**NAVFAC SW CONTRACT NO. N62473-07-D-3211**
**CTO NO. 0008**

# DRAFT
# WINTER 2008/2009 SEMIANNUAL POST-CLOSURE INSPECTION AND MAINTENANCE REPORT
# May 6, 2009

**INSTALLATION RESTORATION PROGRAM SITE 7**
**(FORMER STATION LANDFILL)**
**NAVAL WEAPONS STATION SEAL BEACH**
**SEAL BEACH, CALIFORNIA**

**DCN: ECSD-3211-0008-0004**

**Naval Facilities Engineering Command Southwest**
**Contracts Department**
**1220 Pacific Highway, Building 127, Room 112**
**San Diego, CA 92132-5190**

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# TABLE OF CONTENTS

# TABLE OF CONTENTS
(Continued)

## FIGURES



## APPENDICES

# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| bgs | below ground surface |
| DON | Department of the Navy |
| DTSC | Department of Toxic Substances Control |
| IR | Installation Restoration |
| IRP | Installation Restoration Program |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| NAVWPNSTA | Naval Weapons Station |
| NTCRA | non-time-critical removal action |
| PCIMP | Post-Closure Inspection and Maintenance Plan |
| RWQCB | Regional Water Quality Control Board |
| SBNWR | Seal Beach National Wildlife Refuge |
| TtEC | Tetra Tech EC, Inc. |
| TtFW | Tetra Tech FW, Inc. |

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# 1.0 INTRODUCTION

This report describes the results and findings of the winter 2008/2009 semiannual post-closure inspections and maintenance activities conducted at the Installation Restoration Program (IRP) Site 7 Area 1, also referred to as the Former Station Landfill, located at Naval Weapons Station (NAVWPNSTA) Seal Beach in Seal Beach, California (Figures 1-1 and 1-2).

The purpose of this report is to document the condition of the landfill cover and access road, any changes to the landfill cover such as settlement, changes to the surface water management system, the condition and performance of the vegetation cover that was found during the winter 2008/2009 inspections, and any maintenance activities that were conducted during this period.

Tetra Tech EC, Inc. (TtEC), as General Contractor, conducted the post-closure inspection and maintenance activities described in this report under the Department of the Navy's (DON's) directive, and under Remedial Action Contract Number N62473-07-D-3211. The inspections were conducted in accordance with procedures outlined in the Post-Closure Inspection and Maintenance Plan (PCIMP) (TtFW 2004a). The PCIMP describes the procedures and requirements for post-closure inspections and maintenance activities for IRP Site 7 Area 1.

The first post-closure inspection was conducted on October 3, 2008, before the seasonal rainfall. Several rainfall events have occurred following the October 2008 inspection. Two additional inspections were conducted on December 17, 2008, and February 13, 2009, following heavy rainfall events. Subsequent to the site inspections and discussions with the DON, cover maintenance was performed on March 6, 2009, to alleviate drainage issues.

This report contains information generated during the site inspections conducted on the above dates and site visits conducted on December 12, 2008, and January 20, and February 20, 2009. This report includes a description of inspections conducted, documents the monitoring and inspection results and findings, provides recommendations, and reports any progress made during the inspection timeframe.

This report documents the condition of the cover at the time of the inspections to ensure that 1) the soil cover is functioning adequately to isolate the buried waste from the surface, 2) the cover continues to provide adequate drainage, minimizing its erosion, and 3) any settlement and subsidence of the cover are not jeopardizing the cover integrity. The inspections conducted during this reporting period focused on the functional aspects of the cover. Therefore, the soil cover was inspected to document whether it is intact and free of major cracking (defined as cracks 2 inches or wider, deeper than l2 inches, and longer than 20 feet). The cover was also inspected to detect erosion (deeper than 6 inches) and surface depressions that could cause ponding or any unusual surface conditions. A visual inspection of surface drainage swales and slopes was also conducted. The vegetation cover was inspected to document any soil losses

caused by precipitation, lack of vegetation cover, and winds, and to identify the causes of erosion problem areas. The vegetation inspection also focused on areas lacking vegetation cover at the western portion of the site and making recommendations to restore this area.

All inspections were conducted by a state of California registered civil engineer who has experience in landfill design and site development.

The monitoring and inspection of the landfill cover, drainage, and vegetation cover conducted on October 3, 2008, was the first semiannual inspection conducted at IRP Site 7 for winter 2008/2009. The inspections were conducted as part of 3 years of monitoring and inspection described and proposed in the PCIMP (TtFW 2004a). The last semiannual inspection and maintenance activities were conducted in March 2006 which were documented and reported in the Final 2006 First Semiannual Post-Closure Inspection and Maintenance Report (TtEC 2006a).

The pertinent PCIMP (TtFW 2004a) inspection forms completed during the inspections are attached as Appendix A to this report. Photographs taken during the inspections and site visits are provided in Appendix B. Appendix C includes the agronomic analysis results from soil samples taken in October 2008 and February 2009.

This report will be kept on file with the NAVWPNSTA Installation Restoration (IR) Program Coordinator and NAVWPNSTA Seal Beach Administration Records. Copies will also be kept in the Naval Facilities Engineering Command Southwest (NAVFAC SW) Administrative Record files.

## 1.1 SITE HISTORY AND BACKGROUND

This section describes the facility and site locations and provides a description of the past history of operations at IRP Site 7, along with a brief description of the nature and extent of the contamination at this site.

IRP Site 7 consists of six distinctive areas (designated as Areas 1 through 6) totaling approximately 33 acres located near the southern boundary of NAVWPNSTA Seal Beach and at the eastern boundary of the Seal Beach National Wildlife Refuge (SBNWR) (see Area 1 shown on Figure 1-2). Landfill activities were reportedly conducted at the site from approximately 1955 to 1973. A large variety of wastes generated by NAVWPNSTA Seal Beach during the period of active landfilling may have been buried in trenches at IRP Site 7. Almost any type of waste generated on the station may have been disposed of at IRP Site 7. The major types of waste reportedly disposed of in the landfill include small, mostly empty containers that once contained paints, petroleum products, various solvents, used rags, batteries, asbestos, and inert construction debris.

Area 1, located in the northeast portion of the IRP Site 7, covers approximately 8 acres. Most of the waste disposal and landfilling activities took place in Area 1 in a series of unlined trenches lying in an east-west orientation (Naval Energy and Environmental Support Activity 1985). Exploration during a supplemental characterization indicated that the depth of the debris varied between 5.5 and 9 feet below ground surface (bgs), with an average depth of 6.4 feet bgs (SWDIV 1999).

The DON completed a non-time-critical removal action (NTCRA) at IRP Site 7 in April 2004. The intent of the NTCRA was to minimize any potential threats to human health and the surrounding environment. The removal action decision for IRP Site 7 was documented in the joint Final Action Memorandum/Non-Time-Critical Remedial Action Plan at the Naval Weapons Station Seal Beach, California, Site 7 and Site 4 Areas of Potential Concern 1A and 2A, prepared by the DON (CH2M Hill 2004).

Under the DON's directive, TtEC, as General Contractor, implemented the removal action at the site under Remedial Action Contract Number N68711-98-D-5713. The removal action was conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act and National Oil and Hazardous Substances Pollution Contingency Plan requirements.

The removal action at IRP Site 7 Area 1 involved repair to the existing soil cover by placing additional cover in areas where waste was exposed or where cover thickness was deficient. The intent of the removal action at IRP Site 7 Area 1 was to repair the existing landfill soil cover and ensure a minimum of 2 feet of soil cover over the buried waste, thus preventing direct contact with buried waste and eliminating the potential migration of contamination through windblown dust, infiltrations, and surface runoff. Removal action at the remaining areas of IRP Site 7 involved removal of buried and surface debris. The removal action at IRP Site 7 (Areas 1 through 6) is documented in the Final Project Closeout Report, Non-Time-Critical Remedial Action Installation Restoration Site 7 (Station Landfill) and Site 4 (Perimeter Road AOPCs 1A and 2A), Naval Weapons Station Seal Beach, California (TtFW 2004b). Only Area 1 (Former Station Landfill) requires post-closure inspection and maintenance.

A PCIMP (TtFW 2004a) was developed following the completion of the removal action to describe the post-closure annual inspections and maintenance activities for IRP Site 7 Area 1.

Based on the recommendations made in the Final 2005 First Semiannual Post-Closure Inspection and Maintenance Report (TtEC 2005) following the March 2005 inspections, landfill cover maintenance was conducted to repair several settlement and ponding areas at the western portion of the landfill, and to reseed and revegetate the western portion following the grading and repairs of the settlement areas. Landfill maintenance was conducted in September 2005. The second 2005 semiannual post-closure inspection was conducted in October and November 2005 (TtEC 2006b). Subsequent third semiannual inspection and maintenance activities were conducted in

March 2006, the results of which were discussed and documented in the Final 2006 First Semiannual Post-Closure Inspection and Maintenance Report (TtEC 2006a). Results of the 2006 report indicated that there were no areas that needed repairs or corrective action, and that the landfill cover grading provided adequate sheet flow drainage to minimize future ponding. Landfill post-closure inspections and maintenance activities were temporarily suspended after the March 2006 event, and resumed with the winter 2008/2009 inspections that are documented in this report.

## 1.2 SCOPE OF WINTER 2008/2009 SEMIANNUAL INSPECTIONS

This report addresses landfill cover maintenance, cover inspection, vegetation inspection, and drainage inspections conducted as part of the semiannual inspections for winter 2008/2009. This report and the inspections conducted during this timeframe do not include groundwater monitoring, landfill gas monitoring, or leachate monitoring.

The DON had developed a groundwater monitoring program for IRP Site 7 to monitor the status and condition of groundwater at this site. Results of the Third Annual Groundwater Monitoring Report for IR Sites 5 & 7 (BEI 2007) recommended discontinuing groundwater monitoring at the site based on findings of a fate and transport evaluation. The Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board (RWQCB) concurred with the findings of this report and the recommendation to discontinue groundwater sampling at IRP Site 7 in their letters dated August 1 and July 12, 2007, respectively (DTSC 2007, RWQCB 2007).

The IRP Site 7 landfill does not have a landfill gas control, recovery, or emissions and migration monitoring system. There are no perimeter landfill gas migration monitoring wells at this site. Previous investigations conducted at IRP Site 7 have indicated insignificant landfill gas at this site (CH2M Hill 2002). No surface or subsurface emissions of landfill gas, including methane gas, have been detected at IRP Site 7 during previous site investigations.

The IRP Site 7 landfill does not have a liquid management system, and none is planned for this site. The site does not produce any liquids associated with collection, nor does it have monitoring and disposal of landfill gas condensate, groundwater seepage, a leachate collection system, groundwater extraction wells, or groundwater storage tanks and sumps.

## 1.3 LAND USE CONTROL

There are no structures or buildings on the site, and none are planned for the future. No regular station activities have taken place at IRP Site 7 Area 1. Future developments or agricultural activities on the landfill are highly unlikely. The future land use at this site is open space, and the site will continue to be maintained as such.

# 2.0 SOIL COVER INSPECTION AND MAINTENANCE

This section addresses and describes landfill inspections conducted on October 3, 2008, and subsequent periodic inspections conducted on December 17, 2008, and February 13, 2009, of the IRP Site 7 landfill soil cover. The inspection and field observation results were evaluated relative to the performance standards and requirements provided in the PCIMP (TtFW 2004a).

The purpose and the primary function of the soil cover is to isolate the buried waste from the surface, promote drainage and minimize erosion or abrasion of the cover, and accommodate settlement and subsidence so that the cover integrity is maintained. In order to perform these functions, the soil should remain intact and free of major cracking (defined as cracks 2 inches or wider, deeper than l2 inches, and longer than 20 feet), erosion (deeper than 6 inches), and surface depressions that could cause ponding.

## 2.1 SOIL COVER INSPECTION

Routine visual inspection of the soil cover was conducted on October 3, 2008, and inspections were conducted during subsequent site visits following major rain events on December 17, 2008, and February 13, 2009. A California-registered Civil Engineer performed the visual inspections of the soil cover. The following inspection procedures were followed in accordance with the PCIMP:

- Inspection and observation for any surface cracking, ponding, or unusual surface conditions
- Inspection and observation of all surface drainage swales and slopes (all slopes and drainage areas were visually inspected and documented on Forms 101 and 102 in Appendix A.)

## 2.2 SUMMARY OF FIELD OBSERVATIONS

A lack of cover vegetation was noted in the western portion of the landfill during the winter 2008/2009 site inspections, and minimal soil losses and erosion were noted during those inspections. Shallow ponding areas were observed on the west side and in the southwestern corner during the December 2008 and February 2009 site visits. No cover failures resulting from stormwater runoff were identified. No waste exposure due to lack of soil cover, unstable cover, or unusual surface conditions were identified or observed during the inspections. Despite the presence of ponding areas, the landfill cover was determined to be stable, and no severe settlements were noted during the inspections.

## 2.3 SOIL COVER FINDINGS AND RECOMMENDATIONS

There were no unstable surface depressions, deep cracks, major soil losses, or excessive rodent burrowing observed during any of the inspections for this reporting period. No vector controls for the soil cover will be required at this time.

The eastern half of the landfill appears to be in good condition with good vegetative soil cover and was found to satisfy the requirements of the PCIMP (TtFW 2004a) and project specifications. The western half of the landfill cover does not have adequate ground cover to prevent future soil erosion/loss that could be triggered by heavy rain or excessive winds. Figure 2-1 shows the approximate limits of the western portion of the landfill which lack vegetation. Vegetation inspection and maintenance is discussed in more detail in Section 3.0.

Ponding at the southwestern section of the landfill, which may result from rain water or high tide, is attributed to lack of adequate drainage of the water that accumulates in this area.

The area near the southwestern side of the landfill site consists of historic tidal salt marsh wetlands, which are at elevations that would historically receive periodic tidal inundation. In the past, tide waters were excluded from the site by a gated channel; however, the gate at the outfall of the channel is in disrepair, thereby allowing tidal waters to reach the area. If the gate was repaired, it could restrict tidal waters from flowing into the area, which could endanger or threaten the habitat for Belding's Savannah sparrow, a state endangered bird species.

Several earthen berms act as barriers to the normal tidal influx patterns. In a number of places, these berms form dams, diverting tide waters or excluding them completely during most tide sequences. Based on site observations, it appears that only the very highest (infrequent) tides are able to top these berms and then flood the historic wetland area and the southwestern portions of the landfill. When the tides retreat, the berms prevent the flooded areas from draining, leaving ponds or "perched basins" that do not drain freely. As the summer progresses, these basins empty very slowly through the process of evapotranspiration. Under natural conditions, this evaporation process leads to the formation of salt pans (Zedler et al. 1992).

Rather than breach the berms, two 12-inch-diameter pipes with flapper gates will be installed near the south side of the site to drain the tide waters back into the drainage channel that leads to the Bolsa Chica Flood Control Channel. The proposed location of the drainage pipes is shown on Figure 2-1.

It is recommended that these improvements be put into place prior to fall 2009. Inspection of the pipes will occur as part of the semiannual and periodic inspections, prior to and following the rainy season and after heavy rainfalls, to verify that the pipes are free from debris. A grate will be placed at the inlet of each pipe to help alleviate this concern. As part of drainage maintenance activities, debris and other obstructions found during the inspections will be removed to prevent clogging of the pipes and allow the free flow of runoff or tidal water. The pipes will be maintained until such time as the site is closed.

# 3.0 VEGETATION COVER INSPECTION AND MAINTENANCE

The purpose and the primary function of the vegetative cover are to provide erosion control and visual enhancement across the landfill top and slopes. The vegetation cover at IRP Site 7 Area 1 was designed to evolve into a natural climax vegetation community, which will enable long-term succession of the vegetation to blend with the natural character of adjacent open spaces. The vegetative cover is intended to turn green during the rainy season and is expected to fade to brown during the dry season. The plants will need to survive on seasonal rainfall. Rainfall data for the Huntington Beach station obtained from the Watersheds Division of Orange County Public Works indicates no captured rainfall for the period of June through November 25, 2008. Rainfall data from July 2007 through March 2009 is presented in Figure 3-1. The greatest amount of rainfall during that time period occurred on November 26, 2008, which measured 1.93 inches.

