each site general size and shape only, and are simply convenient encirclements around each site's individual survey areas. These boundaries do not necessarily represent that which was actually surveyed.

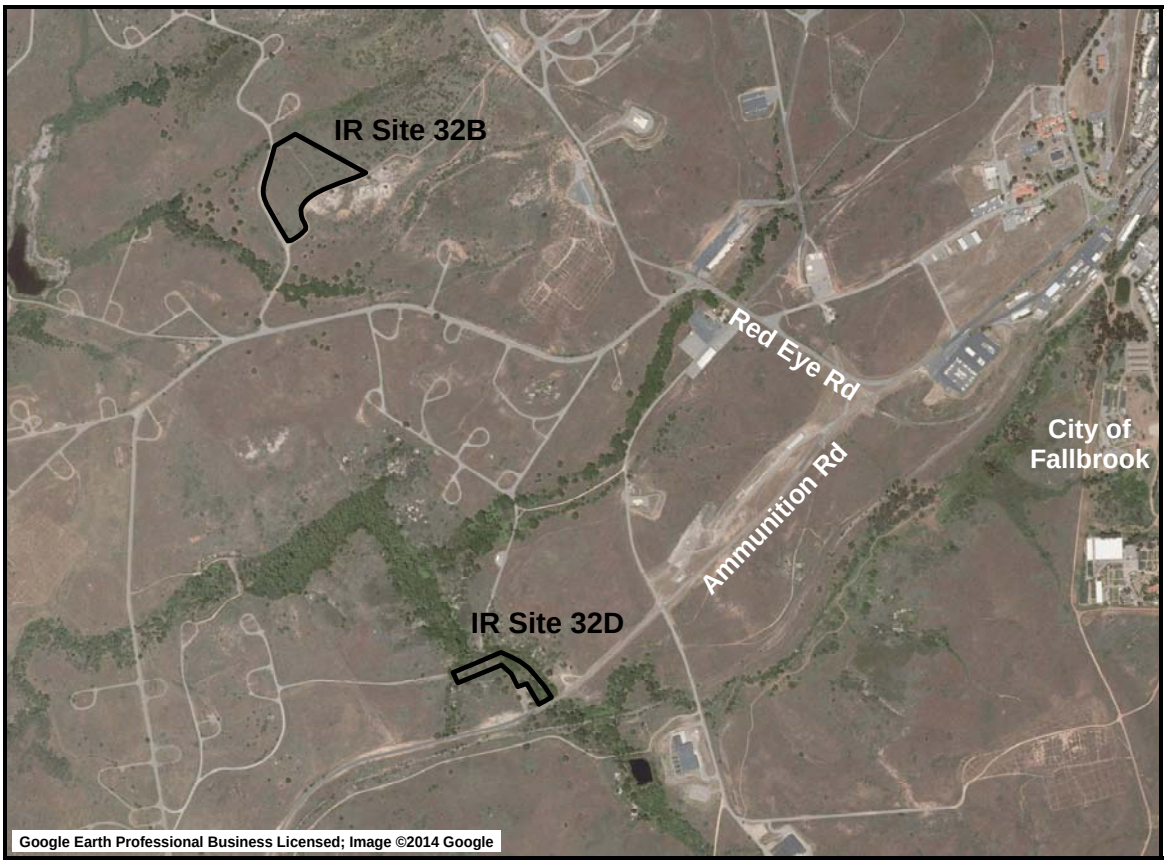


FIGURE 2. Survey area location map.

All initial surveying was performed with a cart-mounted, dual-coil, time-domain EM device and a Cesium-Vapor Overhauser-type magnetometer, both with integrated DGPS positioning systems. Note that both instruments can take instantaneous readings and do not require their sensors to be stationary or preferentially oriented. Both units were configured to auto-record an electromagnetic/magnetic reading every 0.5 seconds while simultaneously recording the sensor's latitude/longitude. The units' operator then continuously and methodically walked all portions of the designated survey areas so as to insure that a reading was taken at a maximum of 5 feet in any direction. Gridded spatial coverage did however average less than 3 feet in most areas where clear sky views and complete GPS satellite coverage existed, and where space was available for unobstructed instrument traversing (i.e., free of overhead tree canopy and/or heavy ground vegetation, including the charred remains of densely clustered bushes).

Some portions of IR Site 34D possessed thick overhead tree canopies which negated the effective use of the EM/DGPS combination. Within these areas both the EM and magnetic data sets had numerous missing data points since neither instrument will record a reading if the GPS systems have lost signal and a position cannot be determined. While the EM device is extremely sensitive and can detect even small objects at relatively significant depth, its sensing capabilities are focused more downwards and less to the sides, and

the instrument must generally be within 3-5 feet of an object in order to detect it, depending on target size. Consequently, the missing data points meant that potential anomalies where going undetected. In addition, present cart-mounted EM data points underlying IR Site 34D's tree canopy were also determined to have positional errors up to ±10 feet, and the processed and gridded data would erroneously show what should be clusters of small anomalies instead as large anomalies spread out over large areas. Lastly, many portions of these same areas also possessed heavy vegetation that prevented effective traversing of the EM sensor, which is relatively large and mounted on a wheeled cart.

Therefore, within IR Site 34D, cart-mounted EM/DGPS data was collected only within open areas. In areas underlying the tree canopy where heavy ground vegetation also existed EM surveying was conducted using a nearly identical device but with a smaller sensor that is handheld, more portable, yet lacks data-recording capabilities as well GPS positioning. This instrument was used in free-traversing mode in which the operator systematically traverses all portion of the survey area in organized directions while monitoring the device continuously and in real-time in order to manually detect anomalies and mark out their locations directly in the field. Additional traverses would also be taken for detailing and confirmation where anomalous conditions were found.

The use of the handheld EM device in free-traversing mode was advantageous in that it allows for immediate detection of anomalous objects and facilitated the opportunity to investigate them further, without the need to first download and process data in the office. In addition, since the handheld EM instrument was highly portable, the portions of IR Site 34D that were obstructed with heavy vegetation that otherwise would have gone un-surveyed were ultimately fully investigated. Again, the penalty for its use is that the geophysical data could not be recorded in order to put into gridded map format. Note however that the location of anomalies detected with the handheld EM device where still measured manually while in the field and are still presented below in map format.

The magnetometer/DGPS combination was still used effectively underlying IR Site 34D's tree canopy. While the magnetometer is also a metal detector, it best detects only larger metallic objects or perhaps smaller objects if they are clustered together in a buried debris pod, for example. It is also just as effective at sensing anomalies to its sides as those underlying it, perhaps up to 10 feet away. Therefore, despite missing data points due to poor GPS satellite coverage, its ability to effectively detect large objects or large clusters of objects was still intact, although the shape and size of the resulting anomaly in gridded map format might be in error (like the cart-mounted EM/DGPS instrument, magnetometer/DGPS positioning error under the tree canopy was estimated to be ±10 feet). Furthermore, since it is a small device which is mounted on a backpack, it could still access areas obstructed with heavy vegetation that might otherwise be considered un-surveyable, and its continued use was still considered worthwhile.

Note also that the magnetometer survey in each designated survey area was performed within 2 hours from start to end. Therefore, a base station was not established and the data was not corrected for diurnal drift since this type drift over such a short time span would likely be approximately 10 nT or less. Note that the anomalous response from a significant metallic object such as a drum container can be 500 nT or more, thus making diurnal drift correction unnecessary for this type survey.

Lastly, a utility locator with line tracing capabilities was also used in certain areas within IR Site 35D to impress signals onto several abandoned pipes, generally through stubbed-off risers found in certain areas. The locator's receiver then detects and traces out the pipe's location and orientation.

All electromagnetic readings discussed below are in milliVolts (mV) and magnetic readings are in nanoTeslas (nT). GPS station coordinates are in Zone 11N Universal Transverse Mercator (UTM) in meters. The GPS positions for the cart-mounted EM/DGPS instrument were estimated to be a maximum of ±2 feet, most being much less. The GPS positions for the magnetometer/DGPS instrument were estimated to be a maximum of ±5 feet, most being much less. Depth sensing capabilities for all instruments are highly variable and depend on target size but can be as much as 10 feet below ground level for the cart-mounted EM, 5 feet below ground level for the handheld EM, and 20 feet below ground level for the magnetometer.

Gridded cart-mounted EM surveying was performed with a Geonics EM61MK2 with an external Trimble AgGPS 114 with OmniStar-provided differential GPS corrections (Figure 3). Gridded magnetic surveying was conducted with a GEM Systems GSM-19W with its own internal GPS receiver with WAAS-provided differential corrections (Figure 4). Handheld EM free-traversing was performed with a Geonic's EM61MK2HH (Figure 5). A Metrotech 9890 utility locator rounded out the tools applied.

FIGURE 3

FIGURE 4

FIGURE 5

Brief Description of the Geophysical Methods Applied – The EM61MK2 and EM61MK2HH instruments are high resolution, time-domain devices for detecting buried conductive objects. Both consists of a powerful transmitter that generates a pulsed primary magnetic field when its coils are energized, which induces eddy currents in nearby conductive objects. The decay of the eddy currents, following the input pulse, is measured by the coils, which in turn serve as receiver coils. The decay rate is measured for two coils, mounted concentrically, one above the other for the cart-mounted EM and side-by-side for the handheld EM. By making the measurements at a relatively long time interval (measured in microseconds) after termination of the primary pulse, the response is nearly independent of the electrical conductivity of the ground. Thus, the instrument is a super-sensitive metal detector. Due to its unique coil arrangement, the response curve is a single well-defined positive peak directly over a buried conductive object. This facilitates quick and accurate location of targets.

Standard magnetic surveying employs a small, portable magnetometer to measure changes or distortions in the Earth's total magnetic field intensity, and can detect variations as minute as 0.1 nanoTeslas (nT). Non-native buried ferrous objects will distort the Earth's magnetic field immediately around the object resulting in sudden spatial variations that deviate suddenly and unexpectedly from the Earth's normal background levels; and the location of these sudden distortions generally correspond to the location of the anomalous object and such distortions for anomalous metals can differ from normal background by 50 to 2000 nT depending on target size and depth.

The line locator is used to passively detect energized high voltage electric lines and electrical conduit (50-60 Hz), VLF signals (14-22 kHz), as well as to actively trace other utilities. Where risers are present, the

utility locator transmitter can be connected directly to the object, and a signal (9.8-82 kHz) is sent traveling along the conductor, pipe, conduit, etc. In the absence of a riser, the transmitter can be used to impress an input signal on the utility by induction. In either case, the receiver unit is tuned to the input signal, and is used to actively trace the signal along the pipe's surface projection.

Data Presentation and Interpretation - The initial interpretation took place in real time as the survey progressed, and was confirmed and enhanced after processing and reviewing of all recorded data. Findings are further documented with EM and magnetic data maps for IR Site 35B (Figures 6 and 7, respectively) and EM and magnetic data maps for IR Site 35D (Figures 8 and 9, respectively). Additionally, site photographs of more unusual findings for IR Site 35D, Area 1 are shown in Figures 10-15.

Note that both EM and magnetic instruments would sometimes detect the same anomaly, while other anomalies would only be observed within one data set. For the discussion below it will be helpful to note that the EM devices excel at detecting shallow items of relatively small size, while the magnetometer is more apt to detect larger objects, or small objects if densely clustered, and at greater depths. A good example of their differing capabilities is at IR Site 34D within Area 2. Here, the EM detected three small items within the northern portion of the survey area (Figure 8) which the magnetometer did not (Figure 9). However, the magnetometer did detect a relatively large object within the southern portion of the survey area that is not likewise seen within the EM data. In reconciling both data sets we can conclude that the three EM anomalies are likely very small, perhaps less than six inches in diameter, and are therefore invisible to magnetics. They are clearly metallic but may be non-ferrous (copper, aluminum, brass, etc.). The single large object seen with magnetics is either entirely steel or has a significant amount of steel incorporated within it such as rebar reinforcing. It also must be relatively deep and is therefore invisible to EM. In this case the object is probably greater than five feet below ground level.

Numerous examples of identical EM and magnetic responses can be found within IR Site 34B, Area 2 (Figures 6 and 7). The interpretation of both data sets together would suggest that these objects are likely less than one foot below the surface and are both large and small in size. Again, if small, the objects would be found tightly clustered together along with other small objects. The abundance of magnetic anomalies here means that most debris is in pods and is not necessarily spread around.

<u>IR Site 34B</u>

Both EM and magnetics detected purposely buried debris only in IR Site 34B's Area 2 (Figures 6 and 7), almost entirely within the shallow drainage gully and either at the surface or within several feet it. Note that the debris appears to be in pods, but the pods are spread out the entire length of the surveyed portion of the gully. As indicated in the figures, most debris is visible at the surface, or at least some small portion of the greater pod of debris is visible. Debris entirely buried is less than one foot below the ground surface and all debris, visible or not, does not appear to extend downwards greater than five feet below the surface. Note that items here included rusted wiring, short sections of cables, irregular-shaped metal shards, collapsed steel drums, broken glass, occasional wood, etc.

Three very small items of surface debris are found within Area 1 and include such innocuous items as a short section of electrical wire and a small rusted metal bracket. Again, these were entirely at the surface and may have been pick up and tossed from its original location during the course of the survey. It appears clear that no purposeful dumping of junk or debris has occurred within Area 1.

No significant items were found within Area 3, and it appears clear that no purposeful dumping of junk or debris has occurred here.

IR Site 34D

A significant amount of junk piping was detected within IR Site 35D's Area 1, all associated with the concrete foundation of a former structure and the remains of a nearby clarifier. The locations and orientations of these pipes are indicated in both data maps (Figures 8 and 9) as well as the included site photographs (Figures 10-15). One pipe runs from the concrete foundation to the clarifier, then from the clarifier to the west where it daylights within a nearby streambed (Figure 15). Another pipe departs the concrete foundation heading to the north, and was found to terminate outside the survey area at what appears to be an object entirely of metal, approximately 5x4 feet in size, and less than four feet below the ground surface (Figure 13). This object is also immediately adjacent to the former road. The geophysical nature of this anomaly is suggestive of it being a possible underground fuel storage tank (UST) or some similar structure.

Additional anomalies within Area 1 included only small metal objects at the southwest and southeast corners of the survey area, each less than 6 inches in diameter and likely less than 1 foot below the ground surface.

Area 2 may have been the location of a former bridge that crossed the nearby creek from south to north as the asphalt remains of the old road here appears to turn in this direction and there is a similar old asphalt road on the north side of the creek. The three detected EM anomalies here are possibly old bridge parts, although each appears to be very small, less than six inches in diameter, and very shallow (Figure 8). Of more interest is the large magnetic anomaly on the south side of Area 2 which could be the remains of a rebar-reinforced concrete footing (Figure 9). Its geophysical response suggests that it is elongate in the east-west direction, possible four feet wide in the north-south direction, and may be up to five feet below the ground surface. Its total length is indeterminable as it appears to extend outside the survey area further to the west.

No significant objects were detected in Areas 3 and 4 although there were numerous small items at the surface or several inches below it, some of which were pick up and tossed from their original location during the course of the survey and therefore do not appear in the data sets. These items included a short section of twisted wire and a broken metal shard. A metal strap/band still exists in place within Area 4, exposed at the surface. Any other remaining items within Areas 3 and 4 are likely less than 2 or 3 inches in diameter and are too small to be detected.

Indicated in Figures 8 and 9 are the portions of Area 5 that was grid surveyed with the cart-mounted EM61MK2 or free-traversed the EM61MK2HH (handheld). All areas were investigated with the magnetic instrument. No surveying was performed in the two areas of rock outcropping.

Within the gridded portion of Area 5 the two largest EM anomalies are plates of corrugated sheeting, both at the surface. Most other anomalies detected with either instrument were also visible at the surface and included old ammunition boxes, cut-off remains of fence posts, machinery parts, portions of a dented-in drum, and even old soda cans. In no case were large debris pods detected and all items that were found were single, randomly scattered objects, very small, and less than one foot below ground level. Note that nearly all of the objects detected with EM were invisible to the magnetic instrument therefore additionally

confirming that these items are small, innocuous objects and are likely identical in nature to the same items found at the surface and listed above.

Within Area 5's very southeast corner there are two areas of concrete rubble riprap within the creek bed immediately downstream of the Ammunition Road bridge crossing over the stream. The concrete appears to be purposely placed so as to inhibit erosion but the rubble is clearly pre-used from other sites as there is occasional rebar and embedded bricks within in. Several other larger metal objects also exist here such as a former manhole support ring and an old sign post. It is these larger objects that are creating the magnetic anomalies observed in Figure 9.

Conclusions – Based on the results of the geophysical survey, it would appear that purposeful dumping and burying of junk or debris has occurred only in IR Site 34B's Area 2. No other surveyed area within IR Site 34B or 34D has similar concentrations of debris as that resulting from concerted waste disposal. All other junk or debris detected in all other areas simply appears to have coincidently fallen into their current locations due to human activity likely unrelated to purposeful dumping. These items are single, randomly scattered objects, very small, and at ground surface or less than one foot below ground level. They include such things as scrap wires, rusted metal shards, old ammunition boxes, cut-off remains of fence posts, machinery parts, former sign posts, and even old soda cans.

Three possible exceptions to this are found within IR Site 34D's Areas 1, 2, and 5. Within Area 1 purposely placed piping appears to lead from an old concrete structure foundation to a possible UST located 40 feet north of the foundation. Within Area 2 an object was detected on the south side of the survey area that may be a reinforced concrete footing for a former bridge. It is indeterminably elongate in the north-south direction, approximately four feet wide in the north-south direction, and may be up to five feet below the ground surface. Lastly, in Area 5 concrete rubble riprap appears to have been purposefully placed within the creek bed immediately downstream of the Ammunition Road bridge so as to inhibit erosion.

Limitations and Further Recommendations - It should be understood that limitations inherent in geophysical instruments and/or surveying techniques exist at all sites, and nearly all sites exhibit conditions under which such might not perform optimally. Consequently, the detection of buried objects in all circumstances **cannot be guaranteed**. Such limitations are numerous and include, but are not limited to, rebar-reinforced foundation ground cover, abrupt changes in ground cover type, above-ground obstacles preventing full traverses or traverses in one direction only, above-ground conductive objects interfering with instrument signal, nearby powerlines or EM transmitters, highly conductive background soil conditions, entirely non-metallic targets, shallower or larger objects shielding deeper or smaller targets, and tracing signal jumping. If one or more geophysical instrument is rendered ineffective and cannot be utilized, or its effectiveness is degraded, the geophysical survey in general and its ultimate interpretation can be limited or degraded as well. The client should bear these limitations in mind and judiciously balance the opinions presented hererin with other data and findings in order to develop an assessment of the site more complete than what is possible with geophysics alone.

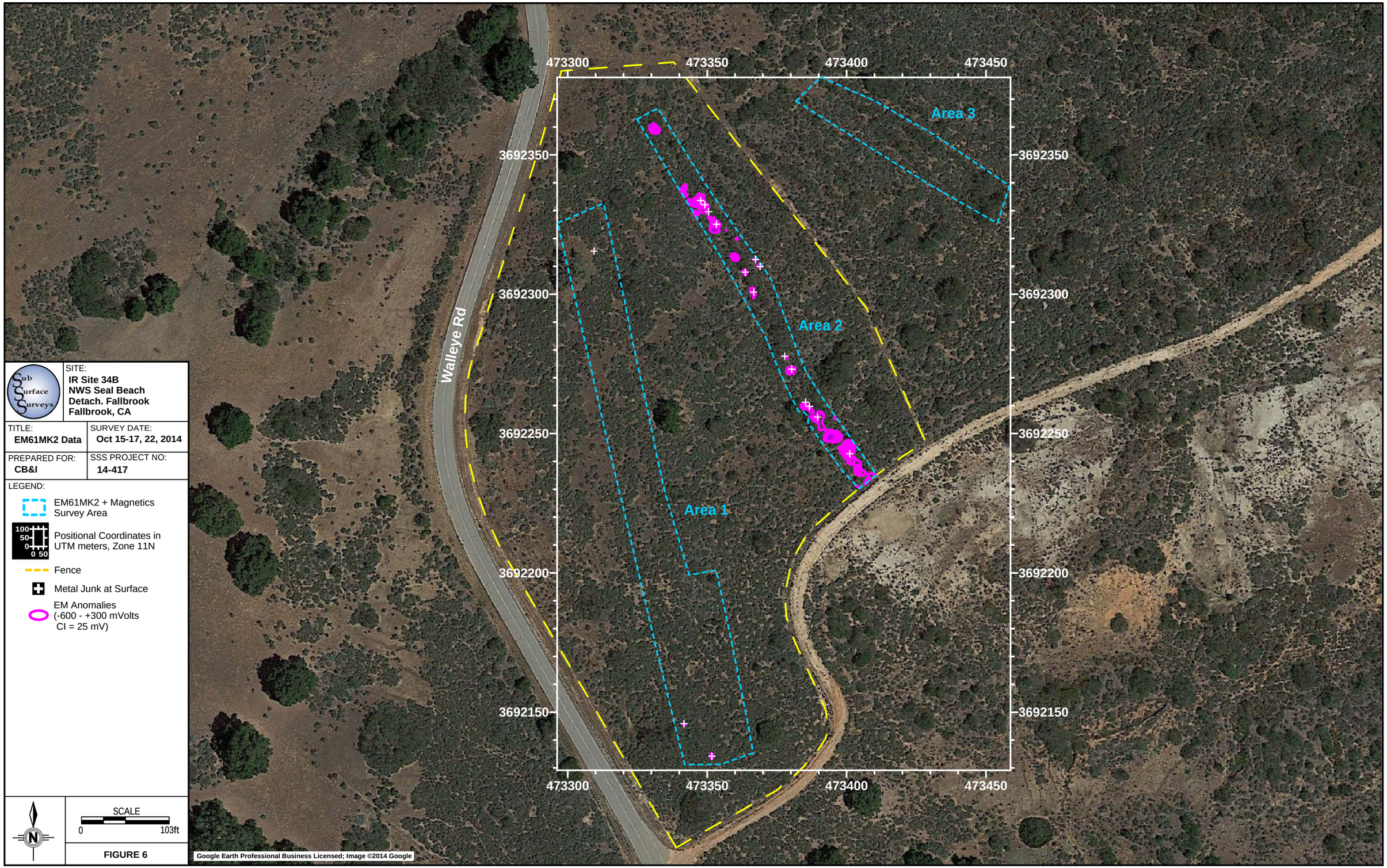
SubSurface Surveys may include maps in some reports. While they are an accurate general representation of the site and our findings, they are not of engineering quality (i.e., measured and mapped by a licensed land surveyor).

SubSurface Surveys and Associates makes no guarantee either expressed or implied regarding the accuracy of the findings and interpretations present. And, in no event will SubSurface Surveys and Associates be

liable for any direct, indirect, special, incidental, or consequential damages resulting from interpretations and opinions presented herewith.

All data generated on this project are in confidential file in this office, and are available for review by authorized persons at any time. The opportunity to participate in this investigation is very much appreciated. Please call, if there are questions.

Travis Crosby
California State Geophysics Registration GP1044
Senior Geophysicist, SubSurface Surveys



SITE:
IR Site 34B
NWS Seal Beach
Detach. Fallbrook
Fallbrook, CA

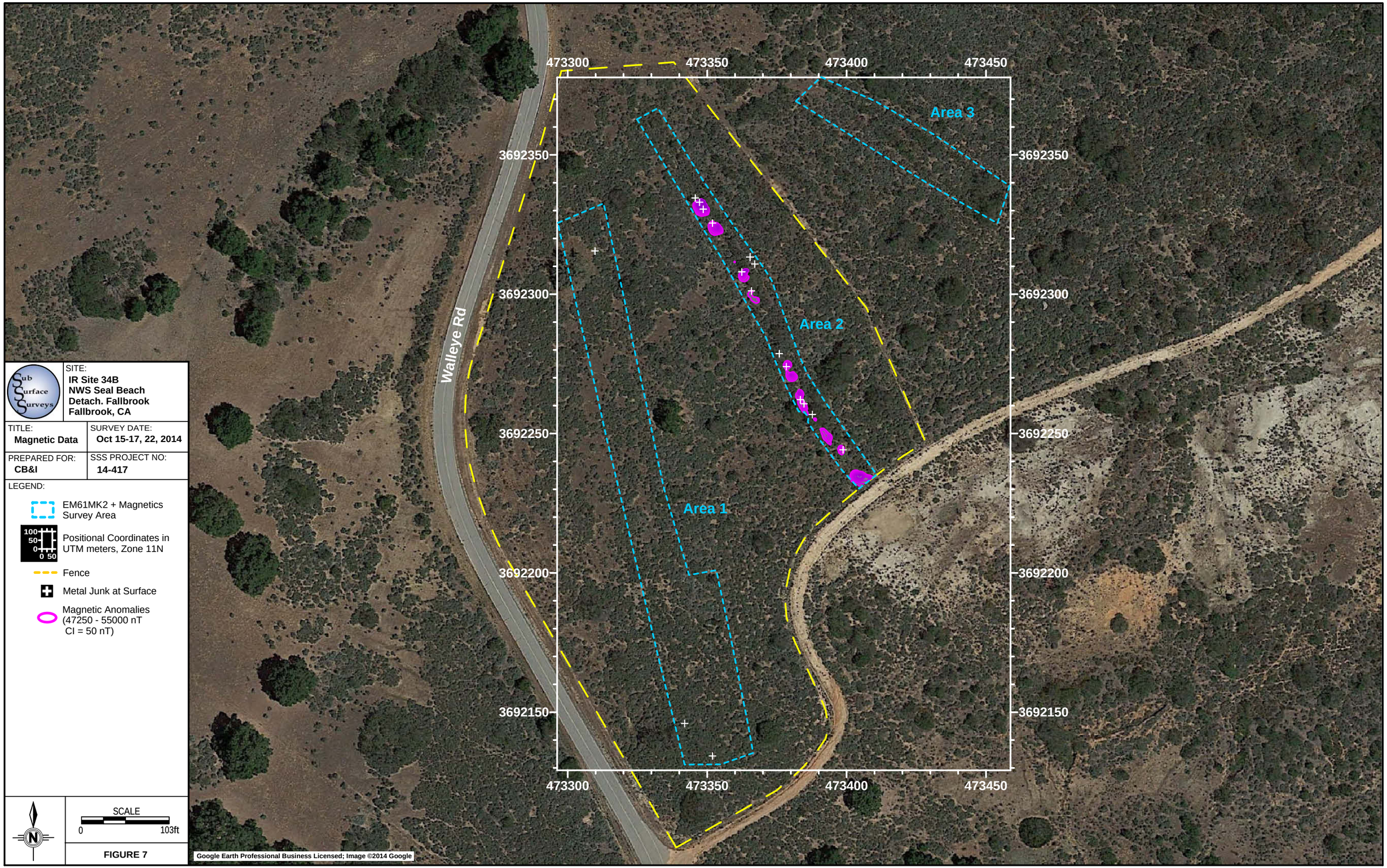
TITLE:	SURVEY DATE:
EM61MK2 Data	**Oct 15-17, 22, 2014**
PREPARED FOR: **CB&I**	SSS PROJECT NO: **14-417**

LEGEND:

- EM61MK2 + Magnetics Survey Area
- Positional Coordinates in UTM meters, Zone 11N
- Fence
- Metal Junk at Surface
- EM Anomalies (-600 - +300 mVolts CI = 25 mV)