## 3.1 PROTECTIVE VEGETATION COVER INSPECTION

During the October 2008, December 2008, and February 2009 inspections, the overall condition of the vegetation growth on the eastern half of the landfill cover was observed to be very satisfactory. The western portion of the landfill had only patches of significant vegetative growth as shown on Figure 2-1. The lack of vegetation in the western portion is due to salinity rather than soil loss. Minimal soil loss was observed during the inspections.

Forms 103 in Appendix A for the inspections conducted for this reporting period indicate small shrubs, but no fire hazards, dead vegetation, or deep rooted plants were noted in any of the inspections. Non-native plants such as tumbleweeds and ice plants were found, but the quantities are not a concern.

## 3.2 VEGETATION COVER INSPECTION FINDINGS

The majority of the site (the eastern portion) is covered with suitable native vegetation. Although the vegetation on the eastern portion of the landfill is in satisfactory condition, the western portion lacks adequate coverage. The satisfactory condition of vegetation in the eastern portion of the landfill could be attributed to higher surface elevations of this area that allows drainage to lower areas; it would also be attributed to infrequent flooding of a small area in the southeastern portion of the site due to a rise in tidal waters.

The western portion of the site, which has lower surface elevations, has remained bare or supports only spotty vegetation and stunted live plants because it experiences ponding of tidal waters which it is unable to drain (Crooks 2009).

The site currently supports a number of native salt marsh plant seedlings (under 2 months old) in many of the previously bare areas. The current seedling growth could be due to the abundant and regular rainfall that occurred between November 2008 and February 2009. It is likely that the influxes of fresh water have temporarily leached much of the salts in the soils at the site, thus allowing the native salt marsh plants to be able to germinate and grow.

Due to the lack of improvement in vegetation cover establishment since the 2005 and 2006 inspections, TtEC recommended, following the October 3, 2008, inspection, collecting soils samples from the western portion of the landfill for agronomic analysis. TtEC further recommended evaluating the soil conditions in this area to determine the possible causes for lack of vegetation growth in this area.

Four soil samples were collected on October 30, 2008, prior to the winter rains, and submitted to Wallace Laboratories located in El Segundo, California, for analysis. Soil analysis results show that soils in the bare areas had very high salt concentrations (up to 195.30 millimho/cm) (Wallace Laboratories 2008). This salt concentration is believed to be the reason for the lack of plant establishment. The salinity values range from 42.20 millimho/cm to 195.30 millimho/cm, with an average salinity concentration of 117.28 millimho/cm. The salinity of seawater is about 45 millimho/cm. Salt-tolerant native plants may tolerate salinity at about half that of seawater salinity. Native salt tolerant plant germination or survival is nearly impossible in any area with salt concentrations exceeding 60 millimho/cm (Crooks 2009, Sullivan 2009). The location of the soil samples and the salinity values derived from those samples are shown in Figure 2-1. Agronomic analysis results are presented in Appendix C.

During the site visit conducted on February 12, 2009, TtEC recommended collecting additional surface soil samples and conducting agronomic analysis and salinity testing to assess any changes in soil salinity concentrations for the areas sampled on October 30, 2008, and to determine whether salt concentrations have decreased since October 2008 as a result of the leaching effects caused by heavy rain in winter 2008/2009. Soil samples for agronomic analysis were collected from 16 locations–14 samples from areas in the western third of the landfill, and 2 samples from the eastern portion of the landfill. The samples were collected on February 20, 2009, and sent to Wallace Laboratories for analysis. The agronomic analysis results indicated significant reductions in salt concentrations in the soil samples. Salt concentrations for samples collected on February 20 ranged from 4.68 millimho/cm to 59.20 millimho/cm, with an average salinity concentration of 26.0 millimho/cm. In summary, the analysis determined that the areas lacking vegetation cover contain high salinity in soils.

Optimal salinity concentration for salt-sensitive plants is about 1 millimho/cm. Most plants prefer salinity below 4 millimho/cm. Saline soil is defined as soil with a salinity concentration greater than 4 millimho/cm.

High salinity in soils is attributed primarily to interrupted drainage of tidal and precipitation waters that accumulate in the southwestern portion of the site, as discussed in Section 2.3. Water is lost through evapotranspiration in which water evaporates and salt remains and accumulates over time. The presence of saline water occurs regularly via surface tidal flooding and groundwater influx, but the removal of salts (through brief winter rains) is minimal. Due to the climatic conditions of the area, salt content is likely to increase in salt marsh wetlands between April and November when evapotranspiration is dominant, and decrease between December and late March if there is enough precipitation to flush the accumulated salt out (Zedler et al. 1992). Because of the lack of natural drainage at the site, however, salinity concentration will tend to increase as long as drainage remains interrupted.

## 3.3 RECOMMENDATIONS FOR RESTORATION OF VEGETATION COVER

Reducing the salinity of the soil in the western portion of the landfill would likely improve the conditions for vegetation establishment in this area. Measures to improve the drainage in the southwestern area are addressed and discussed in Section 2.3.

For purposes of restoring vegetation at the site, the site can be divided into three zones as shown on Figure 2-1. Zone A represents the lowest elevation sub-unit (mid-marsh), and Zone C represents the highest elevation sub-unit (high marsh). Because Zone A is frequently inundated with water, it is recommended that there be no planting in this zone due to the likelihood that vegetation will soon develop on its own as a result of the recommended drainage improvements.

A list of potential salt-tolerant plants appropriate for each zone is shown on Figure 2-1. It is recommended that small 2-inch live plug plants (suitable salt marsh species) be placed in a grid pattern with 5-feet spacing. This would be done only in areas where the ground is completely bare. The addition of these plug plants are intended to supplement the existing population of young native plant seedlings. The following readily available plants have been identified as appropriate for the landfill cover:

- *Salicornia virginia* – Pickleweed
- *Salicornia subterminale* – Pickleweed
- *Frankenia salina* – Alkali Heath
- *Sueda taxifolia* – Wooly Seablite

The *Sueda taxifolia* can be used to substitute for the *Sueda esteroa* and *Sueda californica* shown as appropriate for the three zones.

Planting should not occur in areas with seedling growth or in any drainage swales. The new plantings should not be allowed to damage natural seedling groupings of native plants, but should instead be distributed in areas with limited current vegetation cover. The new live plants

will provide “insurance” in the event that survival of existing native plant seedlings is low. Distributing seeds in the area is not recommended. The site is already well covered in native plant seeds through the natural action of tides.

The planting of the live plants should be completed in December or January, because these are the best months for planting. Prior to planting, the locations of the plug plants will be flagged by the project biologist to guide the on-site laborers.

# 4.0 SURFACE WATER MANAGEMENT SYSTEM INSPECTION AND MAINTENANCE

This section provides the scope, data summary, and evaluation of surface water management.

## 4.1 SURFACE WATER MANAGEMENT SYSTEM INSPECTION

The surface water management system was inspected during October 2008 and subsequent periodic inspections on December 17, 2008, and February 13, 2009. The inspections included the following:

- Visual inspection of all surface drainage swales and slopes.
- Visual inspection of the cover system for any eroded areas (no erosions deeper than 6 inches were found).
- Inspection and observation of ponding areas and surface drainage conditions.

The landfill stormwater control inspection conducted on October 3, 2008, was the first semi-annual inspection since 2006. The subsequent inspections were conducted following several rainfalls that occurred between December 2008 and February 2009. One of the inspection objectives was to identify any failure of the surface drainage and sheet flow system, focusing primarily on any cover erosions, wet or saturated cover soils, ponding, or areas where there is a potential for increased infiltration.

## 4.2 SUMMARY OF FIELD OBSERVATIONS

No on-site downstream drainage obstructions were noted in IRP Site 7 Area 1 as of February 13, 2009, and no soil cover washouts or areas of heavy erosion were observed. Inspection observations were documented in the field on Form 102 and are included in Appendix A.

The eastern half of the landfill cover did not show any evidence of soil loss, which indicates that the vegetation and ground cover in this area have effectively minimized soil erosion. The western portion of the landfill cover had only a few patches of vegetative ground cover; however, soil erosion in this area has been minimal. Minimal vegetation washout was observed in October 2008, and ponding and lack of positive drainage was observed during the December 2008 and February 2009 inspections, particularly in the southwestern corner of the site. Two-inch deep rills along the roadway side slopes were also noted in February 2009 following heavy rains.

## 4.3 FINDINGS AND RECOMMENDATIONS

Neither cover system washout nor waste exposure was observed during the October 3, 2008 inspection and subsequent periodic inspections conducted in December 2008 and February 2009. The surface water drainage system complied with the landfill cover system performance criteria described in the PCIMP (TtFW 2004a).

Survival of the existing seedlings in the previously bare areas of the western portion of the landfill is time-sensitive. The native plant seedlings that are currently growing would likely die out if the surface drainage issues at the site are not soon addressed. Warmer weather is likely to rapidly alter soil chemistry and increase soil salinity on-site, so it is important that all surface drainage maintenance work be completed soon. In the absence of alterations to site drainage and tidal flow, warming weather and the salinification process will likely result in most of the plants currently growing at the western portion of the site dying out. Maintenance of the surface drainage was conducted on March 6, 2009, and is discussed further in Section 4.4.

## 4.4 SURFACE DRAINAGE MAINTENANCE

Based on site inspection findings and recommendations, the following corrective action and maintenance activities were completed on March 6, 2009, to allow for uninterrupted drainage of tidal water and rainwater at the site, and to prevent soil erosion caused by rain:

- Removed existing silt fence at various locations at the western portion of the site to allow for uninterrupted sheet-flow drainage. In lieu of silt fence, 6-inch-diameter and 25-feet-long wattles were used to slow down sheet flow. The wattles were fixed to the ground using 18-inch-long wood sticks. The locations of the wattles are shown on Figure 2-1, and photographs are provided in Appendix B.
- Removed small ridges of soil created from build-up of sediments behind the silt fences that impeded the sheet-flow drainage of precipitation water.
- Removed raised areas between small shallow ponds to allow these areas to drain properly to the lower elevations at the south side of the landfill.
- Filled and graded erosion rills that had developed along the eastern slopes of the access road with surrounding soils. Following hand-grading and filling of the rill erosion areas, 5-feet-wide jute mesh were placed over these areas to prevent future erosion and development of additional rills.

Hand shovels, rakes, and tools were used during the maintenance and implementation of the above improvements to avoid destroying the native seedling plants at the site. Excess soil generated from removing sediments along the silt fence, drainage improvements, and construction of swales were removed and distributed along the southern slopes of the railroad embankment at the north end of the site. No additional artificial site alterations were introduced.

# 5.0 LANDFILL SURVEY

This section provides the scope, data summary, and evaluation of landfill settlement.

## 5.1 SURVEY SCOPE

The scope is to address settlement surveys of the landfill as it relates to the performance of the cover system.

## 5.2 SUMMARY OF FIELD OBSERVATIONS

Visual site inspection findings are documented in photographs taken of the site condition and presented in Appendix B and described below. No major earthquakes and no sloughing, cracks, or cover deformation occurred during this reporting period that would require a topographic survey by a licensed land surveyor.

A settlement-related visual site inspection was conducted for routine cover maintenance repairs. Minor depressions and ponding of rainwater were observed during the inspection conducted in February 2009.

## 5.3 FINDINGS AND RECOMMENDATIONS

The existing drainage swale flowlines were hand-graded to provide a more positive drainage flow, which should help to minimize future ponding. No additional survey of the drainage swale flowlines is warranted.

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# 6.0 ACCESS ROADS INSPECTION AND MAINTENANCE

This section addresses and describes observations made during the winter 2008/2009 inspection of the access roads.

## 6.1 SUMMARY OF ACCESS ROADS OBSERVATIONS

The unpaved access road along the northwest and west side of the IRP Site 7 was found to be well-graded and adequately maintained; it should continue to provide access to the site in all weather conditions. The access road along the north side of the site is partially paved and partially covered with gravel; therefore, it would provide the necessary safe access to the site in the event of an emergency or for maintenance equipment.

## 6.2 FINDINGS AND RECOMMENDATIONS

The access roads around the landfill were found to be in good condition and capable of providing adequate access to the landfill for maintenance and inspections.

No unstable ground or surfaces and no major erosion or loss of road base were observed during the winter 2008/2009 inspections of the access roads along the north and west sides of IRP Site 7. No maintenance is recommended for the access roads.

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# 7.0 SUMMARY OF RECOMMENDATIONS

This section summarizes the recommendations mentioned in Sections 2.3 and 3.3.

To improve the drainage in the southwestern portion of the landfill, two 12-inch-diameter pipes with flapper gates will be installed. The installed pipes will allow the tide waters to drain back into the drainage channel that leads to the Bolsa Chica Flood Control Channel. The proposed location of the drainage pipes is shown on Figure 2-1. The pipes will be inspected and maintained as part of the IRP Site 7 post-closure inspection and maintenance activities until the site is closed. It is recommended that these improvements be put into place prior to fall 2009.

For purposes of restoring vegetation on the western half of the landfill cover, it is recommended in Section 3.3 that small 2-inch live plug plants be placed in a grid pattern with 5-feet spacing. Planting should only occur in Zone B and Zone C areas where the ground is completely bare, so as not to interfere with seedling growth and drainage swales. A list of potential salt-tolerant plants appropriate for each zone is shown on Figure 2-1 and acceptable plants that are readily available are described in Section 3.3. The best months for planting live plants are December and January.

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# 8.0 REFERENCES


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# FIGURES

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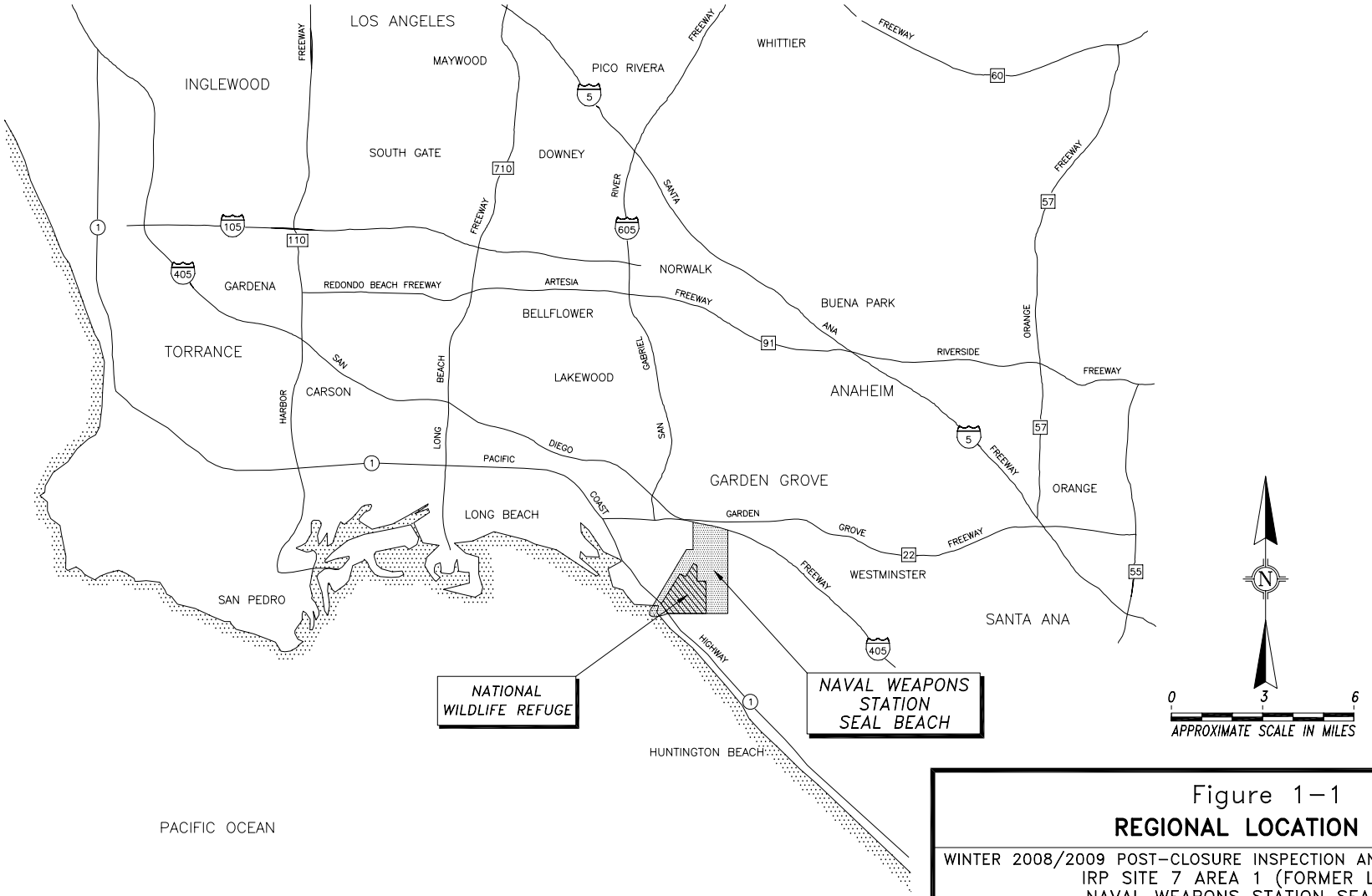


SOURCE: CH2M HILL, 2002.

Figure 1-1

**REGIONAL LOCATION MAP**

WINTER 2008/2009 POST-CLOSURE INSPECTION AND MAINTENANCE REPORT
IRP SITE 7 AREA 1 (FORMER LANDFILL)
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

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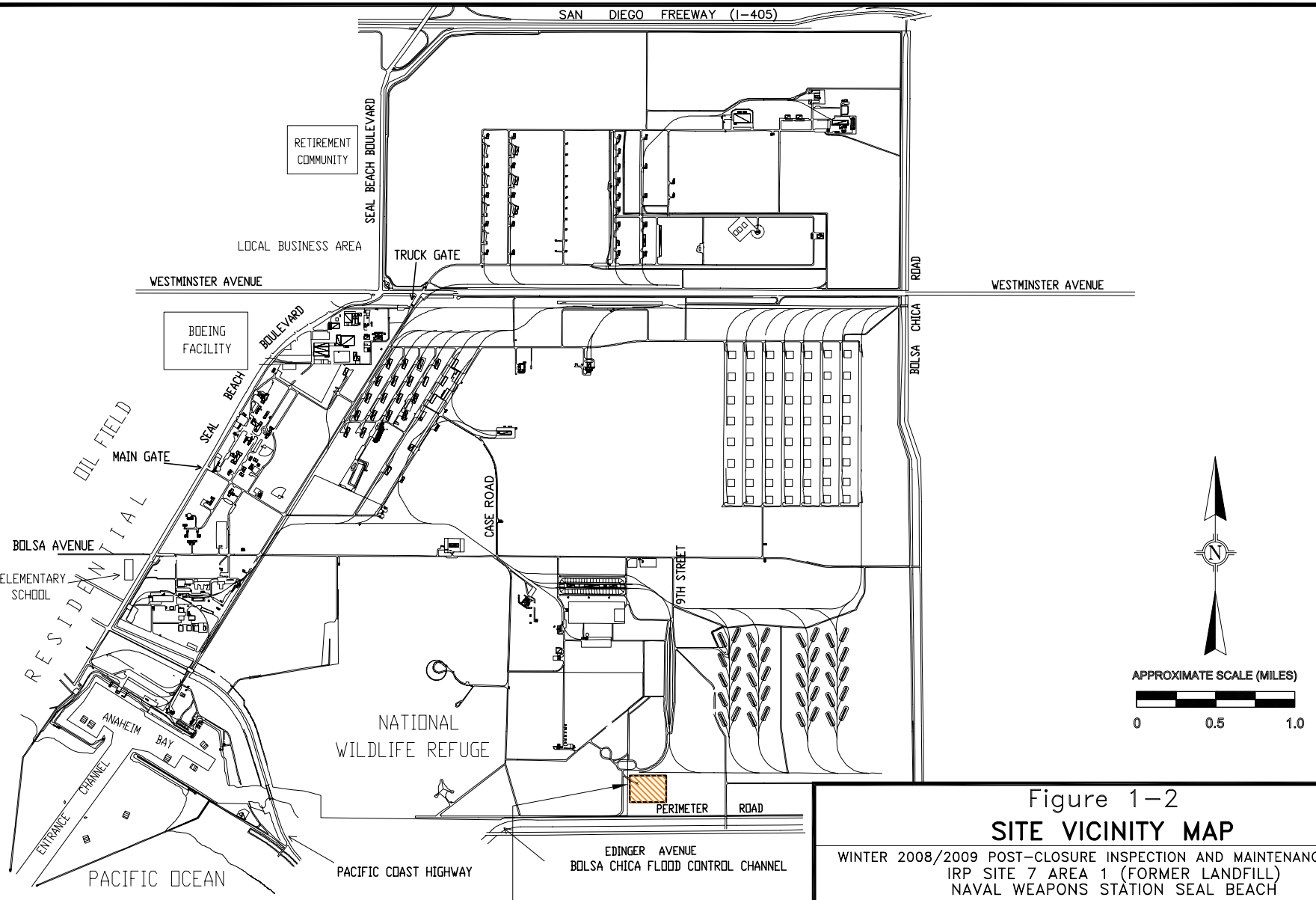


**IRP SITE 7**
**AREA 1 (LANDFILL)**

Figure 1-2

## SITE VICINITY MAP

WINTER 2008/2009 POST-CLOSURE INSPECTION AND MAINTENANCE REPORT
IRP SITE 7 AREA 1 (FORMER LANDFILL)
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

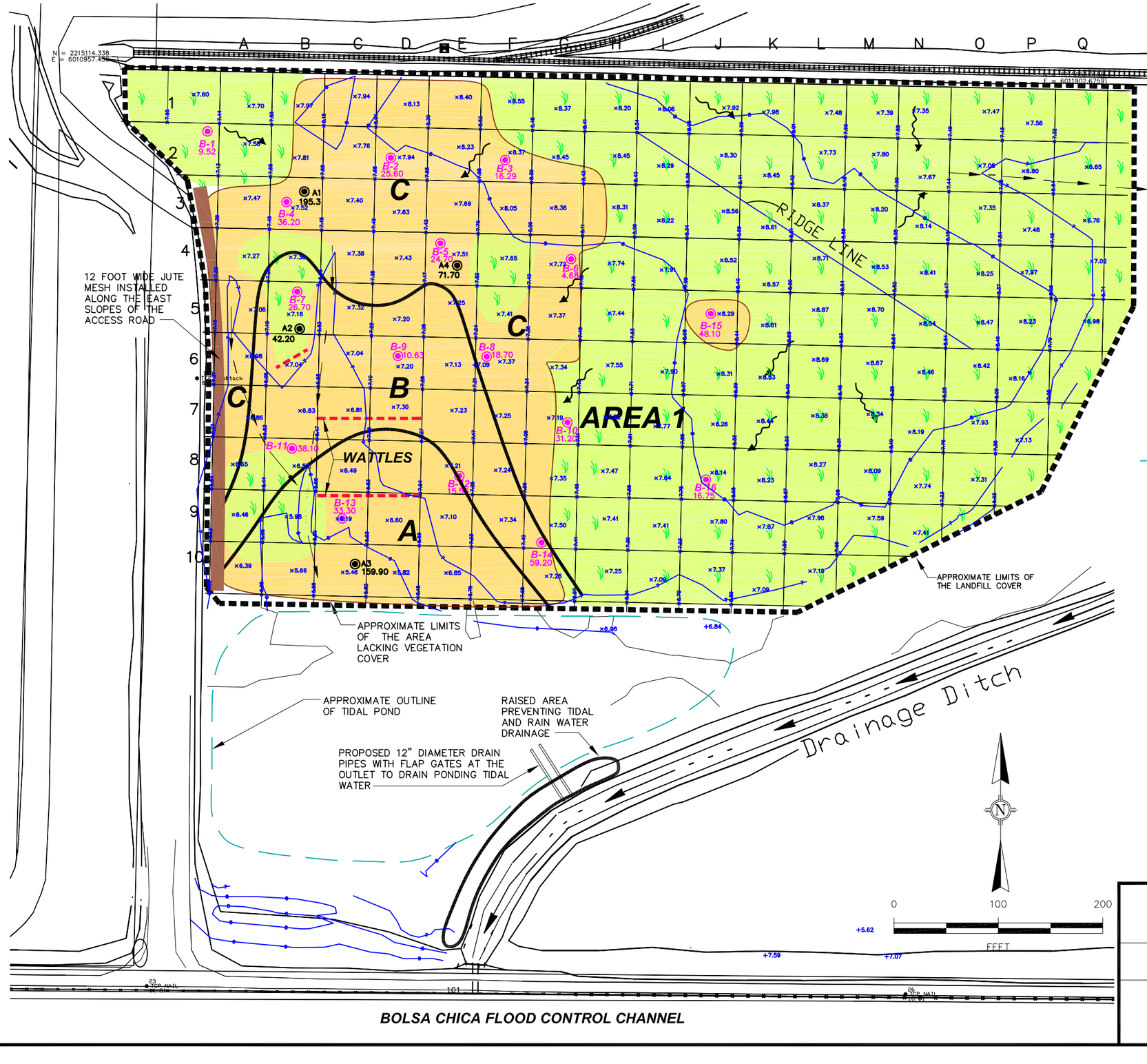


Figure 2-1
**SITE MAP**
**SITE 7 (AREA 1) LANDFILL**

WINTER 2008/2009 POST-CLOSURE INSPECTION AND MAINTENANCE REPORT
IRP SITE 7 AREA 1 (LANDFILL)
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

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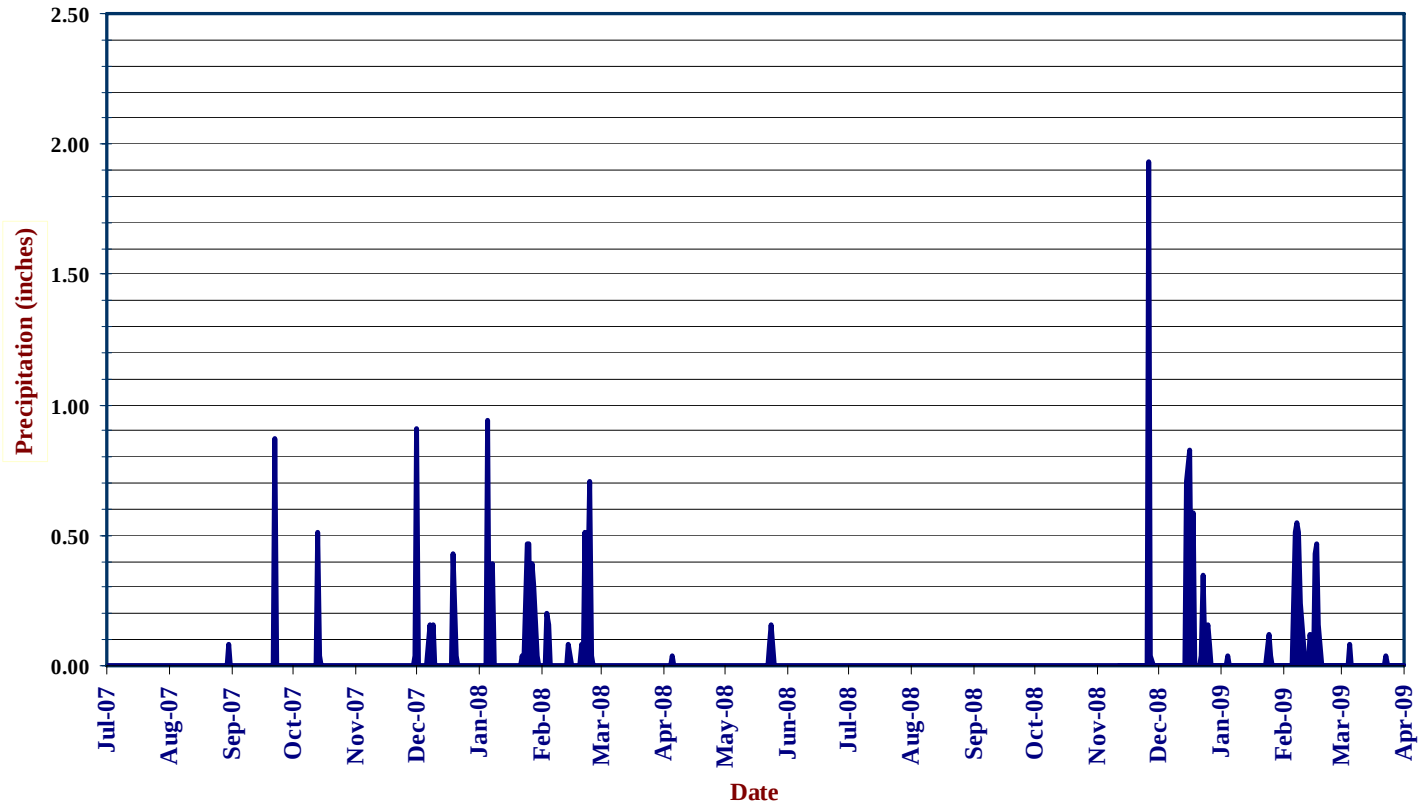


Figure 3-1
**RAINFALL DATA FOR HUNTINGTON BEACH, CALIFORNIA (JULY 2007-MARCH 2009)**

WINTER 2008/2009 POST-CLOSURE INSPECTION AND MAINTENANCE REPORT
IRP SITE 7 AREA 1 (FORMER LANDFILL)
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

# APPENDIX A

# INSPECTION FORMS 101, 102, AND 103

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# FORM 101

# SOIL COVER INSPECTION

**Type of Inspection:** Semiannually

**Inspector:** Name: Michael Cowan, P.E. Affiliation (Name of Navy Consultant or Representative): TtEC

**Date:** 10/3/08 **Time:** 2:00 p.m. Weather Condition: Sunny Warm 70°

OBSERVATION TYPE AND DETAILED DESCRIPTION:

☐ Erosion ☐ Sloughing/Sliding ☐ Cracks/Fissures ☐ Subsidence/ Depression ☐ Evidence of Excessive Borrowing Rodents ☒ Others

Lack of Cover Vegetation

Silt fence starting to deteriorate

LOCATION OF OBSERVATION (Show on the attached Figure A-1a):

See Figures 1-1 and 1-2 for Regional Location Map and Site Vicinity Map, respectively. Location of observations is shown on Figure A1-a (Landfill Cover Inspection Map). Refer to the attached photos.

Approximately 3 acres.

RECOMMENDATIONS:

Collect soil samples for agronomic analysis. Evaluate a new seed or plant mix.

Reseed or replant after first rain event.

REMARKS:

Monitor monthly for growth following reseeding/replanting.

Signature

Site Inspector/Engineer  Date 10/3/08

# FORM 102

## STORMWATER/EROSION CONTROL INSPECTION

**Date:** 10/3/08 **Name of Inspector/Engineer:** Michael Cowan, P.E.

Observations:

1. Ponding
2. Downstream Drainage Obstructions
3. Cover Washouts
4. Gully Erosion
5. Lack of Positive Drainage
6. Silt Deposition at Low Areas
X 7. Vegetation Washout

TYPE OF DEFICIENCY:

Lack of protective ground cover over the soil cap on approximately 1/3 (2.5 acres) of the site.

LOCATION OF OBSERVATION (show on attached Figure A-1a [Landfill Cover Inspection Map]):

Western side of the site (as shown in Figure A-1a) shows no vegetative erosion control protection.

Refer to the attached photos.

RECOMENDATIONS:

Conduct soil testing for agronomic analysis and evaluate a new seed or plant mix design for restoration.

COMMENTS:

Reseed/replant following evaluation of the soil agronomic analysis results.