SCALE
0 103ft

FIGURE 6



SITE:
IR Site 34B
NWS Seal Beach
Detach. Fallbrook
Fallbrook, CA

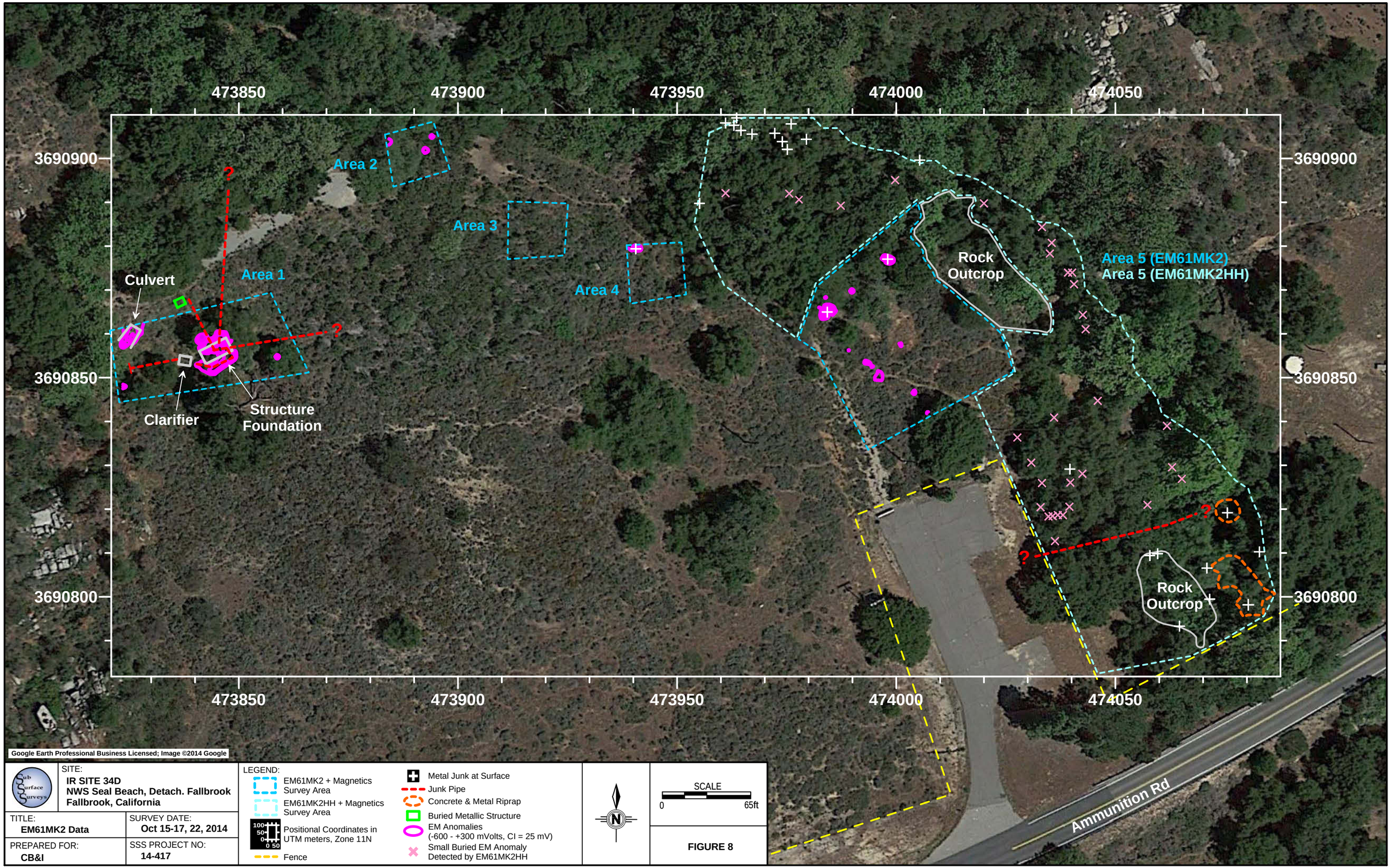
TITLE:	SURVEY DATE:
Magnetic Data	**Oct 15-17, 22, 2014**
PREPARED FOR: **CB&I**	SSS PROJECT NO: **14-417**

LEGEND:

- EM61MK2 + Magnetics Survey Area
- Positional Coordinates in UTM meters, Zone 11N
- Fence
- Metal Junk at Surface
- Magnetic Anomalies (47250 - 55000 nT CI = 50 nT)

SCALE
0 103ft

FIGURE 7



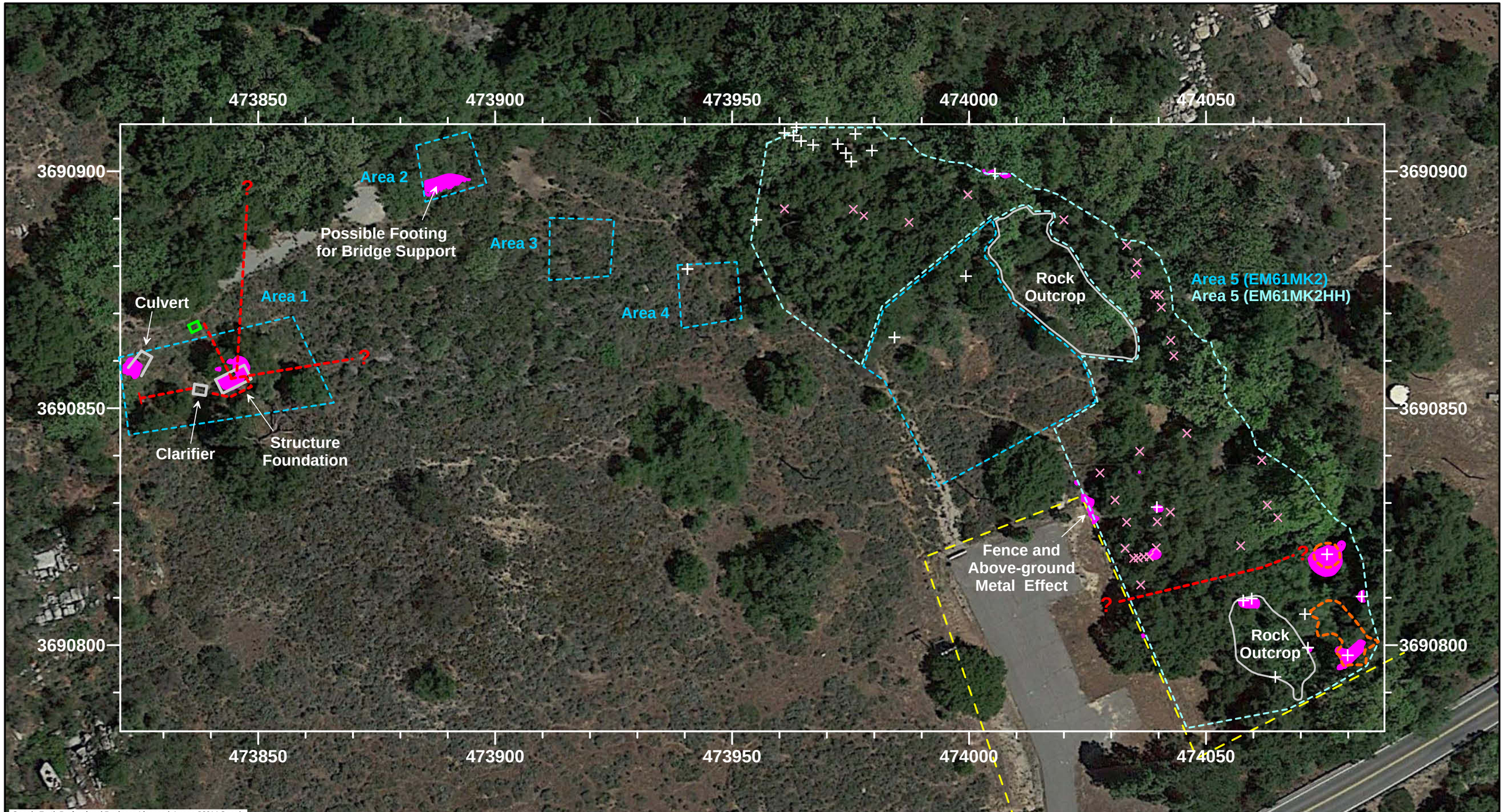
SITE:
IR SITE 34D
NWS Seal Beach, Detach. Fallbrook
Fallbrook, California

TITLE:	SURVEY DATE:
EM61MK2 Data	**Oct 15-17, 22, 2014**
PREPARED FOR:	SSS PROJECT NO:
CB&I	**14-417**

LEGEND:
- EM61MK2 + Magnetics Survey Area
- EM61MK2HH + Magnetics Survey Area
- Positional Coordinates in UTM meters, Zone 11N
- Fence
- Metal Junk at Surface
- Junk Pipe
- Concrete & Metal Riprap
- Buried Metallic Structure
- EM Anomalies (-600 - +300 mVolts, CI = 25 mV)
- Small Buried EM Anomaly Detected by EM61MK2HH

SCALE
0 65ft

FIGURE 8



SITE:
IR SITE 34D
NWS Seal Beach, Detach. Fallbrook
Fallbrook, California

TITLE:	SURVEY DATE:
Magnetic Data	**Oct 15-17, 22, 2014**
PREPARED FOR:	SSS PROJECT NO:
CB&I	**14-417**

LEGEND:
- EM61MK2 + Magnetics Survey Area
- EM61MK2HH + Magnetics Survey Area
- Positional Coordinates in UTM meters, Zone 11N
- Fence
- Metal Junk at Surface
- Junk Pipe
- Concrete & Metal Riprap
- Buried Metallic Structure
- Magnetic Anomalies (47250 - 55000 nT, CI = 50 nT)
- Small Bureid EM Anomaly Detected by EM61MK2HH

SCALE
0 65ft

FIGURE 9

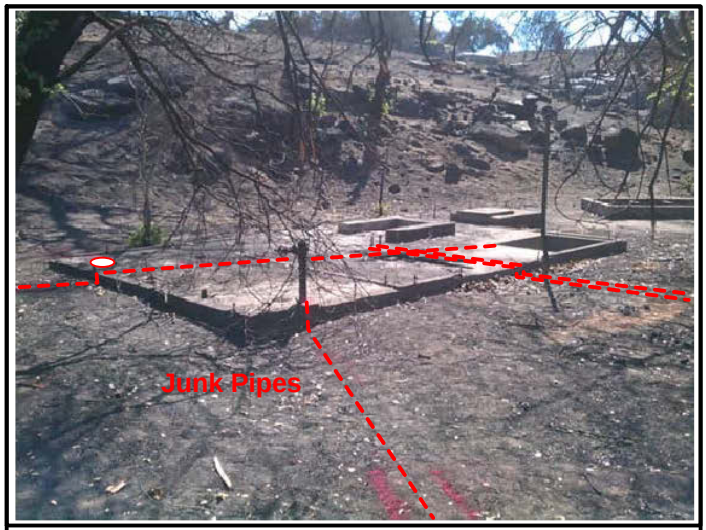


Figure 10

Figure 11

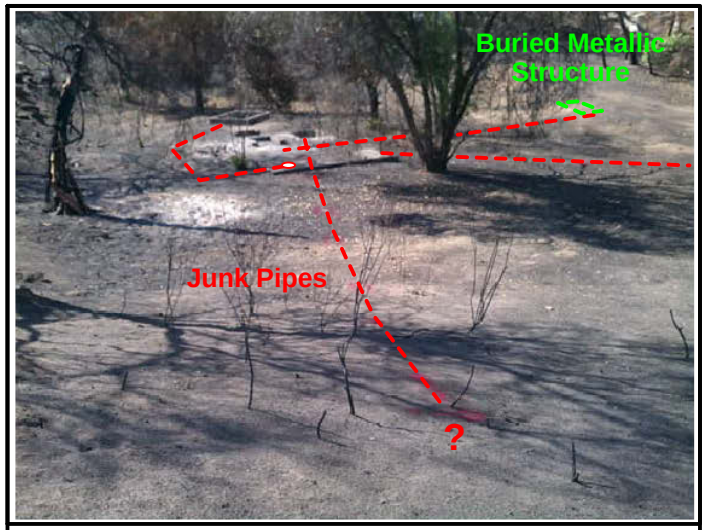


Figure 12

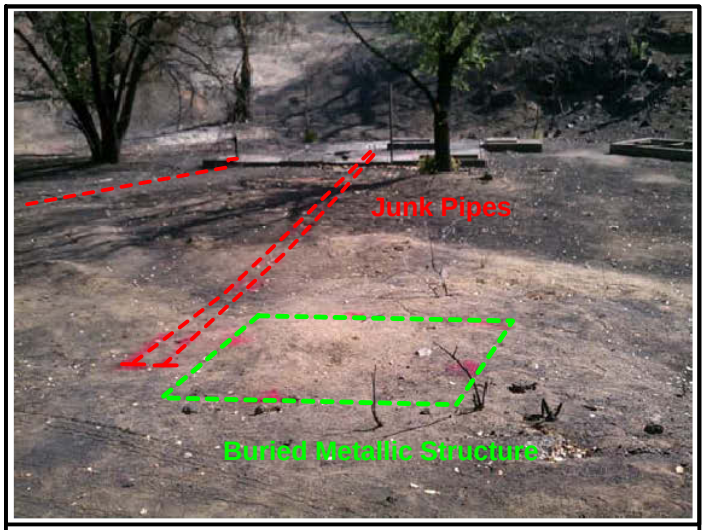


Figure 13

Figure 14

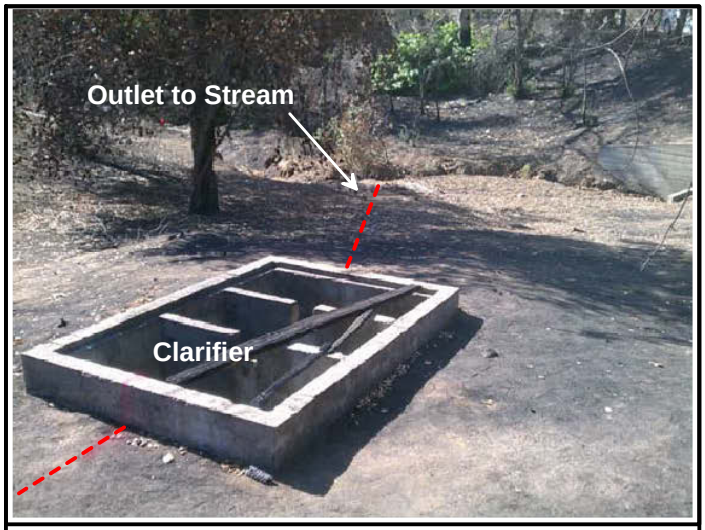


Figure 15

Sub Surface Surveys	SITE: **IR SITE 34D, Area 1** **NWS Seal Beach, Detach. Fallbrook** **Fallbrook, California**	TITLE: **Anomaly Photographs**	SURVEY DATE: **October 15-17, 22, 2014**
		PREPARED FOR: **CB&I**	SSS PROJECT NO: **14-417**

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Attachment 2
Aerial Photographs for IR Site 34b

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1946 – Disposal Trench visible, and the two linear features noted in SI can be seen in southwestern portion of the site. Quarry or borrow area visible southeast of site. Apparent vehicle traffic traces, mowing, or firebreaks visible both on and off the site.

1953 – Generally the same activities as seen in the 1946 photo.

1964 – Disposal Trench visible, no other structures seen, and the linear features noted in the SI are no longer prominent. Apparent vehicle traffic traces, mowing, or firebreaks visible both on and off the site.

RESPONSE TO AGENCY COMMENTS – AERIAL PHOTOGRAPH REVIEW, IR SITE 34b
DRAFT WORK PLAN FOR IR SITES 34b AND 34d
NAVAL WEAPONS STATION SEAL BEACH, DETACHMENT FALLBROOK, CALIFORNIA
Work Plan Document Dated September 2014

1980 – Disposal Trench visible, no other structures seen, linear features noted in SI no longer prominent.

1994 –Lower quality photograph. Disposal Trench not visible. No other structures seen.

2008 - Disposal Trench faintly visible based on vegetation lineament. No other structures seen.

2009 - Disposal Trench visible based on vegetation lineament. Track or dirt trail along fenceline visible and more prominent than the Disposal Trench. No other structures seen.

RESPONSE TO AGENCY COMMENTS – AERIAL PHOTOGRAPH REVIEW, IR SITE 34b
DRAFT WORK PLAN FOR IR SITES 34b AND 34d
NAVAL WEAPONS STATION SEAL BEACH, DETACHMENT FALLBROOK, CALIFORNIA
Work Plan Document Dated September 2014

2014 - Disposal Trench visible based on vegetation lineament. Track or dirt trail along fenceline still visible and more prominent than the Disposal Trench. No other structures seen.