Signature

Site Inspector/Engineer  Date 10/3/08

# FORM 103

# PROTECTIVE VEGETATIVE COVER INSPECTION

**Location:** Landfill **Date and Time:** 10/3/08 / 2:00 p.m.

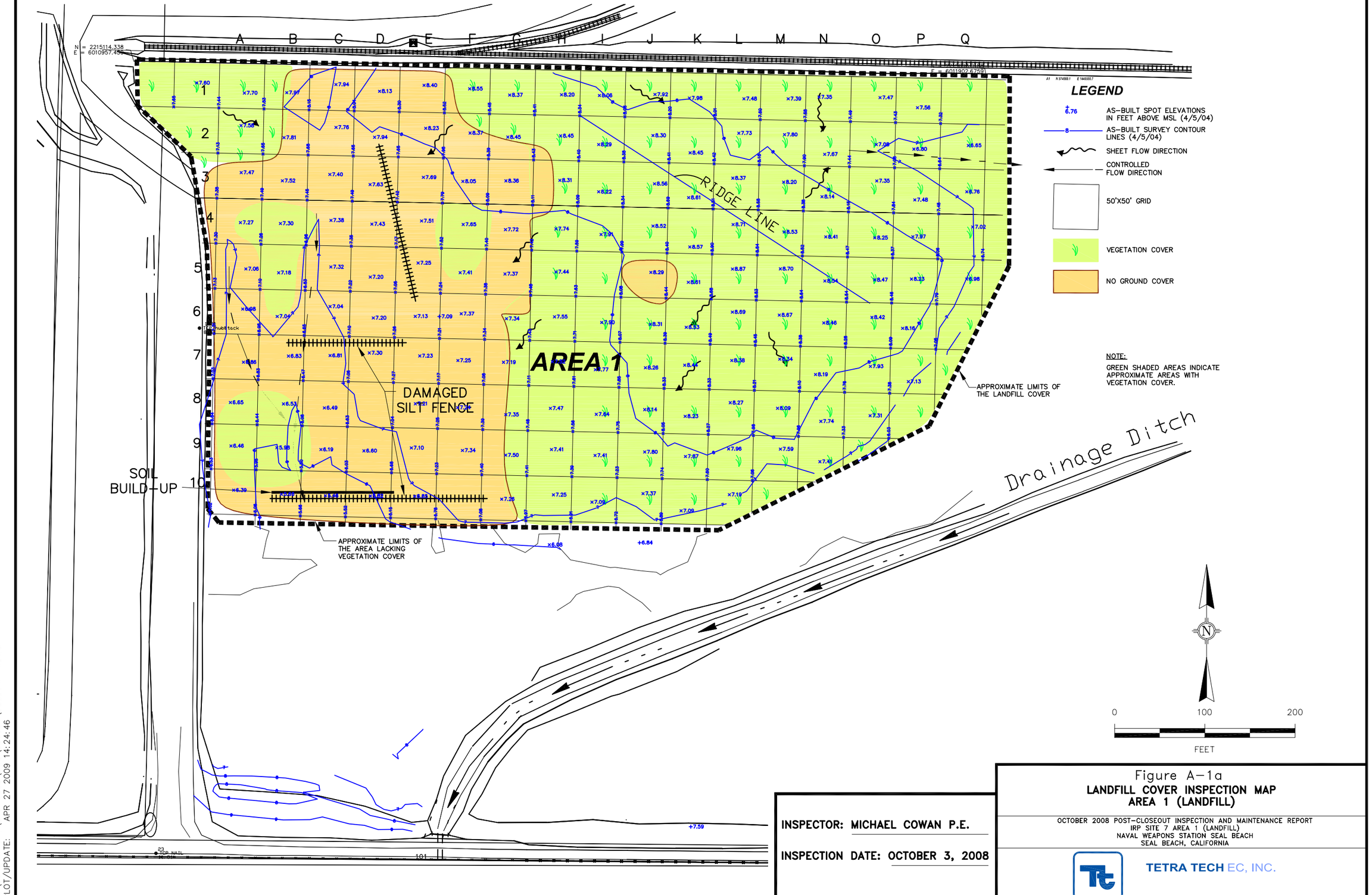
**Boundary Roads:** Patrol Road **Inspector:** Michael Cowan, P.E.

**General Soil Condition:** Wet _____ Dry X **Weather:** 70°

| ITEM | COMMENTS | RECOMMENDATIONS |
|---|---|---|
| Grass Cover | 1/3 Lacking | Reseed/replant 1/3 of Site |
| Shrubs | Small | Not a Concern |
| Vegetation Loss with Soil Erosion | Minor | Not a Concern<br>Need to Monitor |
| Non-native Plants | N/A | Not a Concern |
| Fire Hazard, Dead Vegetation, and Deep Rooted Plants | None | No Action |

Signature

Site Inspector/Engineer  Date 10/3/08

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INSPECTOR: MICHAEL COWAN P.E.

INSPECTION DATE: OCTOBER 3, 2008

Figure A-1a
**LANDFILL COVER INSPECTION MAP**
**AREA 1 (LANDFILL)**

OCTOBER 2008 POST-CLOSEOUT INSPECTION AND MAINTENANCE REPORT
IRP SITE 7 AREA 1 (LANDFILL)
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

# FORM 101

# SOIL COVER INSPECTION

**Type of Inspection:** Semiannually

**Inspector Name:** Michael Cowan, P.E. **Affiliation (Name of Navy Consultant or Representative):** Tetra Tech EC, Inc. (TtEC)

**Date:** 12/17/08 **Time:** 10:00 a.m. **Weather Condition:** Rainy

OBSERVATION TYPE AND DETAILED DESCRIPTION:

☐ Erosion ☐ Sloughing/Sliding ☐ Cracks/Fissures ☐ Subsidence/ Depression ☐ Evidence of Excessive Borrowing Rodents ☒ Others

Soil cover was in place – no erosion or loss noted.

Silt fence has further deteriorated

LOCATION OF OBSERVATION (Shown on the attached Figure A-1b):

Ponding noted as shown on Figure A-1b attached.

RECOMMENDATIONS:

Grade swale line to drain.

REMARKS:

A) Vegetative cover is lacking on the western 1/3 of the landfill.

B) Check soil cover for salty condition.

C) Reseed or replant.

Signature

Site Inspector/Engineer  Date 12/17/08

# FORM 102

## STORMWATER/EROSION CONTROL INSPECTION

**Date:** 12/17/08 **Name of Inspector/Engineer:** Michael Cowan, P.E.

Observations:

X 1. Ponding
2. Downstream Drainage Obstructions
3. Cover Washouts
4. Gully Erosion
X 5. Lack of Positive Drainage
6. Silt Deposition at Low Areas
7. Vegetation Washout

TYPE OF DEFICIENCY:

Minimal grade of the landfill cover causes ponding. No soil erosion was noted.

LOCATION OF OBSERVATION (shown on the attached Figure A-1b):

The western 1/3 of the landfill cover showed ponding with minimum grade for drainage.
In addition, the western 1/3 of the landfill lacks ground cover as shown on Figure A-1b attached.

RECOMENDATIONS:

Hand grade existing swale to provide for positive drainage.

COMMENTS:

A) Ground cover is lacking due to possible salty soil conditions – check soil condition.
B) Add new cover soil, if needed in depressions or grade to drain.
C) Reseed or replant.

Signature

Site Inspector/Engineer  Date 12/17/08

# FORM 103

# PROTECTIVE VEGETATIVE COVER INSPECTION

**Location:** Seal Beach LF, Site 7 **Date and Time:** 12/17/08 10:00 a.m.

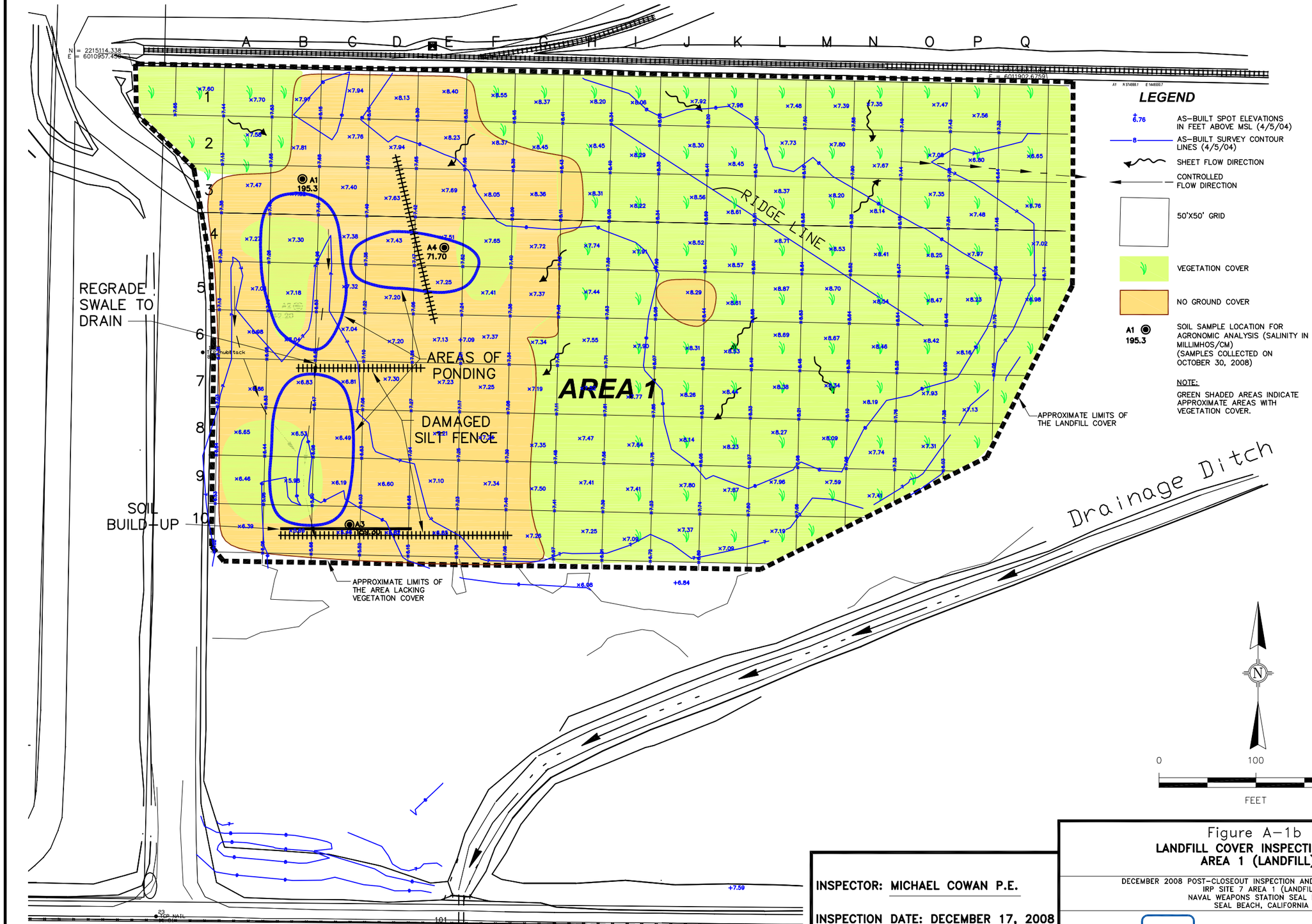
**Boundary Roads:** LF Across and Patrol Road **Inspector Name:** Michael Cowan, P.E.

**General Soil Condition:** Wet X Dry _____ **Weather:** Rainy

| ITEM | COMMENTS | RECOMMENDATIONS |
|---|---|---|
| Grass Cover | Low to none | Reseed or replant / check soil condition |
| Shrubs | None | None |
| Vegetation Loss with Soil Erosion | No soil erosion | re-vegetate western portion of the landfill cover |
| Non-native Plants | N/A | N/A |
| Fire Hazard, Dead Vegetation, and Deep Rooted Plants | None | None |

Signature

Site Inspector/Engineer  Date 12/17/08




INSPECTOR: MICHAEL COWAN P.E.

INSPECTION DATE: DECEMBER 17, 2008

Figure A-1b

**LANDFILL COVER INSPECTION MAP**
**AREA 1 (LANDFILL)**

DECEMBER 2008 POST-CLOSEOUT INSPECTION AND MAINTENANCE REPORT
IRP SITE 7 AREA 1 (LANDFILL)
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

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# FORM 101

# SOIL COVER INSPECTION

**Type of Inspection:** Semiannually

**Inspector Name:** Michael Cowan, P.E. **Affiliation (Name of Navy Consultant or Representative):** Tetra Tech EC, Inc. (TtEC)

**Date:** 2/13/09 **Time:** 8:00 a.m. **Weather Condition:** Cloudy

OBSERVATION TYPE AND DETAILED DESCRIPTION:

☒ Erosion ☐ Sloughing/Sliding ☐ Cracks/Fissures ☒ Subsidence/ Depression ☐ Evidence of Excessive Borrowing Rodents ☐ Others

Soil losses were minimal. Erosion was very minor. Low ponding area noted on the west and southwestern corner (depression)

LOCATION OF OBSERVATION (Shown on the attached Figure A-1c):
The western one third and southwestern area of the site had minor soil erosion with 2-inch deep rill along roadway side slopes.
Shallow ponding area noted in southwestern corner as shown on the attached Figure A-1c.

RECOMMENDATIONS:
Repair silt fence and replace or improve vegetative ground cover soils in the western and southwestern area of the site to avoid soil loss.
Remove sediment buildup from behind silt fences. Fill in low ponding area on the western side of the site or grade to drain to the south.

REMARKS:
Soils may have high salt concentrations that would not support vegetation cover on the southwestern portion of the landfill.
Test existing soil before any revegetation.

Signature

Site Inspector/Engineer  Date 2/13/09

# FORM 102

# STORMWATER/EROSION CONTROL INSPECTION

**Date:** 2/13/09 **Name of Inspector/Engineer:** Michael Cowan, P.E.

Observations:

- X 1. Ponding
- 2. Downstream Drainage Obstructions
- 3. Cover Washouts
- 4. Gully Erosion
- X 5. Lack of Positive Drainage
- X 6. Silt Deposition at Low Areas
- 7. Vegetation Washout

TYPE OF DEFICIENCY:
Lack of positive slope is believed to have resulted in ponding (wet area). Standing water with less than 3-inches in depth was noted at the time of inspection.
Silt fences were damaged from wind and rain and require repair or replacement. Sediment build-up along the southern silt fence was also noted.

LOCATION OF OBSERVATION (shown on the attached Figure A-1c):
The western one third and southwestern portions of the site lacks vegetative ground cover.
Ponding areas on the western side are shown on the attached Figure A-1c.

RECOMENDATIONS:
A) Grade western area to drain the ponded areas or add fill (soil cover) to prevent ponding of water.
B) Repair or replace silt fence with straw rolls or wattles. Wattles require less maintenance in comparison to silt fence that are prone to wind damage.
C) Collect soil samples from the cover and conduct agronomic analysis to determine soil conditions and ability to establish vegetation.

COMMENTS:
Soil cover may have excessive salt content that might be hampering vegetation establishment and growth on the protective cover.
If establishing vegetation with salt tolerant species in the bare areas is unsuccessful, new soil cover may be required for establishment of vegetation in the western portion of the landfill.

Signature

Site Inspector/Engineer  Date 2/13/09

# FORM 103

# PROTECTIVE VEGETATIVE COVER INSPECTION

**Location:** Seal Beach LF **Date and Time:** 2/13/09 8:00 a.m.

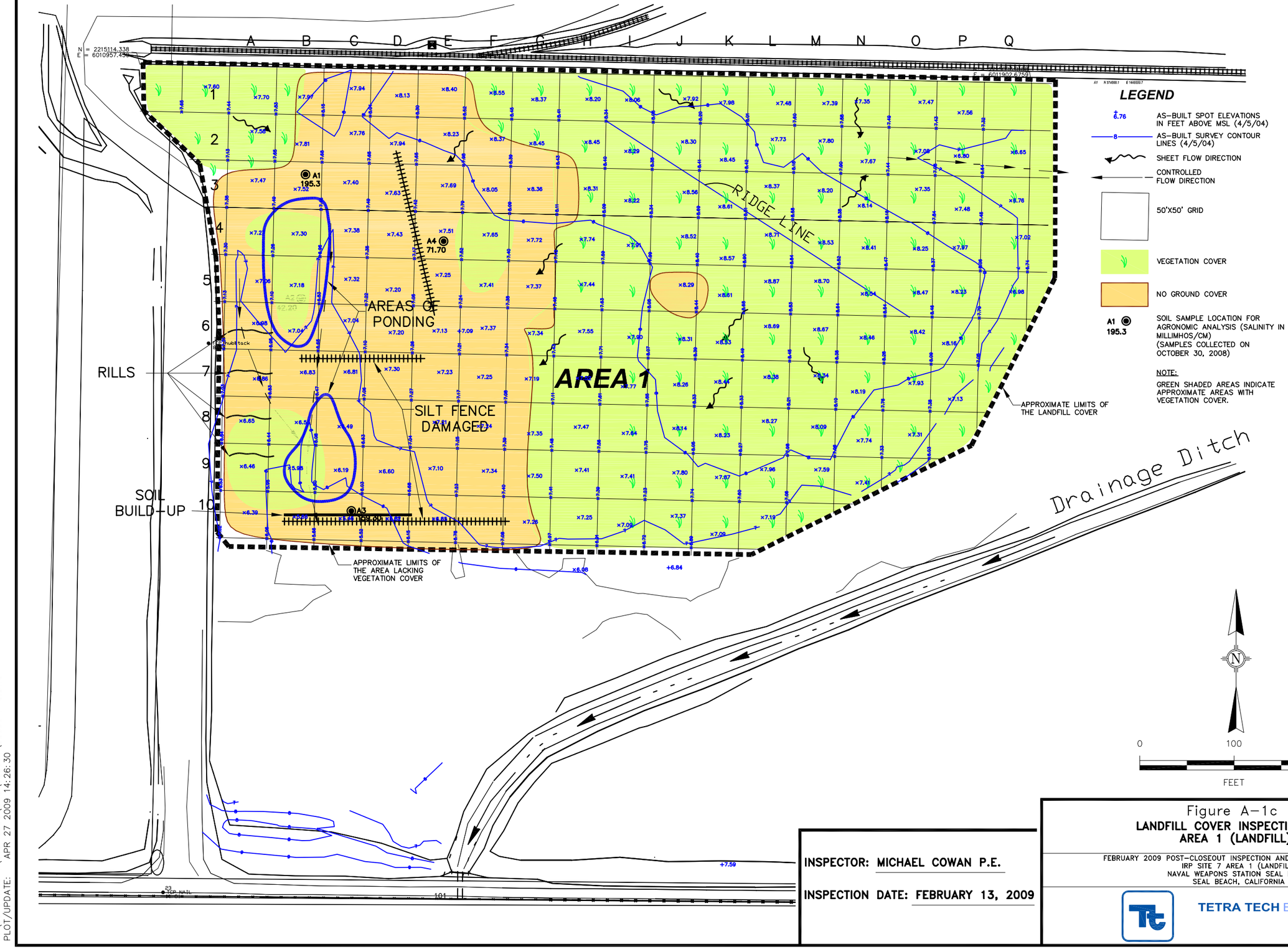
**Boundary Roads:** LF Across and Patrol Road **Inspector Name:** Michael Cowan, P.E.

**General Soil Condition:** Wet X Dry _____ **Weather:** Cloudy

| ITEM | COMMENTS | RECOMMENDATIONS |
|---|---|---|
| Grass Cover | Southwestern area little cover | Restore vegetation cover with planting native vegetation species |
| Shrubs | N/A | Not observed |
| Vegetation Loss with Soil Erosion | Loss of vegetation was not due to erosion | Salty soils may need a salt plant type vegetation |
| Non-native Plants | N/A | Not observed |
| Fire Hazard, Dead Vegetation, and Deep Rooted Plants | No concerns noted | Site was found to be clear of any fire hazard or deep rooted vegetation |

Signature

Site Inspector/Engineer  Date 2/13/09




INSPECTOR: MICHAEL COWAN P.E.

INSPECTION DATE: FEBRUARY 13, 2009

Figure A-1c

**LANDFILL COVER INSPECTION MAP**
**AREA 1 (LANDFILL)**

FEBRUARY 2009 POST-CLOSEOUT INSPECTION AND MAINTENANCE REPORT
IRP SITE 7 AREA 1 (LANDFILL)
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

TETRA TECH EC, INC.

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# APPENDIX B

# SITE PHOTOGRAPHS

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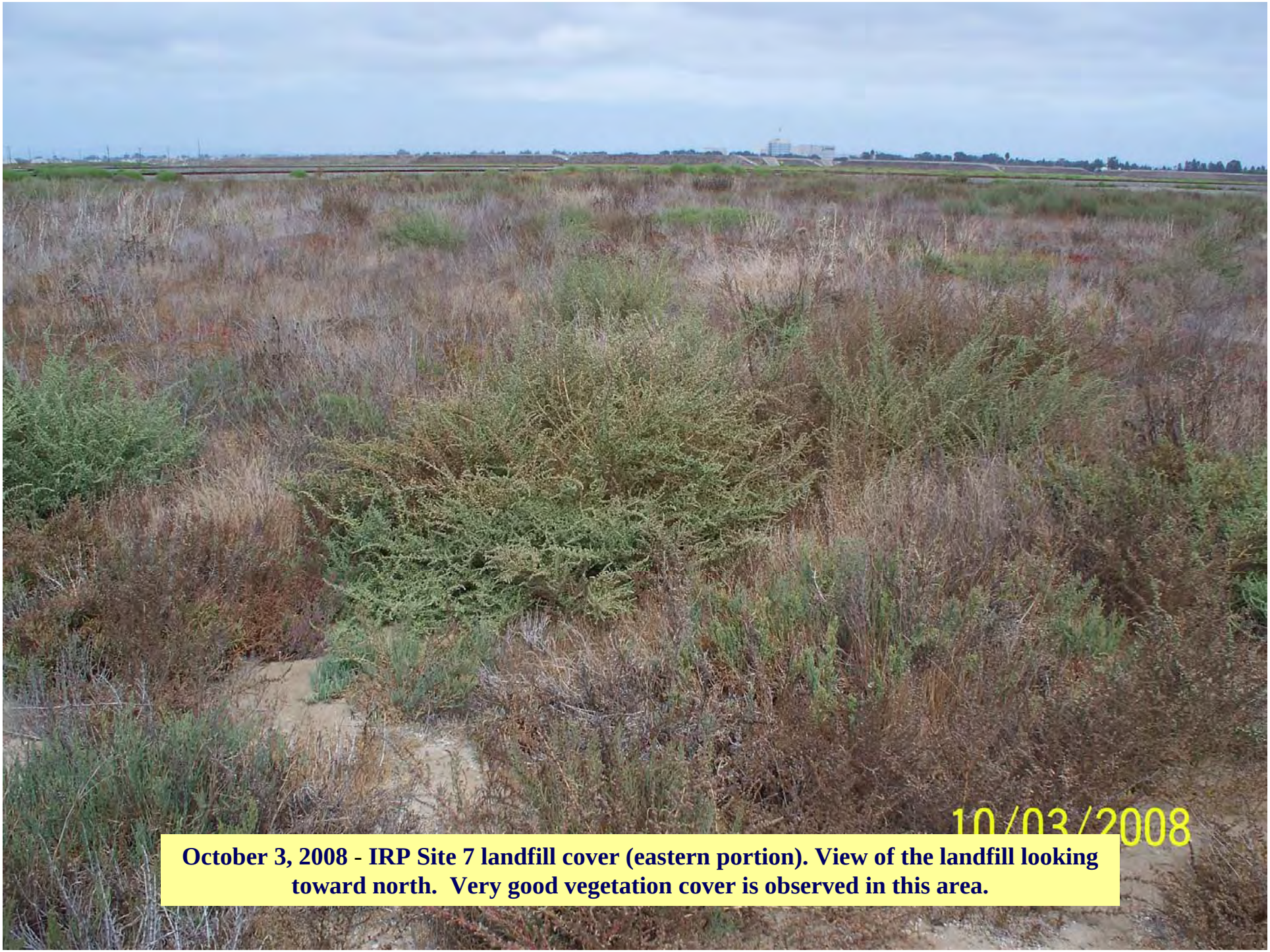
**October 3, 2008 - IRP Site 7 landfill cover (western portion). View of the landfill looking toward south and along the access road. No wet spots, depressions or erosion is observed.**

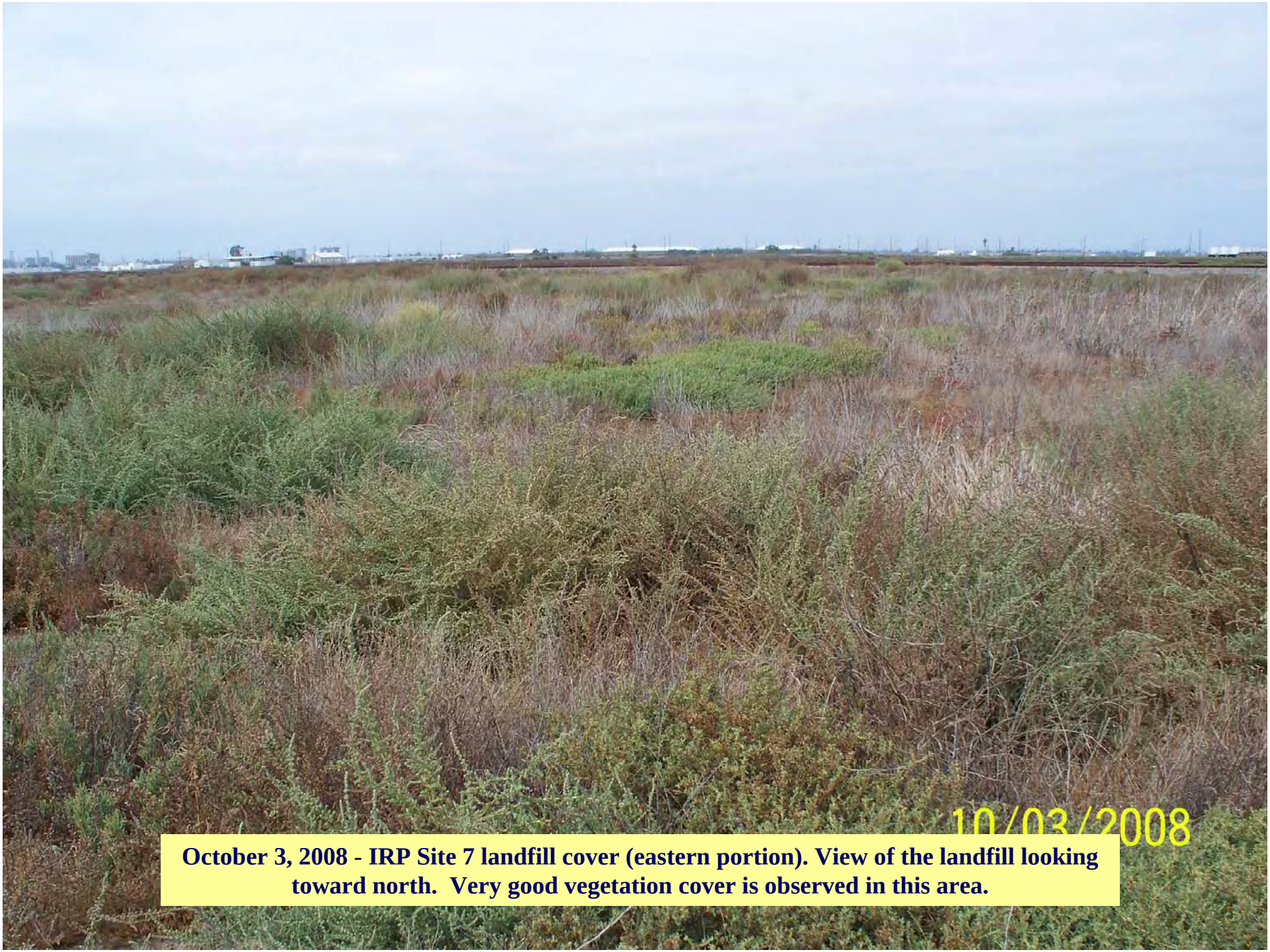

**October 3, 2008 - IRP Site 7 landfill cover (western portion).**
**Minor washes (less than 2 inches deep) is observed.**


**October 3, 2008 - IRP Site 7 landfill cover (western portion). View of the landfill looking toward south. Some sparse vegetation growth is observed.**


**October 3, 2008 - IRP Site 7 landfill cover (western portion). View of the landfill looking toward west from the center of the landfill. Vegetation growth becomes sparse at the western portion of the site.**




**October 3, 2008 - IRP Site 7 landfill cover (eastern portion). View of the landfill looking toward north. Very good vegetation cover is observed in this area.**




**October 3, 2008 - IRP Site 7 landfill cover (eastern portion). View of the landfill looking toward north. Very good vegetation cover is observed in this area.**

**December 17, 2008 – Ponding over the southern portion of the landfill following heavy precipitation during the days preceding the period inspection.**

**December 17, 2008 – View of the western portion of the landfill cover looking toward northeast, following heavy precipitation prior to periodic site inspection.**

**December 17, 2008 – A patch of ponding over the northwestern corner of the landfill immediately following heavy precipitation.**


During the site visit conducted on January 20, 2009, it was observed that
the ponded water over the western portion of the landfill had
for the most part drained.

**During the site visit conducted on January 20, 2009, it was observed that the ponded water over the western portion of the landfill had for the most part drained, and there was evidence of improvement in vegetation growth and establishment in this area compared to previous years.**

**February 12, 2009 – View of the southwestern section of the landfill, looking toward northeast.**

**February 12, 2009 – Several small areas with shallow ponded water were observed.**

**February 12, 2009 – Several small areas with shallow ponded water were observed at the south side of the landfill.**

**February 12, 2009 – Several shallow ponding areas near the northwest corner of the landfill. Looking toward southeast.**

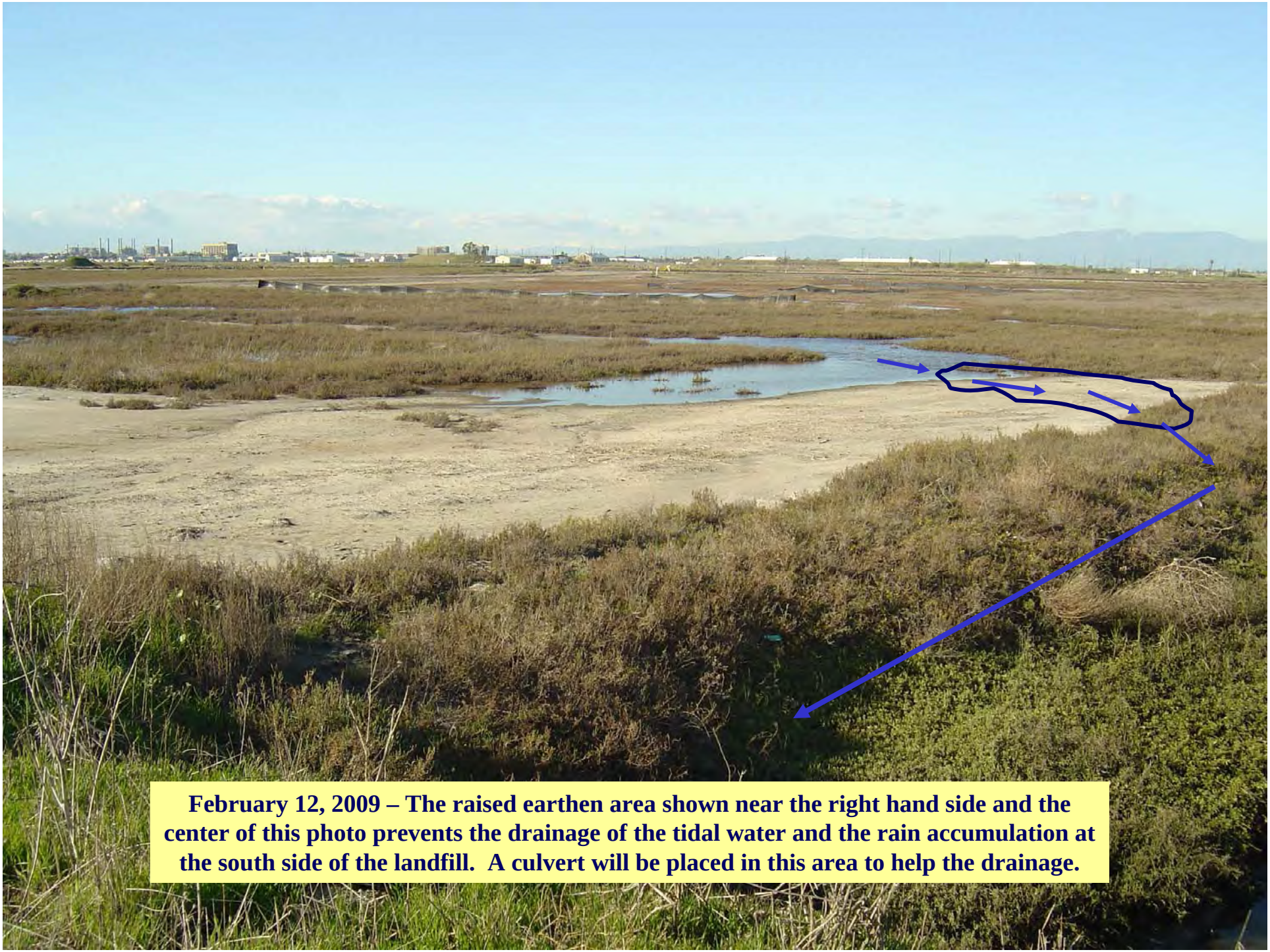
**February 12, 2009 - Picture showing vegetation growth in an area that was bare during prior years.**