Attachment 3
Aerial Photographs for IR Site 34d

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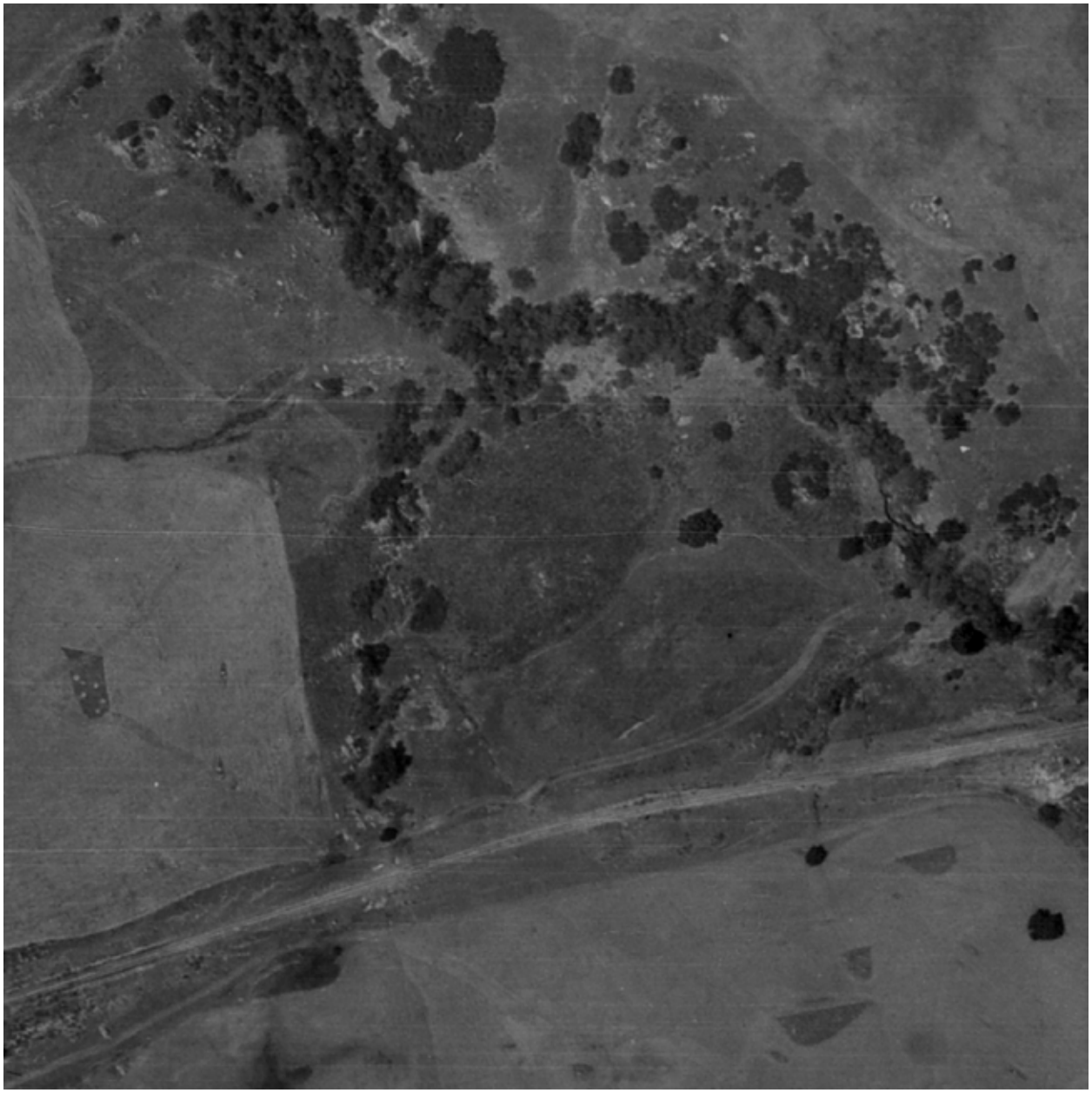
1938 – Site largely undeveloped. Apparent vehicle traffic traces visible.



1946 – The site has been developed. Building 325 visible in the middle of the site, cut back into the hill, with an apparent mound or buttress of soil visible North of the building.. Linear feature on the hill above Building 325 may be retaining structure for cut. Buildings 341 (small structure) and 430 (sump) visible to the left of Building 325. Building 338 can be seen on the right side of the photo, with a parking area near the paved road.

RESPONSE TO AGENCY COMMENTS – AERIAL PHOTOGRAPH REVIEW, IR SITE 34d
DRAFT WORK PLAN FOR IR SITES 34b AND 34d
NAVAL WEAPONS STATION SEAL BEACH, DETACHMENT FALLBROOK, CALIFORNIA
Work Plan Document Dated September 2014

April 11, 1953 – Apparent vehicle traffic traces, mowing, or firebreaks visible along roads both on and off the site. Building 325 visible in the middle of the site, cut into the hill, with an apparent mound or buttress of soil visible North of the building. Building 341 (small structure) visible, with a path or other linear feature leading towards Building 325. Building 338 visible on right side of photo.

1964 – Apparent vehicle traffic traces, mowing, or firebreaks visible along roads both on and off the site. Building 325 has been removed, though the cut where it was formerly located remains. Building 341 still visible. Building 338 visible on right side of photo.

Feb 23, 1974 – Lower quality photo. Generally the same as the 1964 photo except that vegetation appears to be growing in the former footprint of Building 325.

April 8, 1980 – Lower quality photo. Generally the same as the 1964 and 1974 photos.

1982 –Generally the same as the 1964, 1974, and 1980 photos.

August 15, 1989 The Building 325 cut appears to have been filled in. Building 338 still visible on right side of photo with cars in the parking area.

Appendix F: SI Report Soil Data Tables

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APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB01	IRP34B-SB02	IRP34B-SB03	IRP34B-SB03	IRP34B-SB04	IRP34B-SB04	IRP34B-SB05
Sample ID	IRP34B-SB01(2-2.	IRP34B-SB02(0-2)	IRP34B-SB03(0-2)	IRP34B-SB03(3-4)	IRP34B-SB04(0-2)	IRP34B-SB04(2.5-	IRP34B-SB05(0-2)
Sample Date	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008
Sample Depth	2.00 - 2.50	0.00 - 2.00	0.00 - 2.00	3.00 - 4.00	0.00 - 2.00	2.50 - 3.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
1,1,1-TRICHLOROETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,1,2,2-TETRACHLOROETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,1,2-TRICHLOROETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,1-DICHLOROETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,1-DICHLOROETHENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,2,4-TRIMETHYLBENZENE	0.0062 U	**0.032**	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,2-DICHLOROETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,2-DICHLOROPROPANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
1,3,5-TRIMETHYLBENZENE	0.0062 U	**0.01**	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
2-BUTANONE	0.012 U	0.0098 UJ	0.011 U	0.01 U	0.024 U	0.029 U	0.023 U
2-HEXANONE	0.025 U	0.02 U	0.023 U	0.021 U	0.049 U	0.057 U	0.047 U
4-METHYL-2-PENTANONE	0.025 U	0.02 U	0.023 U	0.021 U	0.049 U	0.057 U	0.047 U
ACETONE	0.025 U	0.042 UJ	0.023 U	0.021 U	0.049 U	0.057 U	0.047 U
BENZENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
BROMODICHLOROMETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
BROMOFORM	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
BROMOMETHANE	0.012 U	0.0098 U	0.011 U	0.01 U	0.024 U	0.029 U	0.023 U
CARBON DISULFIDE	0.0062 U	0.0049 UJ	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 UJ
CARBON TETRACHLORIDE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
CHLOROBENZENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
CHLOROETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
CHLOROFORM	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
CHLOROMETHANE	0.012 U	0.0098 U	0.011 U	0.01 U	0.024 U	0.029 U	0.023 U
CIS-1,2-DICHLOROETHENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
CIS-1,3-DICHLOROPROPENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
DIBROMOCHLOROMETHANE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
ETHYLBENZENE	0.0062 U	**0.0033 J**	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
ISOPROPYLBENZENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
M,P-XYLENE	0.012 U	**0.016**	0.011 U	0.01 U	0.024 U	0.029 U	0.023 U
METHYLENE CHLORIDE	0.012 U	0.0098 UJ	0.011 U	0.01 U	0.024 UJ	0.029 U	0.023 U
N-BUTYLBENZENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
N-PROPYLBENZENE	0.0062 U	**0.0021 J**	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
O-XYLENE	0.0062 U	**0.01**	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
P-ISOPROPYLTOLUENE	0.0062 U	**0.0052**	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB01	IRP34B-SB02	IRP34B-SB03	IRP34B-SB03	IRP34B-SB04	IRP34B-SB04	IRP34B-SB05
Sample ID	IRP34B-SB01(2-2.	IRP34B-SB02(0-2)	IRP34B-SB03(0-2)	IRP34B-SB03(3-4)	IRP34B-SB04(0-2)	IRP34B-SB04(2.5-	IRP34B-SB05(0-2)
Sample Date	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008
Sample Depth	2.00 - 2.50	0.00 - 2.00	0.00 - 2.00	3.00 - 4.00	0.00 - 2.00	2.50 - 3.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
SEC-BUTYLBENZENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
STYRENE	0.0062 U	**0.0036 J**	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
TERT-BUTYLBENZENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
TETRACHLOROETHENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
TOLUENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
TRANS-1,2-DICHLOROETHENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
TRANS-1,3-DICHLOROPROPENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
TRICHLOROETHENE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
VINYL CHLORIDE	0.0062 U	0.0049 U	0.0056 U	0.0051 U	0.012 U	0.014 U	0.012 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4,5-TETRACHLOROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,2,4-TRICHLOROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,2-DICHLOROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,3-DICHLOROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,4-DICHLOROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4,5-TRICHLOROPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4,6-TRICHLOROPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4-DICHLOROPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4-DIMETHYLPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4-DINITROPHENOL	0.69 UJ	1.5 UJ	0.68 UJ	0.68 UJ	0.67 UJ	0.67 U	0.67 UJ
2,4-DINITROTOLUENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,6-DICHLOROPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-CHLORONAPHTHALENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-CHLOROPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-METHYLPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-NITROANILINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-NITROPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
3,3'-DICHLOROBENZIDINE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
3,3'-DIMETHYLBENZIDINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
3,4-METHYLPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
3-NITROANILINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4,6-DINITRO-2-METHYLPHENOL	0.69 U	1.5 U	0.68 U	0.68 U	0.67 U	0.67 UJ	0.67 U