**February 12, 2009 - Picture of new tiny sprouts in the bare areas of the landfill cover, following rains.**

**February 12, 2009 - Picture of new tiny sprouts in the bare areas of the landfill cover, following rains.**

**February 12, 2009 – A view of the western portion of the landfill looking toward the south following the rains. As part of the maintenance activities, the ponded areas were connected with small shallow swales to drain towards the south.**

**February 12, 2009 – Rain and tide water at the southwestern side of the landfill.
The silt fence was later removed on March 6.**



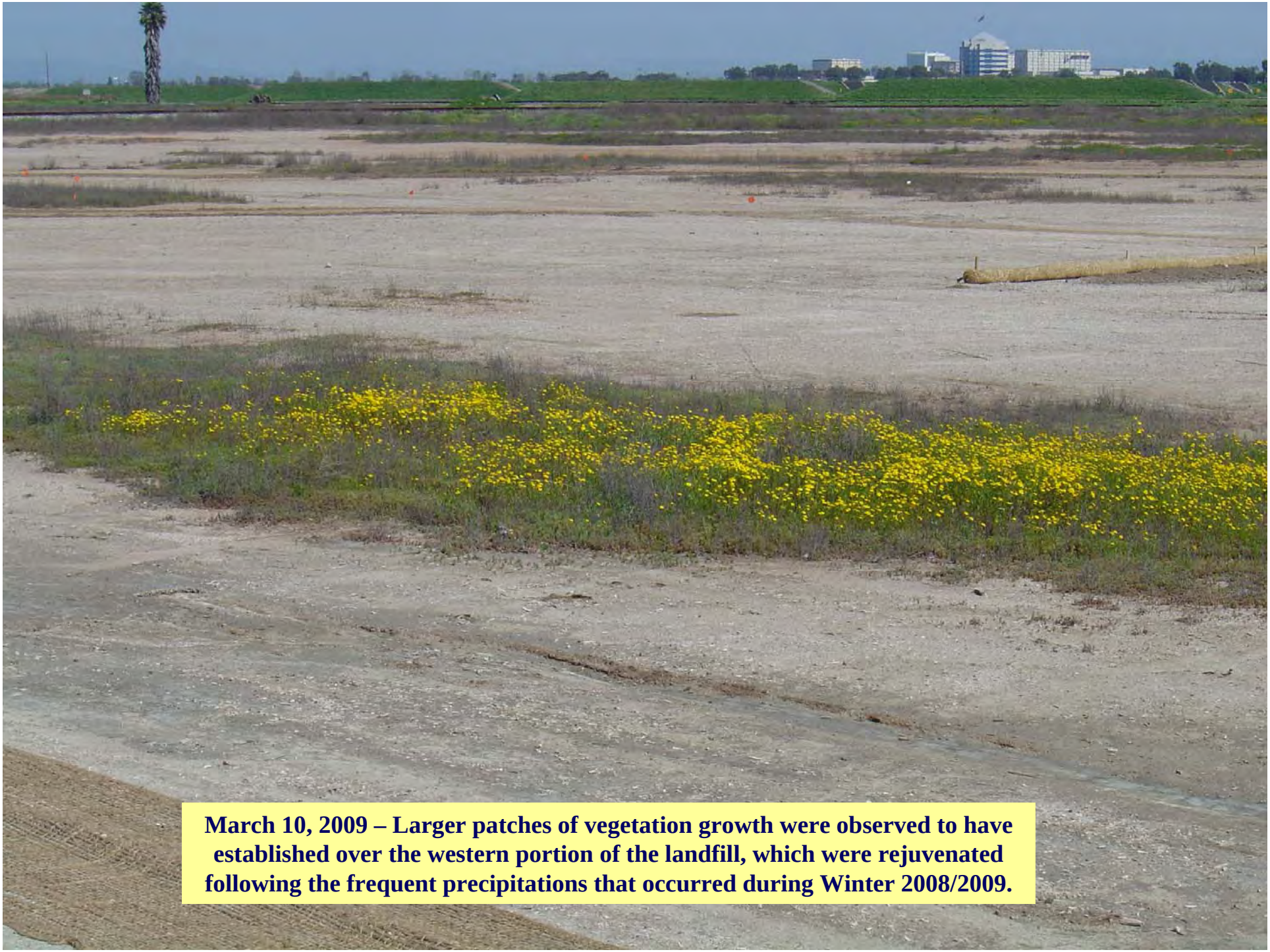
**February 12, 2009 – The raised earthen area shown near the right hand side and the center of this photo prevents the drainage of the tidal water and the rain accumulation at the south side of the landfill. A culvert will be placed in this area to help the drainage.**

**March 10, 2009 – Wattles were placed at different locations to prevent sheet flow erosion, and eroded areas were graded with hand tools and covered with jute mesh to prevent future erosion.**

**March 10, 2009 – Damaged silt fences were removed from the landfill and replaced with wattles. Sediment and silt that accumulated behind the fences were removed and the areas were regraded with hand tools.**

**March 10, 2009 – Silt fences were removed and replaced with wattles for erosion protection. Wattles are less visible than silt fences, that stand out and are visually unsightly.**

**March 10, 2009 - Silt fence at south side of the landfill was removed. This would allow for a more rapid drainage of rainwater and northward expansion of the vegetation from the marsh area to the south of the landfill.**



**March 10, 2009 – Larger patches of vegetation growth were observed to have established over the western portion of the landfill, which were rejuvenated following the frequent precipitations that occurred during Winter 2008/2009.**

# APPENDIX C

# AGRONOMIC ANALYSIS RESULTS

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# WALLACE LABORATORIES
## 365 Coral Circle
## El Segundo, CA 90245
## phone (310) 615-0116 fax (310) 640-6863

November 4, 2008

Fax (949) 756-7560
Hamlet Hamparsumian
Tetra Tech EC, Inc.
1940 East Deere Ave, Suite 200
Santa Ana, CA 92705

RE: Site 7, Area 1

Dear Mr. Hamparsumian,

These four samples contain extreme salinity, high sodium, high chloride, high magnesium and high calcium. The salinity values range from 195.30 millimho/cm in sample A-01 to 42.20 millimho/cm in sample A-02. The desired salinity for salt-sensitive plants is about 1 millimho/cm. Most plants need salinity below about 4 millimho/cm. Saline soil is defined as having salinity over 4 millimho/cm. The salinity of seawater is about 45 millimho/cm. Salt-tolerant native plants may tolerate salinity at about half seawater.

Most salt-tolerate plant tolerate high sodium. Magnesium based salinity is not common. These samples have high magnesium. Sulfur is also high in samples A-02 and A-03.

The soils are acidic. The pH values range from 5.16 to 6.57.

Phosphorus is low in sample A-01. Other nutrients are high. Boron is excessive in sample A-03. Samples A-02 and A-04 are hydrophobic. They are difficult to wet. Water beads up on the soil surface.

Recommendations

Determine the source of the salinity and eliminate. Analyze the water quality and soils in the surrounding area and in the subsoils. Salinity may be the highest at the soil surface if the soil is crusted. If salinity is lower with depth, remove the surface soil crust.

Establish drainage. If necessary, install subdrains.

Irrigate and leach the salinity, sodium, magnesium, chloride, and boron out of the soils using good water quality. Monitor the soils during the reclamation. At least several months of leaching will probably be needed in the best conditions.

Use salt-tolerant or halophyte plants.

Sincerely,

Garn A. Wallace, Ph. D.
Executive Director
GAW:n

**WALLACE LABS**
**365 Coral Circle**
**El Segundo, CA 90245**
**(310) 615-0116**

# SOILS REPORT

Print Date Nov. 3, 2008 Receive Date 10/31/08

Location Site 7, Area 1

Requester Andrew Egenes, Tetra Tech

graphic interpretation: * very low, ** low, *** moderate

**ammonium bicarbonate/DTPA**

* * * * high, * * * * * very high

extractable - mg/kg soil

Interpretation of data

low medium high

0 - 7 8-15 over 15
0-60 60 -120 121-180
0 - 4 4 - 10 over 10
0- 0.5 0.6- 1 over 1
0 - 1 1 - 1.5 over 1.5
0- 0.2 0.3- 0.5 over 0.5
0- 0.2 0.2- 0.5 over 1

ratio of calcium to magnesium
needs to be more than 2 or 3

should be less than potassium

**The following trace elements may be toxic**
**The degree of toxicity depends upon the pH of the soil, soil texture, organic matter, and the concentrations of the individual elements as well as to their interactions**

**The pH optimum depends upon soil organic matter and clay content- for clay and loam soils: under 5.2 is too acidic**
**6.5 to 7 is ideal**
**over 8.0 is too alkaline**

**The ECe is a measure of the soil salinity:**
**1-2 affects a few plants**
**2-4 affects some plants,**
**> 4 affects many plants.**

**problems over 150 ppm**
**good 20 - 30 ppm**

**toxic over 800**

**toxic over 1 for many plants**

**increasing problems start at 3**

**est. gypsum requirement-lbs./1000 sq. ft.**

| Sample ID Number | 08-308-02 | | | 08-308-03 | | | 08-308-04 | | | 08-308-05 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **A 01** | | | **A 02** | | | **A 03** | | | **A 04** | | |
| **elements** | | graphic | | | graphic | | | graphic | | | graphic | |
| **phosphorus** | 3.94 | ** | | 38.61 | ***** | | 13.25 | **** | | 26.67 | ***** | |
| **potassium** | 334.74 | ***** | | 603.20 | ***** | | 1,423.39 | ***** | | 669.17 | ***** | |
| **iron** | 6.27 | *** | | 87.57 | ***** | | 33.10 | ***** | | 66.84 | ***** | |
| **manganese** | 11.55 | ***** | | 52.53 | ***** | | 14.80 | ***** | | 29.65 | ***** | |
| **zinc** | 3.14 | **** | | 24.09 | ***** | | 5.97 | **** | | 15.06 | ***** | |
| **copper** | 3.29 | ***** | | 18.71 | ***** | | 11.61 | ***** | | 15.04 | ***** | |
| **boron** | 0.58 | **** | | 0.20 | ** | | 5.10 | ***** | | 0.85 | **** | |
| **calcium** | 367.54 | *** | | 1,337.82 | ***** | | 442.56 | **** | | 1,213.02 | ***** | |
| **magnesium** | 3,247.73 | ***** | | 2,654.28 | ***** | | 6,234.87 | ***** | | 5,518.12 | ***** | |
| **sodium** | 21,485.31 | ***** | | 12,276.56 | ***** | | 24,955.17 | ***** | | 23,981.99 | ***** | |
| **sulfur** | 285.46 | *** | | 1,077.69 | ***** | | 3,137.91 | ***** | | 783.38 | **** | |
| **molybdenum** | n d | * | | n d | * | | n d | * | | n d | * | |
| **nickel** | 0.15 | * | | 0.76 | * | | 0.66 | * | | 0.34 | * | |
| **aluminum** | n d | * | | n d | * | | n d | * | | n d | * | |
| **arsenic** | 0.08 | * | | n d | * | | n d | * | | 0.08 | * | |
| **barium** | 0.07 | * | | n d | * | | n d | * | | 0.18 | * | |
| **cadmium** | 0.16 | * | | 0.34 | * | | 0.48 | * | | 0.41 | * | |
| **chromium** | 0.02 | * | | 0.17 | * | | 0.06 | * | | 0.04 | * | |
| **cobalt** | 0.14 | * | | 0.96 | ** | | 0.60 | ** | | 0.50 | ** | |
| **lead** | 5.57 | *** | | 4.92 | ** | | 5.00 | ** | | 7.93 | *** | |
| **lithium** | 0.23 | * | | 0.71 | * | | 0.74 | * | | 0.76 | * | |
| **mercury** | n d | * | | n d | * | | n d | * | | n d | * | |
| **selenium** | 0.36 | * | | 10.48 | ***** | | 2.53 | **** | | 1.48 | *** | |
| **silver** | 0.02 | * | | 0.09 | * | | 0.17 | ** | | n d | * | |
| **strontium** | 5.83 | ** | | 10.64 | ** | | 8.47 | ** | | 14.80 | ** | |
| **tin** | n d | * | | n d | * | | n d | * | | n d | * | |
| **vanadium** | 0.18 | * | | 0.89 | * | | 0.90 | * | | 0.50 | * | |
| **Saturation Extract** | | | | | | | | | | | | |
| **pH value** | 5.16 | * | | 6.20 | *** | | 6.46 | *** | | 6.57 | *** | |
| **ECe (milli-mho/cm)** | 195.30 | ***** | | 42.20 | ***** | | 159.90 | ***** | | 71.70 | ***** | |
| | | | millieq/l | | | millieq/l | | | millieq/l | | | millieq/l |
| **calcium** | 12,358.6 | | 617.9 | 2,025.3 | | 101.3 | 1,933.8 | | 96.7 | 2,903.5 | | 145.2 |
| **magnesium** | 10,281.6 | | 849.7 | 1,383.9 | | 114.4 | 5,593.8 | | 462.3 | 3,193.5 | | 263.9 |
| **sodium** | 29,713.4 | | 1,291.9 | 6,340.2 | | 275.7 | 28,074.2 | | 1,220.6 | 9,298.1 | | 404.3 |
| **potassium** | 564.0 | | 14.4 | 193.4 | | 4.9 | 858.9 | | 22.0 | 245.4 | | 6.3 |
| **cation sum** | | | 2774.0 | | | 496.2 | | | 1801.6 | | | 819.6 |
| **chloride** | 95,777 | | 2697.9 | 17,187 | | 484.1 | 71,875 | | 2024.6 | 29,437 | | 829.2 |
| **nitrate as N** | 833 | | 59.5 | 96 | | 6.9 | 327 | | 23.3 | 173 | | 12.4 |
| **phosphorus as P** | 0.0 | | 0.0 | 6.0 | | 0.2 | 3.7 | | 0.1 | 1.9 | | 0.1 |
| **sulfate as S** | 250.7 | | 15.7 | 524.9 | | 32.8 | 1,774.8 | | 110.9 | 420.4 | | 26.3 |
| **anion sum** | | | 2773.1 | | | 524.0 | | | 2159.0 | | | 867.9 |
| **boron as B** | 1.08 | ***** | | 0.99 | **** | | 3.53 | ***** | | 0.43 | *** | |
| **SAR** | 47.8 | ***** | | 26.6 | ***** | | 73.2 | ***** | | 28.3 | ***** | |
| | 4642 | | | 2880 | | | 6217 | | | 5815 | | |
| **relative infiltration rate** | slow/fair | | | fair | | | fair/slow | | | fair/slow | | |
| **estimated soil texture** | sandy loam | | | loam | | | loam | | | loam | | |
| **lime (calcium carbonate)** | low | | | no | | | slight | | | no | | |
| **organic matter** | low/fair | | | high | hydrophobic | | high | | | high | hydrophobic | |
| **moisture content of soil** | 7.8% | | | 8.1% | | | 26.8% | | | 16.4% | | |
| **half saturation percentage** | 13.8% | | | 88.8% | | | 60.5% | | | 77.5% | | |

**Elements are expressed as mg/kg dry soil or mg/l for saturation extract.**

**pH and ECe are measured in a saturation paste/extract. nd means not detected.**

# WALLACE LABORATORIES
**365 Coral Circle**
**El Segundo, CA 90245**
**phone (310) 615-0116 fax (310) 640-6863**


February 25, 2009

Hamlet Hamparsumian, hamlet.hamparsumian@tteci.com
Tetra Tech EC, Inc.
1940 East Deere Ave, Suite 200
Santa Ana, CA 92705

RE: PO No. 1044803
Seal Beach, Samples Taken 2/20/2009

Dear Hamlet,

These 16 samples contain on average extreme salinity, high sodium, high chloride, high magnesium and high calcium. The salinity values range from 4.68 millimho/cm in sample B-6 to 59.20 millimho/cm in sample B-14. The average salinity is 26.0 millimho/cm. The desired salinity for salt-sensitive plants is about 1 millimho/cm. Most plants need salinity below about 4 millimho/cm. Saline soil is defined as having salinity over 4 millimho/cm. Salt-tolerant native plants may tolerate salinity at about half seawater.