APPENDIX F-1: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB01	IRP34B-SB02	IRP34B-SB03	IRP34B-SB03	IRP34B-SB04	IRP34B-SB04	IRP34B-SB05
Sample ID	IRP34B-SB01(2-2.	IRP34B-SB02(0-2)	IRP34B-SB03(0-2)	IRP34B-SB03(3-4)	IRP34B-SB04(0-2)	IRP34B-SB04(2.5-	IRP34B-SB05(0-2)
Sample Date	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008
Sample Depth	2.00 - 2.50	0.00 - 2.00	0.00 - 2.00	3.00 - 4.00	0.00 - 2.00	2.50 - 3.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
4-BROMOPHENYL-PHENYLETHER	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-CHLORO-3-METHYLPHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-CHLOROANILINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-CHLOROPHENYL-PHENYLETHER	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-NITROANILINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-NITROPHENOL	0.69 U	1.5 U	0.68 U	0.68 U	0.67 U	0.67 U	0.67 U
5-NITRO-O-TOLUIDINE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 U	0.34 UJ
A,A-DIMETHYLPHENETHYLAMINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 UJ	0.34 U
ACENAPHTHENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
ACETOPHENONE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
ANILINE	0.69 U	1.5 U	0.68 U	0.68 U	0.67 U	0.67 U	0.67 U
ARAMITE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
BENZO(A)ANTHRACENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(A)PYRENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(B)FLUORANTHENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(G,H,I)PERYLENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(K)FLUORANTHENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZYL ALCOHOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BIS(2-CHLOROETHOXY)METHANE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BIS(2-CHLOROETHYL)ETHER	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BIS(2-ETHYLHEXYL)PHTHALATE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
BUTYLBENZYLPHTHALATE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
CHLOROBENZILATE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
CHRYSENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DI-N-BUTYLPHTHALATE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DI-N-OCTYLPHTHALATE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
DIALLATE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIBENZ(A,H)ANTHRACENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIBENZOFURAN	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIETHYLPHTHALATE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIMETHYLPHTHALATE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIPHENYLAMINE (1)	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
FLUORANTHENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB01	IRP34B-SB02	IRP34B-SB03	IRP34B-SB03	IRP34B-SB04	IRP34B-SB04	IRP34B-SB05
Sample ID	IRP34B-SB01(2-2.	IRP34B-SB02(0-2)	IRP34B-SB03(0-2)	IRP34B-SB03(3-4)	IRP34B-SB04(0-2)	IRP34B-SB04(2.5-	IRP34B-SB05(0-2)
Sample Date	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008
Sample Depth	2.00 - 2.50	0.00 - 2.00	0.00 - 2.00	3.00 - 4.00	0.00 - 2.00	2.50 - 3.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
FLUORENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
HEXACHLOROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
HEXACHLOROBUTADIENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
HEXACHLOROCYCLOPENTADIENE	0.34 UJ	0.73 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
HEXACHLOROETHANE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
INDENO(1,2,3-CD)PYRENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
ISOPHORONE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
KEPONE	1.4 U	2.9 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
N-NITROSO-DI-N-BUTYLAMINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSO-DI-N-PROPYLAMINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSODIMETHYLAMINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSOMETHYLETHYLAMINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSOPYRROLIDINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
NAPHTHALENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
O-TOLUIDINE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLOROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLOROETHANE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLORONITROBENZENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLOROPHENOL	0.69 U	1.5 U	0.68 U	0.68 U	0.67 U	0.67 U	0.67 U
PHENANTHRENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PHENOL	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PRONAMIDE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PYRENE	0.34 U	0.73 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PYRIDINE	0.86 U	1.8 U	0.85 U	0.85 U	0.84 U	0.85 U	0.85 U
Metals (mg/kg)							
ALUMINUM	**16,000**	**8,560**	**11,400**	**8,310**	**10,900**	**12,400**	**11,700**
ANTIMONY	**0.122 J**	**18.6 J**	**0.982 J**	**0.809 J**	**1 J**	**2.01 J**	**1.83 J**
ARSENIC	**1.87 J**	**2.5 J**	**2.37 J**	**2.02 J**	**2.1 J**	**4.49 J**	**3.33 J**
BARIUM	**171**	**102**	**136**	**109**	**150**	**196**	**155**
BERYLLIUM	**0.184 J**	**0.137 J**	**0.204 J**	**0.121 J**	**0.174 J**	**0.202 J**	**0.203 J**
CADMIUM	0.521 U	**0.867**	**0.503 J**	**0.348 J**	**0.644**	**0.777**	**0.96**
CALCIUM	**2,590**	**1,100**	**1,420**	**929**	**1,870**	**1,970**	**2,520**
CHROMIUM	**17.6**	**20.1**	**15.2**	**11.2**	**11.3**	**17.3**	**22.1**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB01	IRP34B-SB02	IRP34B-SB03	IRP34B-SB03	IRP34B-SB04	IRP34B-SB04	IRP34B-SB05
Sample ID	IRP34B-SB01(2-2.	IRP34B-SB02(0-2)	IRP34B-SB03(0-2)	IRP34B-SB03(3-4)	IRP34B-SB04(0-2)	IRP34B-SB04(2.5-	IRP34B-SB05(0-2)
Sample Date	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008	11/21/2008
Sample Depth	2.00 - 2.50	0.00 - 2.00	0.00 - 2.00	3.00 - 4.00	0.00 - 2.00	2.50 - 3.00	0.00 - 2.00
Metals (mg/kg)							
COBALT	**7.45**	**9.94**	**8.75**	**7.24**	**7.59**	**9.44**	**9.36**
COPPER	**23.8**	**39.3**	**19.7**	**16.7**	**23.9**	**95.1**	**92.8**
IRON	**25,100**	**24,700**	**38,400**	**31,300**	**20,100**	**41,400**	**33,600**
LEAD	**4.19**	**63.1**	**21.9**	**14.8**	**79.1**	**234**	**156**
MAGNESIUM	**6,670**	**3,590**	**4,970**	**3,560**	**4,750**	**4,930**	**4,460**
MANGANESE	**223**	**297**	**469**	**413**	**310**	**403**	**375**
MERCURY	0.104 U	0.11 U	0.102 U	0.103 U	0.102 U	0.102 U	0.102 U
NICKEL	**6.21**	**8.27**	**10.2**	**13.4**	**7.35**	**12.1**	**62.1**
POTASSIUM	**3,690**	**4,180**	**5,930**	**4,030**	**5,570**	**5,680**	**5,120**
SELENIUM	**0.136 J**	0.551 U	**0.118 J**	0.513 U	**0.122 J**	**0.118 J**	**0.142 J**
SILVER	0.521 U	**0.111 J**	0.512 U	0.513 U	**0.107 J**	**0.121 J**	**0.148 J**
SODIUM	**226**	**75.8 J**	**94.5 J**	**75.9 J**	**107**	**116**	**153**
THALLIUM	**0.438 J**	**0.32 J**	**0.396 J**	**0.299 J**	**0.378 J**	**0.371 J**	**0.353 J**
VANADIUM	**66.1**	**32.2**	**41.5**	**32.6**	**40.4**	**43.1**	**43.9**
ZINC	**35.9**	**668**	**339**	**314**	**247**	**399**	**454**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB05	IRP34B-SB06	IRP34B-SB06	IRP34B-SB07	IRP34B-SB07	IRP34B-SB08	IRP34B-SB08
Sample ID	IRP34B-SB05(3-4)	IRP34B-SB06(0-2)	IRP34B-SB06(2-3)	IRP34B-SB07(0-2)	IRP34B-SB07(2-3)	IRP34B-SB08(0-2)	IRP34B-SB08(2-3)
Sample Date	11/21/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008
Sample Depth	3.00 - 4.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00
Volatile Organic Compounds (mg/kg)							
1,1,1-TRICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
1,1,2,2-TETRACHLOROETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
1,1,2-TRICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
1,1-DICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
1,1-DICHLOROETHENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
1,2,4-TRIMETHYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
1,2-DICHLOROETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
1,2-DICHLOROPROPANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
1,3,5-TRIMETHYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
2-BUTANONE	0.023 U	0.023 U	0.023 U	0.016 U	0.025 U	0.027 U	0.027 U
2-HEXANONE	0.046 U	0.046 U	0.046 U	0.033 U	0.05 U	0.053 U	0.054 U
4-METHYL-2-PENTANONE	0.046 U	0.046 U	0.046 U	0.033 U	0.05 U	0.053 U	0.054 U
ACETONE	0.046 U	0.046 U	0.046 U	0.033 U	0.05 U	0.053 U	0.054 U
BENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
BROMODICHLOROMETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
BROMOFORM	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
BROMOMETHANE	0.023 U	0.023 U	0.023 U	0.016 U	0.025 U	0.027 U	0.027 U
CARBON DISULFIDE	0.011 UJ	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
CARBON TETRACHLORIDE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
CHLOROBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
CHLOROETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
CHLOROFORM	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
CHLOROMETHANE	0.023 U	0.023 U	0.023 U	0.016 U	0.025 U	0.027 U	0.027 U
CIS-1,2-DICHLOROETHENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
CIS-1,3-DICHLOROPROPENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
DIBROMOCHLOROMETHANE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
ETHYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
ISOPROPYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
M,P-XYLENE	0.023 U	0.023 U	0.023 U	0.016 U	0.025 U	0.027 U	0.027 U
METHYLENE CHLORIDE	0.023 U	0.023 U	0.023 U	0.016 U	0.025 U	0.027 U	0.027 U
N-BUTYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
N-PROPYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
O-XYLENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
P-ISOPROPYLTOLUENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB05	IRP34B-SB06	IRP34B-SB06	IRP34B-SB07	IRP34B-SB07	IRP34B-SB08	IRP34B-SB08
Sample ID	IRP34B-SB05(3-4)	IRP34B-SB06(0-2)	IRP34B-SB06(2-3)	IRP34B-SB07(0-2)	IRP34B-SB07(2-3)	IRP34B-SB08(0-2)	IRP34B-SB08(2-3)
Sample Date	11/21/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008
Sample Depth	3.00 - 4.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00
Volatile Organic Compounds (mg/kg)							
SEC-BUTYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
STYRENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
TERT-BUTYLBENZENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 UJ
TETRACHLOROETHENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
TOLUENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
TRANS-1,2-DICHLOROETHENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
TRANS-1,3-DICHLOROPROPENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
TRICHLOROETHENE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
VINYL CHLORIDE	0.011 U	0.011 U	0.011 U	0.0082 U	0.012 U	0.013 U	0.013 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4,5-TETRACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,2,4-TRICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,2-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,3-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
1,4-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4,5-TRICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4,6-TRICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4-DICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4-DIMETHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,4-DINITROPHENOL	0.68 UJ	0.68 UJ	0.69 UJ	0.68 UJ	0.69 UJ	0.67 UJ	0.68 UJ
2,4-DINITROTOLUENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2,6-DICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-CHLORONAPHTHALENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-CHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-NITROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-NITROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
3,3'-DICHLOROBENZIDINE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
3,3'-DIMETHYLBENZIDINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
3,4-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
3-NITROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4,6-DINITRO-2-METHYLPHENOL	0.68 U	0.68 U	0.69 U	0.68 U	0.69 U	0.67 U	0.68 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB05	IRP34B-SB06	IRP34B-SB06	IRP34B-SB07	IRP34B-SB07	IRP34B-SB08	IRP34B-SB08
Sample ID	IRP34B-SB05(3-4)	IRP34B-SB06(0-2)	IRP34B-SB06(2-3)	IRP34B-SB07(0-2)	IRP34B-SB07(2-3)	IRP34B-SB08(0-2)	IRP34B-SB08(2-3)
Sample Date	11/21/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008
Sample Depth	3.00 - 4.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00
Semivolatile Organic Compounds (mg/kg)							
4-BROMOPHENYL-PHENYLETHER	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-CHLORO-3-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-CHLOROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-CHLOROPHENYL-PHENYLETHER	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-NITROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
4-NITROPHENOL	0.68 U	0.68 U	0.69 U	0.68 U	0.69 U	0.67 U	0.68 U
5-NITRO-O-TOLUIDINE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
A,A-DIMETHYLPHENETHYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
ACENAPHTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
ACETOPHENONE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
ANILINE	0.68 U	0.68 U	0.69 U	0.68 U	0.69 U	0.67 U	0.68 U
ARAMITE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
BENZO(A)ANTHRACENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(A)PYRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(B)FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(G,H,I)PERYLENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZO(K)FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BENZYL ALCOHOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BIS(2-CHLOROETHOXY)METHANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BIS(2-CHLOROETHYL)ETHER	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
BIS(2-ETHYLHEXYL)PHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
BUTYLBENZYLPHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
CHLOROBENZILATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
CHRYSENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DI-N-BUTYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DI-N-OCTYLPHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
DIALLATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIBENZ(A,H)ANTHRACENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIBENZOFURAN	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIETHYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIMETHYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
DIPHENYLAMINE (1)	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB05	IRP34B-SB06	IRP34B-SB06	IRP34B-SB07	IRP34B-SB07	IRP34B-SB08	IRP34B-SB08
Sample ID	IRP34B-SB05(3-4)	IRP34B-SB06(0-2)	IRP34B-SB06(2-3)	IRP34B-SB07(0-2)	IRP34B-SB07(2-3)	IRP34B-SB08(0-2)	IRP34B-SB08(2-3)
Sample Date	11/21/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008
Sample Depth	3.00 - 4.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00
Semivolatile Organic Compounds (mg/kg)							
FLUORENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
HEXACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
HEXACHLOROBUTADIENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
HEXACHLOROCYCLOPENTADIENE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ
HEXACHLOROETHANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
INDENO(1,2,3-CD)PYRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
ISOPHORONE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
KEPONE	1.3 U	1.3 U	1.4 U	1.3 U	1.4 U	1.3 U	1.3 U
N-NITROSO-DI-N-BUTYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSO-DI-N-PROPYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSODIMETHYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSOMETHYLETHYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
N-NITROSOPYRROLIDINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
NAPHTHALENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
O-TOLUIDINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLOROETHANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLORONITROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PENTACHLOROPHENOL	0.68 U	0.68 U	0.69 U	0.68 U	0.69 U	0.67 U	0.68 U
PHENANTHRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PRONAMIDE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PYRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
PYRIDINE	0.86 U	0.86 U	0.86 U	0.85 U	0.86 U	0.85 U	0.86 U
Metals (mg/kg)							
ALUMINUM	**14,400**	**12,500**	**13,200**	**9,040**	**11,100**	**12,100**	**16,500**
ANTIMONY	**1.93 J**	**5.33**	**7.58**	**0.48 J**	**2.53**	**131**	**285**
ARSENIC	**2.54 J**	**5.25**	**6.86**	**1.64 J**	**2.75 J**	**6.06**	**11.9**
BARIUM	**166**	**244**	**299**	**99.1**	**131**	**328**	**829**
BERYLLIUM	**0.196 J**	**0.213 J**	**0.234 J**	**0.162 J**	**0.238 J**	**0.781**	**0.958**
CADMIUM	**0.568**	**1.99**	**2.44**	**0.392 J**	**0.608**	**3.26**	**6.85**
CALCIUM	**1,960**	**6,180**	**4,860**	**1,150**	**1,460**	**6,790**	**15,700**
CHROMIUM	**12.8**	**21.1**	**27.3**	**9.93**	**17.4**	**30**	**49.9**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB05	IRP34B-SB06	IRP34B-SB06	IRP34B-SB07	IRP34B-SB07	IRP34B-SB08	IRP34B-SB08
Sample ID	IRP34B-SB05(3-4)	IRP34B-SB06(0-2)	IRP34B-SB06(2-3)	IRP34B-SB07(0-2)	IRP34B-SB07(2-3)	IRP34B-SB08(0-2)	IRP34B-SB08(2-3)
Sample Date	11/21/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008	11/24/2008
Sample Depth	3.00 - 4.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	2.00 - 3.00
Metals (mg/kg)							
COBALT	**9.54**	**10.6**	**12.3**	**5.86**	**6.57**	**8.56**	**12.7**
COPPER	**91.2**	**266**	**215**	**80.1**	**1,010**	**227**	**436**
IRON	**22,100**	**76,400**	**78,100**	**16,800**	**24,100**	**25,900**	**38,600**
LEAD	**88.5**	**617**	**934**	**37**	**222**	**5,880**	**18,100**
MAGNESIUM	**5,500**	**4,360**	**4,740**	**3,450**	**3,880**	**3,800**	**4,510**
MANGANESE	**295**	**532**	**602**	**208**	**205**	**410**	**487**
MERCURY	0.103 U	0.104 U	0.104 U	0.103 U	0.104 U	**0.0348 J**	0.103 U
NICKEL	**6.45**	**22.6**	**34.1**	**4.7**	**11.2**	**13.6**	**29.9**
POTASSIUM	**4,750**	**5,050**	**5,250**	**3,330**	**2,700**	**4,740**	**5,340**
SELENIUM	**0.112 J**	**0.203 J**	**0.206 J**	**0.106 J**	**0.153 J**	**0.214 J**	**0.317 J**
SILVER	**0.117 J**	**0.351 J**	**0.369 J**	0.513 U	**0.121 J**	**0.934**	**3.25**
SODIUM	**175**	**319**	**278**	**78.3 J**	**142**	**808**	**1,860**
THALLIUM	**0.394 J**	**0.635**	**0.413 J**	**0.342 J**	**0.321 J**	**0.308 J**	**0.292 J**
VANADIUM	**54.5**	**42.3**	**49.1**	**43.4**	**55.8**	**38.2**	**43.2**
ZINC	**317**	**1,410 J**	**1,790 J**	**120 J**	**276 J**	**1,550 J**	**3,250 J**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB09	IRP34B-SB09	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample ID	IRP34B-SB09(0-2)	IRP34B-SB09(2-3)	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample Date	11/24/2008	11/24/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
1,1,1-TRICHLOROETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,1,2,2-TETRACHLOROETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,1,2-TRICHLOROETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,1-DICHLOROETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,1-DICHLOROETHENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,2,4-TRIMETHYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,2-DICHLOROETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,2-DICHLOROPROPANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
1,3,5-TRIMETHYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
2-BUTANONE	0.04 U	0.027 U	0.012 U	0.018 U	0.016 U	0.014 U	0.014 U
2-HEXANONE	0.08 U	0.053 U	0.024 U	0.037 U	0.033 U	0.028 U	0.029 U
4-METHYL-2-PENTANONE	0.08 U	0.053 U	0.024 U	0.037 U	0.033 U	0.028 U	0.029 U
ACETONE	0.08 U	0.053 U	0.024 U	0.037 U	0.033 U	0.028 U	0.029 U
BENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
BROMODICHLOROMETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
BROMOFORM	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
BROMOMETHANE	0.04 U	0.027 U	0.012 U	0.018 U	0.016 U	0.014 U	0.014 U
CARBON DISULFIDE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
CARBON TETRACHLORIDE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
CHLOROBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
CHLOROETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
CHLOROFORM	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
CHLOROMETHANE	0.04 U	0.027 U	0.012 U	0.018 U	0.016 U	0.014 U	0.014 U
CIS-1,2-DICHLOROETHENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
CIS-1,3-DICHLOROPROPENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
DIBROMOCHLOROMETHANE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
ETHYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
ISOPROPYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
M,P-XYLENE	0.04 U	0.027 U	0.012 U	0.018 U	0.016 U	0.014 U	0.014 U
METHYLENE CHLORIDE	0.04 U	0.027 U	0.012 U	0.018 U	0.016 U	0.014 U	0.014 U
N-BUTYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
N-PROPYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
O-XYLENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
P-ISOPROPYLTOLUENE	**0.057**	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB09	IRP34B-SB09	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample ID	IRP34B-SB09(0-2)	IRP34B-SB09(2-3)	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample Date	11/24/2008	11/24/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
SEC-BUTYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
STYRENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
TERT-BUTYLBENZENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
TETRACHLOROETHENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
TOLUENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
TRANS-1,2-DICHLOROETHENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
TRANS-1,3-DICHLOROPROPENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
TRICHLOROETHENE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
VINYL CHLORIDE	0.02 U	0.013 U	0.0061 U	0.0091 U	0.0081 U	0.0071 U	0.0072 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4,5-TETRACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
1,2,4-TRICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
1,2-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
1,3-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
1,4-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2,4,5-TRICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2,4,6-TRICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2,4-DICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2,4-DIMETHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2,4-DINITROPHENOL	0.67 UJ	0.68 UJ	0.67 UJ	0.67 UJ	0.67 UJ	0.67 UJ	0.68 UJ
2,4-DINITROTOLUENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2,6-DICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2-CHLORONAPHTHALENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2-CHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2-NITROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
2-NITROPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
3,3'-DICHLOROBENZIDINE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.34 UJ
3,3'-DIMETHYLBENZIDINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
3,4-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
3-NITROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
4,6-DINITRO-2-METHYLPHENOL	0.67 U	0.68 U	0.67 U	0.67 U	0.67 U	0.67 U	0.68 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB09	IRP34B-SB09	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample ID	IRP34B-SB09(0-2)	IRP34B-SB09(2-3)	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample Date	11/24/2008	11/24/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
4-BROMOPHENYL-PHENYLETHER	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
4-CHLORO-3-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
4-CHLOROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
4-CHLOROPHENYL-PHENYLETHER	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
4-NITROANILINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
4-NITROPHENOL	0.67 U	0.68 U	0.67 U	0.67 U	0.67 U	0.67 U	0.68 U
5-NITRO-O-TOLUIDINE	0.34 UJ	0.34 UJ	0.34 U	0.34 U	0.34 UJ	0.33 UJ	0.34 UJ
A,A-DIMETHYLPHENETHYLAMINE	0.34 U	0.34 U	0.34 UJ	0.34 UJ	0.34 U	0.33 U	0.34 U
ACENAPHTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
ACETOPHENONE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
ANILINE	0.67 U	0.68 U	0.67 U	0.67 U	0.67 U	0.67 U	0.68 U
ARAMITE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.34 UJ
BENZO(A)ANTHRACENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BENZO(A)PYRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BENZO(B)FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BENZO(G,H,I)PERYLENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BENZO(K)FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BENZYL ALCOHOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BIS(2-CHLOROETHOXY)METHANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BIS(2-CHLOROETHYL)ETHER	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
BIS(2-ETHYLHEXYL)PHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.34 UJ
BUTYLBENZYLPHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.34 UJ
CHLOROBENZILATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.34 UJ
CHRYSENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
DI-N-BUTYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
DI-N-OCTYLPHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.34 UJ
DIALLATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
DIBENZ(A,H)ANTHRACENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
DIBENZOFURAN	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
DIETHYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
DIMETHYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
DIPHENYLAMINE (1)	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB09	IRP34B-SB09	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample ID	IRP34B-SB09(0-2)	IRP34B-SB09(2-3)	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample Date	11/24/2008	11/24/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
FLUORENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
HEXACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
HEXACHLOROBUTADIENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
HEXACHLOROCYCLOPENTADIENE	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.34 UJ
HEXACHLOROETHANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
INDENO(1,2,3-CD)PYRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
ISOPHORONE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
KEPONE	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
N-NITROSO-DI-N-BUTYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
N-NITROSO-DI-N-PROPYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
N-NITROSODIMETHYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
N-NITROSOMETHYLETHYLAMINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
N-NITROSOPYRROLIDINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
NAPHTHALENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
O-TOLUIDINE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PENTACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PENTACHLOROETHANE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PENTACHLORONITROBENZENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PENTACHLOROPHENOL	0.67 U	0.68 U	0.67 U	0.67 U	0.67 U	0.67 U	0.68 U
PHENANTHRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PHENOL	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PRONAMIDE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PYRENE	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.33 U	0.34 U
PYRIDINE	0.85 U	0.85 U	0.84 U	0.84 U	0.85 U	0.84 U	0.85 U
Metals (mg/kg)							
ALUMINUM	**10,500**	**10,600**	**11,900**	**12,000**	**12,100**	**13,000**	**10,700**
ANTIMONY	**0.976 J**	**0.738 J**	**0.114 J**	1.02 UJ	1.02 UJ	1.01 UJ	1.03 UJ
ARSENIC	**1.54 J**	**1.68 J**	**1.79 J**	**1.76 J**	**1.48 J**	**1.47 J**	**1.31 J**
BARIUM	**95.9**	**109**	**129**	**131**	**142**	**140**	**115**
BERYLLIUM	**0.225 J**	**0.232 J**	**0.214 J**	**0.194 J**	**0.195 J**	**0.205 J**	**0.198 J**
CADMIUM	**0.298 J**	**0.352 J**	**0.124 J**	**0.106 J**	**0.106 J**	**0.112 J**	0.513 U
CALCIUM	**1,250**	**1,220**	**1,430**	**1,170**	**1,500**	**1,500**	**1,150**
CHROMIUM	**9.86**	**11**	**11**	**8.38**	**9.46**	**10.3**	**9.06**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SB09	IRP34B-SB09	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample ID	IRP34B-SB09(0-2)	IRP34B-SB09(2-3)	IRP34B-SS01	IRP34B-SS02	IRP34B-SS03	IRP34B-SS04	IRP34B-SS05
Sample Date	11/24/2008	11/24/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008	11/20/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Metals (mg/kg)							
COBALT	**6.21**	**6.63**	**7.81**	**7.71**	**7.62**	**7.89**	**6.67**
COPPER	**15.9**	**14.3**	**8.6**	**7.38**	**7.79**	**7.54**	**7.58**
IRON	**15,400**	**17,500**	**19,200**	**17,400**	**19,100**	**20,200**	**16,700**
LEAD	**30.2**	**20.9**	**8.48**	**2.85**	**4.1**	**8.65**	**3.41**
MAGNESIUM	**3,460**	**3,910**	**4,640**	**4,930**	**5,340**	**5,490**	**4,450**
MANGANESE	**248**	**244**	**309**	**273**	**270**	**269**	**247**
MERCURY	0.102 U	0.103 U	0.102 U	0.102 U	0.102 U	0.101 U	0.103 U
NICKEL	**4.42**	**4.94**	**4.97**	**4.01**	**4.75**	**4.61**	**4.1**
POTASSIUM	**3,560**	**3,590**	**5,250**	**5,370**	**5,020**	**5,740**	**4,960**
SELENIUM	**0.117 J**	**0.115 J**	**0.139 J**	**0.126 J**	**0.105 J**	**0.119 J**	**0.153 J**
SILVER	0.511 U	0.513 U	0.509 U	0.508 U	0.509 U	0.507 U	0.513 U
SODIUM	**105**	**106**	**116**	**89.2 J**	**111**	**96.5 J**	**99.7 J**
THALLIUM	**0.312 J**	**0.334 J**	**0.378 J**	**0.404 J**	**0.418 J**	**0.46 J**	**0.382 J**
VANADIUM	**40.2**	**46.4**	**48.4**	**42.6**	**47.3**	**51.5**	**44.1**
ZINC	**149 J**	**178 J**	**36.2**	**35.3**	**38.7**	**39.3**	**30.9**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09	IRP34D-SB01	IRP34D-SB01	IRP34D-SB02
Sample ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09(0-2)	IRP34D-SB01(0-2)	IRP34D-SB01(4-6)	IRP34D-SB02(0-2)
Sample Date	11/20/2008	11/20/2008	11/20/2008	11/21/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
1,1,1-TRICHLOROETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,1,2,2-TETRACHLOROETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,1,2-TRICHLOROETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,1-DICHLOROETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,1-DICHLOROETHENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,2,4-TRIMETHYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,2-DICHLOROETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,2-DICHLOROPROPANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
1,3,5-TRIMETHYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
2-BUTANONE	0.012 U	0.02 U	0.013 U	0.014 U	0.016 U	0.016 U	0.013 U
2-HEXANONE	0.025 U	0.039 U	0.026 U	0.028 U	0.032 U	0.031 U	0.025 U
4-METHYL-2-PENTANONE	0.025 U	0.039 U	0.026 U	0.028 U	0.032 U	0.031 U	0.025 U
ACETONE	0.025 U	0.039 U	0.026 U	0.028 U	0.032 U	0.031 U	0.025 U
BENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
BROMODICHLOROMETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
BROMOFORM	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
BROMOMETHANE	0.012 U	0.02 U	0.013 U	0.014 U	0.016 U	0.016 U	0.013 U
CARBON DISULFIDE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
CARBON TETRACHLORIDE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
CHLOROBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
CHLOROETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
CHLOROFORM	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
CHLOROMETHANE	0.012 U	0.02 U	0.013 U	0.014 U	0.016 U	0.016 U	0.013 U
CIS-1,2-DICHLOROETHENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
CIS-1,3-DICHLOROPROPENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
DIBROMOCHLOROMETHANE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
ETHYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
ISOPROPYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
M,P-XYLENE	0.012 U	0.02 U	0.013 U	0.014 U	0.016 U	0.016 U	0.013 U
METHYLENE CHLORIDE	0.012 U	0.02 U	0.013 U	0.014 U	0.016 U	0.016 U	0.013 U
N-BUTYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
N-PROPYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
O-XYLENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
P-ISOPROPYLTOLUENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09	IRP34D-SB01	IRP34D-SB01	IRP34D-SB02
Sample ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09(0-2)	IRP34D-SB01(0-2)	IRP34D-SB01(4-6)	IRP34D-SB02(0-2)
Sample Date	11/20/2008	11/20/2008	11/20/2008	11/21/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
SEC-BUTYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
STYRENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
TERT-BUTYLBENZENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
TETRACHLOROETHENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
TOLUENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
TRANS-1,2-DICHLOROETHENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
TRANS-1,3-DICHLOROPROPENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
TRICHLOROETHENE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
VINYL CHLORIDE	0.0061 U	0.0098 U	0.0066 U	0.0071 U	0.008 U	0.0078 U	0.0063 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4,5-TETRACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
1,2,4-TRICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
1,2-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
1,3-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
1,4-DICHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2,4,5-TRICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2,4,6-TRICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2,4-DICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2,4-DIMETHYLPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2,4-DINITROPHENOL	0.67 UJ	0.68 UJ	0.67 UJ	0.67 UJ	1.6 U	0.69 U	0.69 U
2,4-DINITROTOLUENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2,6-DICHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2-CHLORONAPHTHALENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2-CHLOROPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2-NITROANILINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
2-NITROPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
3,3'-DICHLOROBENZIDINE	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.81 UJ	0.34 UJ	0.34 UJ
3,3'-DIMETHYLBENZIDINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
3,4-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
3-NITROANILINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
4,6-DINITRO-2-METHYLPHENOL	0.67 U	0.68 U	0.67 U	0.67 U	1.6 UJ	0.69 UJ	0.69 UJ

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09	IRP34D-SB01	IRP34D-SB01	IRP34D-SB02
Sample ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09(0-2)	IRP34D-SB01(0-2)	IRP34D-SB01(4-6)	IRP34D-SB02(0-2)
Sample Date	11/20/2008	11/20/2008	11/20/2008	11/21/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
4-BROMOPHENYL-PHENYLETHER	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
4-CHLORO-3-METHYLPHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
4-CHLOROANILINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
4-CHLOROPHENYL-PHENYLETHER	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
4-NITROANILINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
4-NITROPHENOL	0.67 U	0.68 U	0.67 U	0.67 U	1.6 U	0.69 U	0.69 U
5-NITRO-O-TOLUIDINE	0.34 UJ	0.34 U	0.34 U	0.33 UJ	0.81 U	0.34 U	0.34 U
A,A-DIMETHYLPHENETHYLAMINE	0.34 U	0.34 UJ	0.34 UJ	0.33 U	0.81 UJ	0.34 UJ	0.34 UJ
ACENAPHTHENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
ACETOPHENONE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
ANILINE	0.67 U	0.68 U	0.67 U	0.67 U	1.6 U	0.69 U	0.69 U
ARAMITE	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.81 UJ	0.34 UJ	0.34 UJ
BENZO(A)ANTHRACENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
BENZO(A)PYRENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
BENZO(B)FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.33 U	**0.99**	0.34 U	0.34 U
BENZO(G,H,I)PERYLENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
BENZO(K)FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
BENZYL ALCOHOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
BIS(2-CHLOROETHOXY)METHANE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
BIS(2-CHLOROETHYL)ETHER	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
BIS(2-ETHYLHEXYL)PHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.81 U	0.34 U	0.34 U
BUTYLBENZYLPHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.81 U	0.34 U	0.34 U
CHLOROBENZILATE	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.81 UJ	0.34 UJ	0.34 UJ
CHRYSENE	0.34 U	0.34 U	0.34 U	0.33 U	**0.56 J**	0.34 U	0.34 U
DI-N-BUTYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
DI-N-OCTYLPHTHALATE	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.81 U	0.34 U	0.34 U
DIALLATE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
DIBENZ(A,H)ANTHRACENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
DIBENZOFURAN	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
DIETHYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
DIMETHYLPHTHALATE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
DIPHENYLAMINE (1)	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
FLUORANTHENE	0.34 U	0.34 U	0.34 U	0.33 U	**1.2**	0.34 U	0.34 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09	IRP34D-SB01	IRP34D-SB01	IRP34D-SB02
Sample ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09(0-2)	IRP34D-SB01(0-2)	IRP34D-SB01(4-6)	IRP34D-SB02(0-2)
Sample Date	11/20/2008	11/20/2008	11/20/2008	11/21/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
FLUORENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
HEXACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
HEXACHLOROBUTADIENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
HEXACHLOROCYCLOPENTADIENE	0.34 UJ	0.34 UJ	0.34 UJ	0.33 UJ	0.81 UJ	0.34 UJ	0.34 UJ
HEXACHLOROETHANE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
INDENO(1,2,3-CD)PYRENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
ISOPHORONE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
KEPONE	1.3 U	1.3 U	1.3 U	1.3 U	3.2 U	1.4 U	1.4 U
N-NITROSO-DI-N-BUTYLAMINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 UJ	0.34 UJ	0.34 UJ
N-NITROSO-DI-N-PROPYLAMINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
N-NITROSODIMETHYLAMINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
N-NITROSOMETHYLETHYLAMINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
N-NITROSOPYRROLIDINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
NAPHTHALENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
O-TOLUIDINE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
PENTACHLOROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
PENTACHLOROETHANE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
PENTACHLORONITROBENZENE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
PENTACHLOROPHENOL	0.67 U	0.68 U	0.67 U	0.67 U	1.6 U	0.69 U	0.69 U
PHENANTHRENE	0.34 U	0.34 U	0.34 U	0.33 U	**0.5 J**	0.34 U	0.34 U
PHENOL	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
PRONAMIDE	0.34 U	0.34 U	0.34 U	0.33 U	0.81 U	0.34 U	0.34 U
PYRENE	0.34 U	0.34 U	0.34 U	0.33 U	**0.83**	0.34 U	0.34 U
PYRIDINE	0.85 U	0.85 U	0.84 U	0.84 U	2 U	0.87 U	0.87 U
Metals (mg/kg)							
ALUMINUM	**10,400**	**10,800**	**9,560**	**11,000**	**8,290 J**	**11,300 J**	**10,600 J**
ANTIMONY	1.02 UJ	**0.196 J**	1.02 UJ	**0.362 J**	**2.58 J**	1.04 UJ	1.04 UJ
ARSENIC	**1.33 J**	**1.53 J**	**1.42 J**	**1.36 J**	**0.926 J**	**0.834 J**	**1.54 J**
BARIUM	**109**	**88.9**	**89.7**	**150**	**113 J**	**165 J**	**127 J**
BERYLLIUM	**0.192 J**	**0.239 J**	**0.223 J**	**0.171 J**	0.616 U	**0.198 J**	**0.208 J**
CADMIUM	0.511 U	0.514 U	0.509 U	**0.127 J**	**0.136 J**	0.522 U	0.522 U
CALCIUM	**1,110**	**1,240**	**1,160**	**1,480**	**1,720**	**3,490**	**1,970**
CHROMIUM	**8.46**	**10.5**	**9.45**	**8.17**	**18.5**	**19.2**	**12.3**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09	IRP34D-SB01	IRP34D-SB01	IRP34D-SB02
Sample ID	IRP34B-SS06	IRP34B-SS07	IRP34B-SS08	IRP34B-SS09(0-2)	IRP34D-SB01(0-2)	IRP34D-SB01(4-6)	IRP34D-SB02(0-2)
Sample Date	11/20/2008	11/20/2008	11/20/2008	11/21/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00
Metals (mg/kg)							
COBALT	**6.18**	**6.52**	**5.84**	**7.12**	**7.73**	**8.27**	**6.81**
COPPER	**6.44**	**6.81**	**5.32**	**6.6**	**11.8**	**17.6**	**7.84**
IRON	**14,500**	**15,200**	**14,200**	**17,900**	**12,500 J**	**16,500 J**	**17,700 J**
LEAD	**2.89**	**4.9**	**3.38**	**3.59**	**34.9**	**3.5**	**6.15**
MAGNESIUM	**3,560**	**3,060**	**3,090**	**5,080**	**4,280**	**5,520**	**4,440**
MANGANESE	**260**	**279**	**251**	**259**	**177 J**	**313 J**	**198 J**
MERCURY	0.102 U	0.103 U	0.102 U	0.101 U	0.123 U	0.104 U	0.104 U
NICKEL	**3.93**	**4.41**	**3.84**	**4.02**	**5.95**	**7.69**	**4.95**
POTASSIUM	**3,720**	**3,120**	**2,650**	**5,080**	**3,680**	**5,550**	**3,350**
SELENIUM	**0.12 J**	**0.23 J**	**0.142 J**	**0.121 J**	0.616 U	**0.126 J**	**0.109 J**
SILVER	0.511 U	0.514 U	0.509 U	0.506 U	0.616 U	0.522 U	0.522 U
SODIUM	**87.3 J**	**92.2 J**	**95.6 J**	**116**	**156**	**97.4 J**	**101 J**
THALLIUM	**0.309 J**	**0.783**	**0.457 J**	**0.646**	**0.302 J**	**0.295 J**	**0.323 J**
VANADIUM	**35.6**	**39.9**	**39.8**	**42.8**	**34.2**	**42.7**	**49**
ZINC	**27.7**	**25.2**	**22.3**	**35.7**	**68.3**	**36.3**	**26.8**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB02	IRP34D-SB03	IRP34D-SB03	IRP34D-SB04	IRP34D-SB04	IRP34D-SB05	IRP34D-SB05
Sample ID	IRP34D-SB02(4-6)	IRP34D-SB03(0-2)	IRP34D-SB03(4-6)	IRP34D-SB04(0-2)	IRP34D-SB04(4-6)	IRP34D-SB05(0-2)	IRP34D-SB05(2-3)
Sample Date	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	2.00 - 3.00
Volatile Organic Compounds (mg/kg)							
1,1,1-TRICHLOROETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,1,2,2-TETRACHLOROETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,1,2-TRICHLOROETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,1-DICHLOROETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,1-DICHLOROETHENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,2,4-TRIMETHYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,2-DICHLOROETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,2-DICHLOROPROPANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
1,3,5-TRIMETHYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
2-BUTANONE	0.015 U	0.017 U	0.016 U	0.021 U	0.015 U	0.011 U	0.01 U
2-HEXANONE	0.029 U	0.035 U	0.031 U	0.042 U	0.029 U	0.022 U	0.02 U
4-METHYL-2-PENTANONE	0.029 U	0.035 U	0.031 U	0.042 U	0.029 U	0.022 U	0.02 U
ACETONE	0.029 U	0.035 U	0.031 U	0.042 U	0.029 U	0.022 U	0.02 U
BENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
BROMODICHLOROMETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
BROMOFORM	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
BROMOMETHANE	0.015 U	0.017 U	0.016 U	0.021 U	0.015 U	0.011 U	0.01 U
CARBON DISULFIDE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
CARBON TETRACHLORIDE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
CHLOROBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
CHLOROETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
CHLOROFORM	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
CHLOROMETHANE	0.015 U	0.017 U	0.016 U	0.021 U	0.015 U	0.011 U	0.01 U
CIS-1,2-DICHLOROETHENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
CIS-1,3-DICHLOROPROPENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
DIBROMOCHLOROMETHANE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
ETHYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
ISOPROPYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
M,P-XYLENE	0.015 U	0.017 U	0.016 U	0.021 U	0.015 U	0.011 U	0.01 U
METHYLENE CHLORIDE	0.015 U	0.017 U	0.016 U	0.021 U	0.015 U	0.011 U	0.01 U
N-BUTYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
N-PROPYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
O-XYLENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
P-ISOPROPYLTOLUENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB02	IRP34D-SB03	IRP34D-SB03	IRP34D-SB04	IRP34D-SB04	IRP34D-SB05	IRP34D-SB05
Sample ID	IRP34D-SB02(4-6)	IRP34D-SB03(0-2)	IRP34D-SB03(4-6)	IRP34D-SB04(0-2)	IRP34D-SB04(4-6)	IRP34D-SB05(0-2)	IRP34D-SB05(2-3)
Sample Date	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	2.00 - 3.00
Volatile Organic Compounds (mg/kg)							
SEC-BUTYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
STYRENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
TERT-BUTYLBENZENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
TETRACHLOROETHENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
TOLUENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
TRANS-1,2-DICHLOROETHENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
TRANS-1,3-DICHLOROPROPENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
TRICHLOROETHENE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
VINYL CHLORIDE	0.0073 U	0.0086 U	0.0078 U	0.01 U	0.0073 U	0.0054 U	0.0051 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4,5-TETRACHLOROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
1,2,4-TRICHLOROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
1,2-DICHLOROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
1,3-DICHLOROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
1,4-DICHLOROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2,4,5-TRICHLOROPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2,4,6-TRICHLOROPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2,4-DICHLOROPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2,4-DIMETHYLPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2,4-DINITROPHENOL	0.69 U	2.8 U	0.69 U	0.73 U	0.69 U	0.71 U	0.68 U
2,4-DINITROTOLUENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2,6-DICHLOROPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2-CHLORONAPHTHALENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2-CHLOROPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2-METHYLPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2-NITROANILINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
2-NITROPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
3,3'-DICHLOROBENZIDINE	0.34 UJ	1.4 UJ	0.34 UJ	0.36 UJ	0.34 UJ	0.36 UJ	0.34 UJ
3,3'-DIMETHYLBENZIDINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
3,4-METHYLPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
3-NITROANILINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
4,6-DINITRO-2-METHYLPHENOL	0.69 UJ	2.8 UJ	0.69 UJ	0.73 UJ	0.69 UJ	0.71 UJ	0.68 UJ