Most salt-tolerate plant tolerate high sodium. Magnesium based salinity is not common. These samples have high magnesium. Sulfur is also high in samples SS 02 and SS 03.

The soils are near neutral. The pH values range from 6.74 to 7.51. The average pH is 7.07.

The fertility is high. Organic matter is high. The average is 17.3% on a dry weight basis.

Recommendations

Use salt-tolerant or halophytic plants. If non-halophytic plants are to grown, reduce the salinity, chloride, sodium, sulfate and magnesium.

Establish drainage. If necessary, install subdrains.

Irrigate and leach the salinity, sodium, magnesium, and chloride out of the soils using good water quality. Monitor the soils during the reclamation. At least several months of leaching will probably be needed in the best conditions.

Sincerely,

Garn A. Wallace, Ph. D.
Executive Director
GAW:n

**TABLE 1**

**Agronomic Analysis Results**
**For Samples Collected on February 20, 2009**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WALLACE LABS** | **SOILS REPORT** | Print Date | Feb. 25, 2009 | Receive Date | Feb. 24, 2009 | | | | | | | | | |
| **365 Coral Circle** | Location | Seal Beach, Samples Collected 2/20/2009 | | | | | | | | | | | | |
| **El Segundo, CA 90245** | Requester | Tetra Tech EC, Inc. | | | | | | | | | | | | |
| **(310) 615-0116** | | | | | | | | | | | | | | |
| **ammonium bicarbonate/DTPA** | | graphic interpretation: * very low, ** low, *** moderate, * * * * high, * * * * * very high | | | | | | | | | | | | |
| extractable - mg/kg soil | Sample ID Number | 09-55A-13 | | | 09-55A-14 | | | 09-55A-15 | | | 09-55A-16 | | | |
| Interpretation of data | | B-1 | | | B-2 | | | B-3 | | | B-4 | | | |
| low medium high | **elements** | | graphic | | | graphic | | | graphic | | | graphic | | |
| 0 - 7 8-15 over 15 | **phosphorus** | 20.31 | ***** | | 25.70 | ***** | | 72.68 | ***** | | 13.78 | **** | | |
| 0-60 60 -120 121-180 | **potassium** | 75.55 | *** | | 231.47 | ***** | | 363.83 | ***** | | 283.16 | ***** | | |
| 0 - 4 4 - 10 over 10 | **iron** | 25.92 | ***** | | 38.33 | ***** | | 145.57 | ***** | | 17.89 | ***** | | |
| 0- 0.5 0.6- 1 over 1 | **manganese** | 15.93 | ***** | | 12.64 | ***** | | 37.48 | ***** | | 2.29 | **** | | |
| 0 - 1 1 - 1.5 over 1.5 | **zinc** | 3.16 | **** | | 4.29 | **** | | 18.21 | ***** | | 1.97 | **** | | |
| 0- 0.2 0.3- 0.5 over 0.5 | **copper** | 2.83 | **** | | 9.04 | ***** | | 18.19 | ***** | | 3.82 | ***** | | |
| 0- 0.2 0.2- 0.5 over 1 | **boron** | 0.31 | *** | | 0.97 | **** | | 1.25 | ***** | | 1.07 | ***** | | |
| ratio of calcium to magnesium | **calcium** | 480.52 | **** | | 492.62 | **** | | 1,600.92 | ***** | | 296.57 | *** | | |
| needs to be more than 2 or 3 | **magnesium** | 157.34 | ***** | | 1,461.60 | ***** | | 1,530.30 | ***** | | 965.48 | ***** | | |
| should be less than potassium | **sodium** | 476.34 | ***** | | 5,150.42 | ***** | | 4,097.66 | ***** | | 4,872.64 | ***** | | |
| | **sulfur** | 470.01 | **** | | 477.39 | **** | | 408.99 | **** | | 844.33 | ***** | | |
| | **molybdenum** | 0.03 | *** | | n d | * | | 0.15 | **** | | 0.08 | *** | | |
| | **nickel** | 0.22 | * | | 0.27 | * | | 0.37 | * | | 0.14 | * | | |
| **The following trace** | **aluminum** | n d | * | | n d | * | | 5.77 | **** | | n d | * | | |
| **elements may be toxic** | **arsenic** | 0.13 | * | | 0.07 | * | | n d | * | | 0.16 | * | | |
| **The degree of toxicity** | **barium** | 1.47 | * | | 0.71 | * | | 1.77 | * | | 0.46 | * | | |
| **depends upon the pH of** | **cadmium** | 0.04 | * | | 0.13 | * | | 0.18 | * | | 0.07 | * | | |
| **the soil, soil texture,** | **chromium** | 0.08 | * | | 0.04 | * | | 0.13 | * | | n d | * | | |
| **organic matter, and the** | **cobalt** | 0.25 | * | | 0.14 | * | | 0.40 | * | | 0.06 | * | | |
| **concentrations of the** | **lead** | 2.58 | ** | | 3.81 | ** | | 5.54 | *** | | 6.19 | *** | | |
| **individual elements as well** | **lithium** | 0.21 | * | | 0.27 | * | | 0.76 | * | | 0.27 | * | | |
| **as to their interactions** | **mercury** | n d | * | | n d | * | | n d | * | | n d | * | | |
| | **selenium** | n d | * | | 0.03 | * | | n d | * | | 0.15 | * | | |
| **The pH optimum depends** | **silver** | n d | * | | n d | * | | n d | * | | n d | * | | |
| **upon soil organic** | **strontium** | 1.49 | * | | 5.40 | ** | | 12.73 | ** | | 2.58 | * | | |
| **matter and clay content-** | **tin** | 0.01 | * | | 0.02 | * | | 0.10 | * | | 0.01 | * | | |
| **for clay and loam soils:** | **vanadium** | 0.40 | * | | 0.45 | * | | 1.13 | ** | | 0.51 | * | | |
| **under 5.2 is too acidic** | | | | | | | | | | | | | | |
| **6.5 to 7 is ideal** | **Saturation Extract** | | | | | | | | | | | | | |
| **over 8.0 is too alkaline** | **pH value** | 7.24 | *** | | 7.16 | *** | | 7.21 | *** | | 7.06 | *** | | |
| **The ECe is a measure of** | **ECe (milli-** | 9.52 | ***** | | 25.60 | ***** | | 16.29 | ***** | | 36.20 | ***** | | |
| **the soil salinity:** | **mho/cm)** | | | millieq/l | | | millieq/l | | | millieq/l | | | millieq/l | |
| **1-2 affects a few plants** | **calcium** | 940.4 | | 47.0 | 1,410.8 | | 70.5 | 777.1 | | 38.9 | 1,748.1 | | 87.4 | |
| **2-4 affects some plants,** | **magnesium** | 271.4 | | 22.4 | 1,316.6 | | 108.8 | 605.9 | | 50.1 | 1,454.2 | | 120.2 | |
| **> 4 affects many plants.** | **sodium** | 1,010.1 | | 43.9 | 3,795.2 | | 165.0 | 2,455.1 | | 106.7 | 5,754.1 | | 250.2 | |
| | **potassium** | 26.4 | | 0.7 | 93.6 | | 2.4 | 92.8 | | 2.4 | 136.8 | | 3.5 | |
| | **cation sum** | | | 114.0 | | | 346.8 | | | 198.0 | | | 461.3 | |
| **problems over 150 ppm** | **chloride** | 2,924 | | 82.4 | 10,769 | | 303.4 | 6,031 | | 169.9 | 14,927 | | 420.5 | |
| **good 20 - 30 ppm** | **nitrate as N** | 16 | | 1.1 | 69 | | 4.9 | 43 | | 3.0 | 92 | | 6.6 | |
| | **phosphorus as P** | 0.7 | | 0.0 | 3.7 | | 0.1 | 2.0 | | 0.1 | 1.9 | | 0.1 | |
| **toxic over 800** | **sulfate as S** | 520.0 | | 32.5 | 409.0 | | 25.6 | 188.8 | | 11.8 | 593.6 | | 37.1 | |
| | **anion sum** | | | 116.0 | | | 333.9 | | | 184.8 | | | 464.2 | |
| **toxic over 1 for many plants** | **boron as B** | 0.29 | ** | | 0.54 | *** | | 0.79 | *** | | 1.07 | ***** | | |
| **increasing problems start at 3** | **SAR** | 7.5 | **** | | 17.5 | ***** | | 16.0 | ***** | | 24.6 | ***** | | |
| **est. gypsum requirement-lbs./1000 sq. ft.** | | 81 | | | 1275 | | | 1119 | | | 1064 | | | |
| | **relative infiltration rate** | fair | | | fair | | | fair | | | fair/slow | | | |
| | **estimated soil texture** | sandy loam | | | loam | | | loam | | | sandy loam | | | |
| | **lime (calcium carbonate)** | low | | | yes | | | low | | | yes | | | |
| | **organic matter** | 2.09% | | | 13.23% | | | 26.20% | | | 4.06% | | | |
| | **moisture content of soil** | 16.1% | | | 38.1% | | | 104.7% | | | 22.2% | | | |
| | **half saturation percentage** | 14.2% | | | 44.9% | | | 103.1% | | | 21.8% | | | |

**Elements are expressed as mg/kg dry soil or mg/l for saturation extract.**

**pH and ECe are measured in a saturation paste/extract. nd means not detected.**

**TABLE 1**

**Agronomic Analysis Results**
**For Samples Collected on February 20, 2009**

| | | | | | |
|---|---|---|---|---|---|
| **WALLACE LABS** | **SOILS REPORT** | Print Date | Feb. 25, 2009 | Receive Date | Feb. 24, 2009 |
| **365 Coral Circle** | Location | Seal Beach, Samples Collected 2/20/2009 | | | |
| **El Segundo, CA 90245** | Requester | Tetra Tech EC, Inc. | | | |
| **(310) 615-0116** | | | | | |

**ammonium bicarbonate/DTPA** — graphic interpretation: * very low, ** low, *** moderate, * * * * high, * * * * * very high

| extractable - mg/kg soil | Sample ID Number | 09-55A-17 | | 09-55A-18 | | 09-55A-19 | | 09-55A-20 | |
|---|---|---|---|---|---|---|---|---|---|
| Interpretation of data | | B-5 | | B-6 | | B-7 | | B-8 | |
| low medium high | **elements** | | graphic | | graphic | | graphic | | graphic |
| 0 - 7 8-15 over 15 | **phosphorus** | 85.49 | ***** | 107.61 | ***** | 41.94 | ***** | 75.57 | ***** |
| 0-60 60 -120 121-180 | **potassium** | 475.41 | ***** | 382.08 | ***** | 302.83 | ***** | 306.79 | ***** |
| 0 - 4 4 - 10 over 10 | **iron** | 205.63 | ***** | 165.29 | ***** | 102.02 | ***** | 169.06 | ***** |
| 0- 0.5 0.6- 1 over 1 | **manganese** | 53.35 | ***** | 30.09 | ***** | 28.97 | ***** | 51.82 | ***** |
| 0 - 1 1 - 1.5 over 1.5 | **zinc** | 28.14 | ***** | 11.36 | ***** | 6.96 | **** | 27.25 | ***** |
| 0- 0.2 0.3- 0.5 over 0.5 | **copper** | 19.73 | ***** | 14.75 | ***** | 10.63 | ***** | 21.42 | ***** |
| 0- 0.2 0.2- 0.5 over 1 | **boron** | 0.59 | **** | 0.22 | *** | 1.60 | ***** | 0.88 | **** |
| ratio of calcium to magnesium | **calcium** | 955.99 | ***** | 1,280.59 | ***** | 462.81 | **** | 897.63 | ***** |
| needs to be more than 2 or 3 | **magnesium** | 2,305.43 | ***** | 668.12 | ***** | 1,162.41 | ***** | 1,481.46 | ***** |
| should be less than potassium | **sodium** | 14,910.15 | ***** | 2,014.22 | ***** | 7,495.04 | ***** | 9,110.68 | ***** |
| | **sulfur** | 446.47 | **** | 109.54 | ** | 857.54 | ***** | 356.89 | *** |
| | **molybdenum** | 0.11 | **** | n d | * | 0.13 | **** | 0.09 | *** |
| | **nickel** | 0.36 | * | 0.19 | * | 0.32 | * | 0.28 | * |
| **The following trace** | **aluminum** | 4.95 | **** | 8.69 | **** | 1.08 | *** | 7.75 | **** |
| **elements may be toxic** | **arsenic** | 0.16 | * | 0.04 | * | 0.17 | * | n d | * |
| **The degree of toxicity** | **barium** | 0.91 | * | 2.55 | * | 0.50 | * | 1.04 | * |
| **depends upon the pH of** | **cadmium** | 0.20 | * | 0.11 | * | 0.09 | * | 0.12 | * |
| **the soil, soil texture,** | **chromium** | 0.13 | * | 0.09 | * | 0.05 | * | 0.13 | * |
| **organic matter, and the** | **cobalt** | 0.49 | * | 0.40 | * | 0.28 | * | 0.58 | ** |
| **concentrations of the** | **lead** | 6.28 | *** | 2.70 | ** | 14.19 | *** | 5.53 | *** |
| **individual elements as well** | **lithium** | 0.50 | * | 0.58 | * | 0.28 | * | 0.41 | * |
| **as to their interactions** | **mercury** | n d | * | n d | * | n d | * | n d | * |
| | **selenium** | 0.06 | * | 0.07 | * | n d | * | n d | * |
| **The pH optimum depends** | **silver** | n d | * | n d | * | n d | * | n d | * |
| **upon soil organic** | **strontium** | 10.23 | ** | 8.46 | ** | 4.64 | * | 9.06 | ** |
| **matter and clay content-** | **tin** | 0.10 | * | 0.09 | * | 0.03 | * | n d | * |
| **for clay and loam soils:** | **vanadium** | 0.69 | * | 0.89 | * | 0.88 | * | 1.10 | ** |
| **under 5.2 is too acidic** | | | | | | | | | |
| **6.5 to 7 is ideal** | **Saturation Extract** | | | | | | | | |
| **over 8.0 is too alkaline** | **pH value** | 6.98 | *** | 7.24 | *** | 6.95 | *** | 7.03 | *** |
| **The ECe is a measure of** | **ECe (milli-** | 24.70 | ***** | 4.68 | ***** | 26.70 | ***** | 18.70 | ***** |
| **the soil salinity:** | **mho/cm)** | | millieq/l | | millieq/l | | millieq/l | | millieq/l |
| **1-2 affects a few plants** | **calcium** | 923.8 | 46.2 | 163.5 | 8.2 | 1,329.1 | 66.5 | 777.3 | 38.9 |
| **2-4 affects some plants,** | **magnesium** | 803.0 | 66.4 | 126.2 | 10.4 | 914.0 | 75.5 | 571.7 | 47.2 |
| **> 4 affects many plants.** | **sodium** | 4,062.8 | 176.6 | 683.9 | 29.7 | 4,587.1 | 199.4 | 2,968.0 | 129.0 |
| | **potassium** | 105.2 | 2.7 | 44.0 | 1.1 | 109.4 | 2.8 | 78.2 | 2.0 |
| | **cation sum** | | 291.9 | | 49.5 | | 344.2 | | 217.2 |
| **problems over 150 ppm** | **chloride** | 9,753 | 274.7 | 1,656 | 46.7 | 10,478 | 295.2 | 6,886 | 194.0 |
| **good 20 - 30 ppm** | **nitrate as N** | 70 | 5.0 | 11 | 0.8 | 65 | 4.7 | 48 | 3.4 |
| | **phosphorus as P** | 2.6 | 0.1 | 2.1 | 0.1 | 3.0 | 0.1 | 4.6 | 0.1 |
| **toxic over 800** | **sulfate as S** | 191.9 | 12.0 | 34.8 | 2.2 | 582.5 | 36.4 | 144.5 | 9.0 |
| | **anion sum** | | 291.8 | | 49.7 | | 336.3 | | 206.5 |
| **toxic over 1 for many plants** | **boron as B** | 0.54 | *** | 0.15 | * | 1.42 | ***** | 0.47 | *** |
| **increasing problems start at 3** | **SAR** | 23.6 | ***** | 9.8 | ***** | 23.7 | ***** | 19.7 | ***** |
| **est. gypsum requirement-lbs./1000 sq. ft.** | | 3213 | | 480 | | 1575 | | 1955 | |
| | **relative infiltration rate** | fair | | fair | | fair/good | | fair | |
| | **estimated soil texture** | loam | | loam | | loam | | loam | |
| | **lime (calcium carbonate)** | no | | no | | slight | | no | |
| | **organic matter** | 27.07% | | 24.81% | | 12.69% | | 32.57% | |
| | **moisture content of soil** | 103.0% | | 85.7% | | 60.1% | | 120.3% | |
| | **half saturation percentage** | 106.2% | | 99.2% | | 57.7% | | 112.5% | |

**Elements are expressed as mg/kg dry soil or mg/l for saturatio**
**pH and ECe are measured in a saturation paste/extract. nd mea**

**TABLE 1**

**Agronomic Analysis Results**
**For Samples Collected on February 20, 2009**

| | | | | | |
|---|---|---|---|---|---|
| **WALLACE LABS** | **SOILS REPORT** | Print Date | Feb. 25, 2009 | Receive Date | Feb. 24, 2009 |
| **365 Coral Circle** | Location | Seal Beach, Samples Collected 2/20/2009 | | | |
| **El Segundo, CA 90245** | Requester | Tetra Tech EC, Inc. | | | |
| **(310) 615-0116** | | | | | |

**ammonium bicarbonate/DTPA** — graphic interpretation: * very low, ** low, *** moderate, * * * * high, * * * * * very high

| extractable - mg/kg soil | Sample ID Number | 09-55A-21 | | 09-55A-22 | | 09-55A-23 | | 09-55A-24 | |
|---|---|---|---|---|---|---|---|---|---|
| Interpretation of data | | B-9 | | B-10 | | B-11 | | B-12 | |
| low medium high | **elements** | | graphic | | graphic | | graphic | | graphic |
| 0 - 7 8-15 over 15 | **phosphorus** | 13.36 | **** | 43.40 | ***** | 34.84 | ***** | 73.94 | ***** |
| 0-60 60 -120 121-180 | **potassium** | 316.93 | ***** | 449.18 | ***** | 397.07 | ***** | 354.81 | ***** |
| 0 - 4 4 - 10 over 10 | **iron** | 22.13 | ***** | 92.86 | ***** | 41.96 | ***** | 114.70 | ***** |
| 0- 0.5 0.6- 1 over 1 | **manganese** | 5.93 | **** | 64.43 | ***** | 19.48 | ***** | 47.72 | ***** |
| 0 - 1 1 - 1.5 over 1.5 | **zinc** | 2.40 | **** | 9.68 | **** | 8.84 | **** | 26.53 | ***** |
| 0- 0.2 0.3- 0.5 over 0.5 | **copper** | 4.13 | ***** | 15.46 | ***** | 9.31 | ***** | 20.04 | ***** |
| 0- 0.2 0.2- 0.5 over 1 | **boron** | 1.07 | ***** | 0.93 | **** | 0.80 | **** | 0.89 | **** |
| ratio of calcium to magnesium | **calcium** | 387.79 | *** | 589.73 | **** | 431.86 | **** | 871.50 | ***** |
| needs to be more than 2 or 3 | **magnesium** | 425.12 | ***** | 2,278.41 | ***** | 1,753.06 | ***** | 1,580.81 | ***** |
| should be less than potassium | **sodium** | 1,242.67 | ***** | 12,124.15 | ***** | 9,149.49 | ***** | 10,343.67 | ***** |
| | **sulfur** | 657.46 | **** | 618.39 | **** | 559.82 | **** | 481.81 | **** |
| | **molybdenum** | 0.07 | *** | 0.09 | *** | 0.12 | **** | 0.07 | *** |
| | **nickel** | 0.31 | * | 0.31 | * | 0.20 | * | 0.35 | * |
| **The following trace** | **aluminum** | n d | * | n d | * | n d | * | 3.52 | **** |
| **elements may be toxic** | **arsenic** | 0.18 | * | 0.14 | * | 0.05 | * | 0.08 | * |
| **The degree of toxicity** | **barium** | 0.49 | * | 0.71 | * | 0.62 | * | 0.81 | * |
| **depends upon the pH of** | **cadmium** | 0.04 | * | 0.21 | * | 0.14 | * | 0.17 | * |
| **the soil, soil texture,** | **chromium** | 0.01 | * | 0.12 | * | 0.03 | * | 0.12 | * |
| **organic matter, and the** | **cobalt** | 0.07 | * | 0.42 | * | 0.18 | * | 0.38 | * |
| **concentrations of the** | **lead** | 7.55 | *** | 3.34 | ** | 5.45 | *** | 5.92 | *** |
| **individual elements as well** | **lithium** | 0.26 | * | 0.31 | * | 0.23 | * | 0.41 | * |
| **as to their interactions** | **mercury** | n d | * | n d | * | n d | * | n d | * |
| | **selenium** | n d | * | n d | * | n d | * | n d | * |
| **The pH optimum depends** | **silver** | n d | * | n d | * | n d | * | n d | * |
| **upon soil organic** | **strontium** | 2.69 | * | 8.09 | ** | 5.06 | ** | 9.16 | ** |
| **matter and clay content-** | **tin** | 0.04 | * | 0.06 | * | 0.02 | * | 0.03 | * |
| **for clay and loam soils:** | **vanadium** | 0.69 | * | 1.01 | ** | 0.48 | * | 0.79 | * |
| **under 5.2 is too acidic** | | | | | | | | | |
| **6.5 to 7 is ideal** | **Saturation Extract** | | | | | | | | |
| **over 8.0 is too alkaline** | **pH value** | 7.31 | *** | 6.97 | *** | 6.77 | *** | 7.04 | *** |
| **The ECe is a measure of** | **ECe (milli-** | 10.63 | ***** | 31.20 | ***** | 38.10 | ***** | 15.56 | ***** |
| **the soil salinity:** | **mho/cm)** | | millieq/l | | millieq/l | | millieq/l | | millieq/l |
| **1-2 affects a few plants** | **calcium** | 603.3 | 30.2 | 1,538.1 | 76.9 | 1,904.2 | 95.2 | 561.3 | 28.1 |
| **2-4 affects some plants,** | **magnesium** | 289.4 | 23.9 | 1,219.4 | 100.8 | 1,484.4 | 122.7 | 482.5 | 39.9 |
| **> 4 affects many plants.** | **sodium** | 1,781.8 | 77.5 | 4,851.1 | 210.9 | 6,073.9 | 264.1 | 2,706.8 | 117.7 |
| | **potassium** | 64.0 | 1.6 | 137.6 | 3.5 | 146.9 | 3.8 | 71.1 | 1.8 |
| | **cation sum** | | 133.2 | | 392.1 | | 485.7 | | 187.5 |
| **problems over 150 ppm** | **chloride** | 2,888 | 81.3 | 12,649 | 356.3 | 15,834 | 446.0 | 5,674 | 159.8 |
| **good 20 - 30 ppm** | **nitrate as N** | 22 | 1.6 | 69 | 4.9 | 110 | 7.9 | 38 | 2.7 |
| | **phosphorus as P** | 0.0 | 0.0 | 2.6 | 0.1 | 5.0 | 0.2 | 3.0 | 0.1 |
| **toxic over 800** | **sulfate as S** | 494.8 | 30.9 | 413.2 | 25.8 | 451.2 | 28.2 | 170.1 | 10.6 |
| | **anion sum** | | 113.9 | | 387.1 | | 482.2 | | 173.2 |
| **toxic over 1 for many plants** | **boron as B** | 0.76 | *** | 0.25 | ** | 0.22 | ** | 0.79 | *** |
| **increasing problems start at 3** | **SAR** | 14.9 | ***** | 22.4 | ***** | 25.3 | ***** | 20.2 | ***** |
| **est. gypsum requirement-lbs./1000 sq. ft.** | | 269 | | 2730 | | 2051 | | 2198 | |
| | **relative infiltration rate** | slow/fair | | fair/slow | | fair | | fair/slow | |
| | **estimated soil texture** | clay | | loam | | loam | | loam | |
| | **lime (calcium carbonate)** | yes | | no | | slight | | slight | |
| | **organic matter** | 3.39% | | 20.87% | | 17.01% | | 26.26% | |
| | **moisture content of soil** | 25.7% | | 75.8% | | 49.7% | | 96.5% | |
| | **half saturation percentage** | 26.3% | | 75.4% | | 51.2% | | 114.4% | |

**Elements are expressed as mg/kg dry soil or mg/l for saturatio**
**pH and ECe are measured in a saturation paste/extract. nd mea**

**TABLE 1**

**Agronomic Analysis Results**
**For Samples Collected on February 20, 2009**

| | | | | | |
|---|---|---|---|---|---|
| **WALLACE LABS** | **SOILS REPORT** | Print Date | Feb. 25, 2009 | Receive Date | Feb. 24, 2009 |
| **365 Coral Circle** | Location | Seal Beach, Samples Collected 2/20/2009 | | | |
| **El Segundo, CA 90245** | Requester | Tetra Tech EC, Inc. | | | |
| **(310) 615-0116** | | | | | |

**ammonium bicarbonate/DTPA** — graphic interpretation: * very low, ** low, *** moderate, * * * * high, * * * * * very high

| extractable - mg/kg soil | Sample ID Number | 09-55A-25 | | 09-55A-26 | | 09-55A-27 | | 09-55A-28 | |
|---|---|---|---|---|---|---|---|---|---|
| Interpretation of data | | B-13 | | B-14 | | B-15 | | B-16 | |
| low medium high | **elements** | | graphic | | graphic | | graphic | | graphic |
| 0 - 7 8-15 over 15 | **phosphorus** | 82.58 | ***** | 67.69 | ***** | 8.36 | *** | 11.50 | *** |
| 0-60 60 -120 121-180 | **potassium** | 779.76 | ***** | 897.04 | ***** | 224.78 | ***** | 243.36 | ***** |
| 0 - 4 4 - 10 over 10 | **iron** | 233.19 | ***** | 181.70 | ***** | 6.14 | *** | 10.04 | **** |
| 0- 0.5 0.6- 1 over 1 | **manganese** | 54.15 | ***** | 79.90 | ***** | 10.58 | ***** | 1.26 | **** |
| 0 - 1 1 - 1.5 over 1.5 | **zinc** | 10.70 | ***** | 13.44 | ***** | 11.80 | ***** | 1.72 | **** |
| 0- 0.2 0.3- 0.5 over 0.5 | **copper** | 12.54 | ***** | 18.78 | ***** | 7.45 | ***** | 2.56 | **** |
| 0- 0.2 0.2- 0.5 over 1 | **boron** | 3.50 | ***** | 1.71 | ***** | 0.74 | **** | 1.15 | ***** |
| ratio of calcium to magnesium | **calcium** | 1,080.06 | ***** | 889.25 | ***** | 298.69 | *** | 394.16 | *** |
| needs to be more than 2 or 3 | **magnesium** | 3,210.32 | ***** | 3,220.74 | ***** | 1,899.71 | ***** | 357.92 | ***** |
| should be less than potassium | **sodium** | 22,286.70 | ***** | 23,180.51 | ***** | 4,430.59 | ***** | 2,704.66 | ***** |
| | **sulfur** | 774.23 | **** | 1,626.80 | ***** | 949.44 | ***** | 1,446.55 | ***** |
| | **molybdenum** | n d | * | 0.11 | **** | 0.02 | *** | 0.08 | *** |
| | **nickel** | 0.19 | * | 0.36 | * | 0.41 | * | 0.09 | * |
| **The following trace** | **aluminum** | 12.76 | **** | 0.44 | * | n d | * | n d | * |
| **elements may be toxic** | **arsenic** | n d | * | 0.23 | * | 0.11 | * | 0.19 | * |
| **The degree of toxicity** | **barium** | 1.22 | * | 0.48 | * | 0.51 | * | 0.77 | * |
| **depends upon the pH of** | **cadmium** | 0.18 | * | 0.30 | * | 0.18 | * | 0.04 | * |
| **the soil, soil texture,** | **chromium** | 0.07 | * | 0.16 | * | 0.04 | * | 0.01 | * |
| **organic matter, and the** | **cobalt** | 0.48 | * | 0.76 | ** | 0.10 | * | 0.04 | * |
| **concentrations of the** | **lead** | 3.07 | ** | 5.68 | *** | 11.41 | *** | 5.41 | *** |
| **individual elements as well** | **lithium** | 0.62 | * | 0.51 | * | 0.21 | * | 0.21 | * |
| **as to their interactions** | **mercury** | n d | * | n d | * | n d | * | n d | * |
| | **selenium** | 0.14 | * | n d | * | n d | * | n d | * |
| **The pH optimum depends** | **silver** | n d | * | n d | * | n d | * | n d | * |
| **upon soil organic** | **strontium** | 12.98 | ** | 10.57 | ** | 4.11 | * | 2.80 | * |
| **matter and clay content-** | **tin** | n d | * | 0.06 | * | 0.03 | * | 0.03 | * |
| **for clay and loam soils:** | **vanadium** | 1.55 | ** | 1.39 | ** | 0.36 | * | 0.43 | * |
| **under 5.2 is too acidic** | | | | | | | | | |
| **6.5 to 7 is ideal** | **Saturation Extract** | | | | | | | | |
| **over 8.0 is too alkaline** | **pH value** | 6.74 | *** | 6.81 | *** | 7.13 | *** | 7.51 | **** |
| **The ECe is a measure of** | **ECe (milli-** | 33.30 | ***** | 59.20 | ***** | 48.10 | ***** | 16.75 | ***** |
| **the soil salinity:** | **mho/cm)** | | millieq/l | | millieq/l | | millieq/l | | millieq/l |
| **1-2 affects a few plants** | **calcium** | 946.3 | 47.3 | 2,421.3 | 121.1 | 2,507.7 | 125.4 | 723.1 | 36.2 |
| **2-4 affects some plants,** | **magnesium** | 1,313.0 | 108.5 | 2,121.5 | 175.3 | 3,576.4 | 295.6 | 405.7 | 33.5 |
| **> 4 affects many plants.** | **sodium** | 6,799.0 | 295.6 | 10,117.3 | 439.9 | 6,084.1 | 264.5 | 2,976.6 | 129.4 |
| | **potassium** | 186.8 | 4.8 | 344.5 | 8.8 | 144.2 | 3.7 | 78.1 | 2.0 |
| | **cation sum** | | 456.2 | | 745.1 | | 689.2 | | 201.1 |
| **problems over 150 ppm** | **chloride** | 15,225 | 428.9 | 25,760 | 725.6 | 21,753 | 612.8 | 4,831 | 136.1 |
| **good 20 - 30 ppm** | **nitrate as N** | 94 | 6.7 | 176 | 12.6 | 258 | 18.4 | 37 | 2.7 |
| | **phosphorus as P** | 4.5 | 0.1 | 4.6 | 0.1 | 0.9 | 0.0 | 2.1 | 0.1 |
| **toxic over 800** | **sulfate as S** | 384.2 | 24.0 | 716.2 | 44.8 | 525.2 | 32.8 | 749.4 | 46.8 |
| | **anion sum** | | 459.8 | | 783.2 | | 664.0 | | 185.7 |
| **toxic over 1 for many plants** | **boron as B** | 1.42 | ***** | 1.42 | ***** | 0.63 | *** | 0.69 | *** |
| **increasing problems start at 3** | **SAR** | 33.6 | ***** | 36.2 | ***** | 18.3 | ***** | 22.0 | ***** |
| **est. gypsum requirement-lbs./1000 sq. ft.** | | 4766 | | 4921 | | 1298 | | 495 | |
| | **relative infiltration rate** | fair | | fair/good | | fair | | fair | |
| | **estimated soil texture** | loam | | loam | | sandy loam | | sandy loam | |
| | **lime (calcium carbonate)** | slight | | no | | yes | | low | |
| | **organic matter** | 36.12% | | 23.78% | | 3.90% | | 2.94% | |
| | **moisture content of soil** | 175.0% | | 118.0% | | 11.5% | | 21.5% | |
| | **half saturation percentage** | 123.4% | | 89.4% | | 16.0% | | 20.1% | |

**Elements are expressed as mg/kg dry soil or mg/l for saturatio**
**pH and ECe are measured in a saturation paste/extract. nd mea**