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB02	IRP34D-SB03	IRP34D-SB03	IRP34D-SB04	IRP34D-SB04	IRP34D-SB05	IRP34D-SB05
Sample ID	IRP34D-SB02(4-6)	IRP34D-SB03(0-2)	IRP34D-SB03(4-6)	IRP34D-SB04(0-2)	IRP34D-SB04(4-6)	IRP34D-SB05(0-2)	IRP34D-SB05(2-3)
Sample Date	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	2.00 - 3.00
Semivolatile Organic Compounds (mg/kg)							
4-BROMOPHENYL-PHENYLETHER	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
4-CHLORO-3-METHYLPHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
4-CHLOROANILINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
4-CHLOROPHENYL-PHENYLETHER	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
4-NITROANILINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
4-NITROPHENOL	0.69 U	2.8 U	0.69 U	0.73 U	0.69 U	0.71 U	0.68 U
5-NITRO-O-TOLUIDINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
A,A-DIMETHYLPHENETHYLAMINE	0.34 UJ	1.4 UJ	0.34 UJ	0.36 UJ	0.34 UJ	0.36 UJ	0.34 UJ
ACENAPHTHENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
ACETOPHENONE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
ANILINE	0.69 U	2.8 U	0.69 U	0.73 U	0.69 U	0.71 U	0.68 U
ARAMITE	0.34 UJ	1.4 UJ	0.34 UJ	0.36 UJ	0.34 UJ	0.36 UJ	0.34 UJ
BENZO(A)ANTHRACENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BENZO(A)PYRENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BENZO(B)FLUORANTHENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BENZO(G,H,I)PERYLENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BENZO(K)FLUORANTHENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BENZYL ALCOHOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BIS(2-CHLOROETHOXY)METHANE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BIS(2-CHLOROETHYL)ETHER	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BIS(2-ETHYLHEXYL)PHTHALATE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
BUTYLBENZYLPHTHALATE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
CHLOROBENZILATE	0.34 UJ	1.4 UJ	0.34 UJ	0.36 UJ	0.34 UJ	0.36 UJ	0.34 UJ
CHRYSENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DI-N-BUTYLPHTHALATE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DI-N-OCTYLPHTHALATE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DIALLATE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DIBENZ(A,H)ANTHRACENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DIBENZOFURAN	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DIETHYLPHTHALATE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DIMETHYLPHTHALATE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
DIPHENYLAMINE (1)	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
FLUORANTHENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB02	IRP34D-SB03	IRP34D-SB03	IRP34D-SB04	IRP34D-SB04	IRP34D-SB05	IRP34D-SB05
Sample ID	IRP34D-SB02(4-6)	IRP34D-SB03(0-2)	IRP34D-SB03(4-6)	IRP34D-SB04(0-2)	IRP34D-SB04(4-6)	IRP34D-SB05(0-2)	IRP34D-SB05(2-3)
Sample Date	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	2.00 - 3.00
Semivolatile Organic Compounds (mg/kg)							
FLUORENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
HEXACHLOROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
HEXACHLOROBUTADIENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
HEXACHLOROCYCLOPENTADIENE	0.34 UJ	1.4 UJ	0.34 UJ	0.36 UJ	0.34 UJ	0.36 UJ	0.34 UJ
HEXACHLOROETHANE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
INDENO(1,2,3-CD)PYRENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
ISOPHORONE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
KEPONE	1.3 U	5.6 U	1.4 U	1.4 U	1.4 U	1.4 U	1.3 U
N-NITROSO-DI-N-BUTYLAMINE	0.34 UJ	1.4 UJ	0.34 UJ	0.36 UJ	0.34 UJ	0.36 UJ	0.34 UJ
N-NITROSO-DI-N-PROPYLAMINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
N-NITROSODIMETHYLAMINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
N-NITROSOMETHYLETHYLAMINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
N-NITROSOPYRROLIDINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
NAPHTHALENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
O-TOLUIDINE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PENTACHLOROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PENTACHLOROETHANE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PENTACHLORONITROBENZENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PENTACHLOROPHENOL	0.69 U	2.8 U	0.69 U	0.73 U	0.69 U	0.71 U	0.68 U
PHENANTHRENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PHENOL	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PRONAMIDE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PYRENE	0.34 U	1.4 U	0.34 U	0.36 U	0.34 U	0.36 U	0.34 U
PYRIDINE	0.86 U	3.6 U	0.87 U	0.92 U	0.87 U	0.9 U	0.86 U
Metals (mg/kg)							
ALUMINUM	**14,300 J**	**11,000 J**	**15,800 J**	**12,000 J**	**18,300 J**	**11,100 J**	**9,910 J**
ANTIMONY	1.04 UJ	**0.144 J**	**0.199 J**	**0.132 J**	1.04 UJ	**0.116 J**	1.03 UJ
ARSENIC	**1.38 J**	**1.87 J**	**1.47 J**	**1.21 J**	**1.68 J**	**1.46 J**	**1.32 J**
BARIUM	**146 J**	**136 J**	**149 J**	**139 J**	**131 J**	**90 J**	**91.6 J**
BERYLLIUM	**0.206 J**	**0.194 J**	**0.255 J**	**0.221 J**	**0.285 J**	**0.231 J**	**0.203 J**
CADMIUM	**0.105 J**	**0.109 J**	**0.114 J**	0.552 U	0.522 U	0.541 U	0.516 U
CALCIUM	**2,010**	**2,070**	**1,870**	**1,210**	**978**	**1,030**	**834**
CHROMIUM	**17.5**	**15**	**19.8**	**14.1**	**18.7**	**7.6**	**6.43**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB02	IRP34D-SB03	IRP34D-SB03	IRP34D-SB04	IRP34D-SB04	IRP34D-SB05	IRP34D-SB05
Sample ID	IRP34D-SB02(4-6)	IRP34D-SB03(0-2)	IRP34D-SB03(4-6)	IRP34D-SB04(0-2)	IRP34D-SB04(4-6)	IRP34D-SB05(0-2)	IRP34D-SB05(2-3)
Sample Date	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008	12/08/2008
Sample Depth	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	4.00 - 6.00	0.00 - 2.00	2.00 - 3.00
Metals (mg/kg)							
COBALT	**8.45**	**7.36**	**8.86**	**8.05**	**12.1**	**5.24**	**5.17**
COPPER	**13.6**	**10.9**	**13.8**	**10.3**	**10.4**	**6.1**	**4.77**
IRON	**18,300 J**	**17,300 J**	**20,600 J**	**17,600 J**	**20,900 J**	**13,500 J**	**13,100 J**
LEAD	**2.64**	**56.3**	**4.43**	**3.66**	**3.03**	**3.37**	**2.57**
MAGNESIUM	**6,250**	**4,920**	**6,830**	**5,450**	**6,440**	**3,820**	**3,950**
MANGANESE	**241 J**	**219 J**	**248 J**	**260 J**	**257 J**	**212 J**	**217 J**
MERCURY	0.104 U	0.108 U	0.104 U	0.11 U	0.104 U	0.108 U	0.103 U
NICKEL	**7.08**	**5.5**	**7.44**	**6.06**	**7.17**	**3.87**	**3.37**
POTASSIUM	**5,040**	**4,090**	**5,670**	**6,190**	**6,570**	**4,080**	**4,300**
SELENIUM	**0.116 J**	**0.114 J**	**0.179 J**	**0.12 J**	0.522 U	**0.114 J**	**0.109 J**
SILVER	0.519 U	0.539 U	0.521 U	0.552 U	0.522 U	0.541 U	0.516 U
SODIUM	**135**	**75.5 J**	**108**	**52.5 J**	**88.3 J**	**35.4 J**	**32.1 J**
THALLIUM	**0.397 J**	**0.352 J**	**0.472 J**	**0.403 J**	**0.414 J**	**0.44 J**	**0.43 J**
VANADIUM	**49.7**	**47.2**	**56.9**	**45.7**	**63**	**29.6**	**27.9**
ZINC	**35**	**36.3**	**37.4**	**32.3**	**33.7**	**25.7**	**24.9**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB06	IRP34D-SB06	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample ID	IRP34D-SB06(0-2)	IRP34D-SB06(2-3)	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample Date	12/09/2008	12/09/2008	12/08/2008	12/08/2008	12/09/2008	12/09/2008	12/09/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
1,1,1-TRICHLOROETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,1,2,2-TETRACHLOROETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,1,2-TRICHLOROETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,1-DICHLOROETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,1-DICHLOROETHENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,2,4-TRIMETHYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,2-DICHLOROETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,2-DICHLOROPROPANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
1,3,5-TRIMETHYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
2-BUTANONE	0.028 U	0.024 U	0.023 U	0.022 U	0.047 U	0.037 U	0.02 U
2-HEXANONE	0.056 U	0.048 U	0.046 U	0.044 U	0.094 U	0.075 U	0.04 U
4-METHYL-2-PENTANONE	0.056 U	0.048 U	0.046 U	0.044 U	0.094 U	0.075 U	0.04 U
ACETONE	0.056 U	0.048 U	0.046 U	0.044 U	0.094 UJ	0.075 U	0.04 U
BENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
BROMODICHLOROMETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
BROMOFORM	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
BROMOMETHANE	0.028 U	0.024 U	0.023 U	0.022 U	0.047 U	0.037 U	0.02 U
CARBON DISULFIDE	0.014 U	0.012 U	0.012 UJ	0.011 UJ	0.023 U	0.019 U	0.01 U
CARBON TETRACHLORIDE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
CHLOROBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
CHLOROETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
CHLOROFORM	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
CHLOROMETHANE	0.028 U	0.024 U	0.023 U	0.022 U	0.047 U	0.037 U	0.02 U
CIS-1,2-DICHLOROETHENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
CIS-1,3-DICHLOROPROPENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
DIBROMOCHLOROMETHANE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
ETHYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
ISOPROPYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
M,P-XYLENE	0.028 U	0.024 U	0.023 U	0.022 U	0.047 U	0.037 U	0.02 U
METHYLENE CHLORIDE	0.028 U	0.024 U	0.023 U	0.022 U	0.047 U	0.037 U	0.02 U
N-BUTYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
N-PROPYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
O-XYLENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
P-ISOPROPYLTOLUENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB06	IRP34D-SB06	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample ID	IRP34D-SB06(0-2)	IRP34D-SB06(2-3)	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample Date	12/09/2008	12/09/2008	12/08/2008	12/08/2008	12/09/2008	12/09/2008	12/09/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Volatile Organic Compounds (mg/kg)							
SEC-BUTYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
STYRENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
TERT-BUTYLBENZENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
TETRACHLOROETHENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
TOLUENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
TRANS-1,2-DICHLOROETHENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
TRANS-1,3-DICHLOROPROPENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
TRICHLOROETHENE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
VINYL CHLORIDE	0.014 U	0.012 U	0.012 U	0.011 U	0.023 U	0.019 U	0.01 U
Semivolatile Organic Compounds (mg/kg)							
1,2,4,5-TETRACHLOROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
1,2,4-TRICHLOROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
1,2-DICHLOROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
1,3-DICHLOROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
1,4-DICHLOROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2,4,5-TRICHLOROPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2,4,6-TRICHLOROPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2,4-DICHLOROPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2,4-DIMETHYLPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2,4-DINITROPHENOL	0.71 UJ	0.72 UJ	0.72 U	0.72 U	0.86 UJ	0.85 UJ	1.5 UJ
2,4-DINITROTOLUENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2,6-DICHLOROPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2-CHLORONAPHTHALENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2-CHLOROPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2-METHYLPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2-NITROANILINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
2-NITROPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
3,3'-DICHLOROBENZIDINE	0.36 U	0.36 U	0.36 UJ	0.36 UJ	0.43 U	0.42 U	0.74 U
3,3'-DIMETHYLBENZIDINE	0.36 UJ	0.36 UJ	0.36 U	0.36 U	0.43 UJ	0.42 UJ	0.74 UJ
3,4-METHYLPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
3-NITROANILINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
4,6-DINITRO-2-METHYLPHENOL	0.71 UJ	0.72 UJ	0.72 UJ	0.72 UJ	0.86 UJ	0.85 UJ	1.5 UJ

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB06	IRP34D-SB06	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample ID	IRP34D-SB06(0-2)	IRP34D-SB06(2-3)	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample Date	12/09/2008	12/09/2008	12/08/2008	12/08/2008	12/09/2008	12/09/2008	12/09/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
4-BROMOPHENYL-PHENYLETHER	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
4-CHLORO-3-METHYLPHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
4-CHLOROANILINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
4-CHLOROPHENYL-PHENYLETHER	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
4-NITROANILINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
4-NITROPHENOL	0.71 U	0.72 U	0.72 U	0.72 U	0.86 U	0.85 U	1.5 U
5-NITRO-O-TOLUIDINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
A,A-DIMETHYLPHENETHYLAMINE	0.36 UJ	0.36 UJ	0.36 UJ	0.36 UJ	0.43 UJ	0.42 UJ	0.74 UJ
ACENAPHTHENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
ACETOPHENONE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
ANILINE	0.71 U	0.72 U	0.72 U	0.72 U	0.86 U	0.85 U	1.5 U
ARAMITE	0.36 UJ	0.36 UJ	0.36 UJ	0.36 UJ	0.43 UJ	0.42 UJ	0.74 UJ
BENZO(A)ANTHRACENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BENZO(A)PYRENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BENZO(B)FLUORANTHENE	0.36 U	0.36 U	0.36 U	**0.24 J**	0.43 U	0.42 U	0.74 U
BENZO(G,H,I)PERYLENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BENZO(K)FLUORANTHENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BENZYL ALCOHOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BIS(2-CHLOROETHOXY)METHANE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BIS(2-CHLOROETHYL)ETHER	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BIS(2-ETHYLHEXYL)PHTHALATE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
BUTYLBENZYLPHTHALATE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
CHLOROBENZILATE	0.36 U	0.36 U	0.36 UJ	0.36 UJ	0.43 U	0.42 U	0.74 U
CHRYSENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
DI-N-BUTYLPHTHALATE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
DI-N-OCTYLPHTHALATE	0.36 UJ	0.36 UJ	0.36 U	0.36 U	0.43 UJ	0.42 UJ	0.74 UJ
DIALLATE	0.36 UJ	0.36 UJ	0.36 U	0.36 U	0.43 UJ	0.42 UJ	0.74 UJ
DIBENZ(A,H)ANTHRACENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
DIBENZOFURAN	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
DIETHYLPHTHALATE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
DIMETHYLPHTHALATE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
DIPHENYLAMINE (1)	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
FLUORANTHENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB06	IRP34D-SB06	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample ID	IRP34D-SB06(0-2)	IRP34D-SB06(2-3)	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample Date	12/09/2008	12/09/2008	12/08/2008	12/08/2008	12/09/2008	12/09/2008	12/09/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Semivolatile Organic Compounds (mg/kg)							
FLUORENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
HEXACHLOROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
HEXACHLOROBUTADIENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
HEXACHLOROCYCLOPENTADIENE	0.36 U	0.36 U	0.36 UJ	0.36 UJ	0.43 U	0.42 U	0.74 U
HEXACHLOROETHANE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
INDENO(1,2,3-CD)PYRENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
ISOPHORONE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
KEPONE	1.4 UJ	1.4 UJ	1.4 U	1.4 U	1.7 UJ	1.7 UJ	2.9 UJ
N-NITROSO-DI-N-BUTYLAMINE	0.36 U	0.36 U	0.36 UJ	0.36 UJ	0.43 U	0.42 U	0.74 U
N-NITROSO-DI-N-PROPYLAMINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
N-NITROSODIMETHYLAMINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
N-NITROSOMETHYLETHYLAMINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
N-NITROSOPYRROLIDINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
NAPHTHALENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
O-TOLUIDINE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PENTACHLOROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PENTACHLOROETHANE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PENTACHLORONITROBENZENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PENTACHLOROPHENOL	0.71 U	0.72 U	0.72 U	0.72 U	0.86 U	0.85 U	1.5 U
PHENANTHRENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PHENOL	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PRONAMIDE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PYRENE	0.36 U	0.36 U	0.36 U	0.36 U	0.43 U	0.42 U	0.74 U
PYRIDINE	0.9 U	0.9 U	0.91 U	0.91 U	1.1 U	1.1 U	1.9 U
Metals (mg/kg)							
ALUMINUM	**17,500**	**17,600**	**7,520 J**	**10,400 J**	**19,200**	**11,900**	**18,300**
ANTIMONY	1.08 U	1.08 U	**0.468 J**	**0.145 J**	**0.232 J**	1.29 U	1.12 U
ARSENIC	**1.28 J**	**1.68 J**	**1.02 J**	**0.946 J**	**1.7 J**	**1.45 J**	**1.13 J**
BARIUM	**201**	**192**	**90.2 J**	**131 J**	**177**	**137**	**203**
BERYLLIUM	**0.158 J**	**0.113 J**	**0.136 J**	**0.177 J**	**0.229 J**	**0.178 J**	**0.136 J**
CADMIUM	0.541 U	0.542 U	0.548 U	0.546 U	**0.132 J**	0.643 U	0.56 U
CALCIUM	**2,750**	**3,770**	**1,450**	**2,790**	**1,150**	**4,100**	**3,390**
CHROMIUM	**28.1**	**29.8**	**11.4**	**19.7**	**14.4**	**16.2**	**13**

APPENDIX F: SOIL ANALYTICAL RESULTS FOR ALL IRP SITES (Continued)

Naval Weapons Station Seal Beach Detachment Fallbrook, Fallbrook, California

Sample Location ID	IRP34D-SB06	IRP34D-SB06	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample ID	IRP34D-SB06(0-2)	IRP34D-SB06(2-3)	IRP34D-SS01	IRP34D-SS02	IRP34D-SS03	IRP34D-SS04	IRP34D-SS05
Sample Date	12/09/2008	12/09/2008	12/08/2008	12/08/2008	12/09/2008	12/09/2008	12/09/2008
Sample Depth	0.00 - 2.00	2.00 - 3.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00	0.00 - 2.00
Metals (mg/kg)							
COBALT	**10.5**	**11.3**	**5.22**	**7.41**	**8.17**	**7.32**	**8.84**
COPPER	**25.5**	**24.2**	**7.34**	**14.2**	**17.8**	**14.4**	**21.8**
IRON	**22,300**	**24,100**	**12,200 J**	**15,600 J**	**20,100**	**16,500**	**19,000**
LEAD	**1.63 J**	**1.53 J**	**2.07 J**	**2.64**	**17.4**	**4.89**	**3.02**
MAGNESIUM	**9,120**	**10,900**	**3,320**	**5,140**	**6,570**	**5,690**	**7,130**
MANGANESE	**257**	**254**	**147 J**	**205 J**	**226**	**234**	**273**
MERCURY	0.108 U	0.108 U	0.11 U	0.109 U	0.13 U	0.129 U	0.112 U
NICKEL	**10.9**	**11.5**	**4.51**	**7.85**	**6.04**	**6.47**	**5.86**
POTASSIUM	**5,010**	**3,870**	**2,420**	**3,490**	**6,300**	**5,040**	**3,160**
SELENIUM	0.541 U	0.542 U	**0.113 J**	**0.114 J**	**0.174 J**	**0.25 J**	0.56 U
SILVER	0.541 U	0.542 U	0.548 U	0.546 U	0.65 U	0.643 U	0.56 U
SODIUM	**160**	**166**	**103 J**	**178**	**117 J**	**179**	**280**
THALLIUM	**0.365 J**	**0.374 J**	**0.44 J**	**0.328 J**	**1.04**	**0.467 J**	**0.38 J**
VANADIUM	**65.9**	**73.3**	**34.7**	**42.7**	**52.2**	**46.2**	**56.7**
ZINC	**39.4**	**42.4**	**23.2**	**30.2**	**40.2**	**36**	**36.4**