CURRENT ENVIRONMENTAL SOLUTIONS

SITE MANAGEMENT PLAN
IN-SITU THERMAL TREATMENT
FRONTIER FERTILIZER NPL SITE
Davis, CA

Submittal #0007.SMP
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Revision 3 Final RAMP

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FRONTIER FERTILIZER NPL SITE
Davis, CA
Revision 3: Final RAMP

Table of Contents

1.0 INTRODUCTION 1
2.0 SYNOPSIS OF THE ISTT PROJECT 3
2.1 Geology and Hydrogeology 3
2.2 Nature and Extent of Contamination 4
2.3 Contaminant Fate & Transport 5
2.4 Stakeholders 5
2.5 Project Objectives 5
2.6 ISTT System Description & Principles of Operation 9
2.7 Remedial Action Management Plan (RAMP) 11
2.8 Personnel Roles and Responsibilities 11
2.9 General Conditions of the Contract 14
3.0 PROJECT SCHEDULE 17
4.0 PLANS & SUBMITTALS 18
4.1 Engineering Design 18
4.2 Site Specific Health and Safety Plan 18
4.3 Environmental Protection Plan (EPP) 19
4.4 Sampling and Analysis Plan (SAP) 20
4.5 Subcontractor Quality Control Plan (SQC) 20
4.6 Waste Management Plan (WMP) 21
4.7 Process Monitoring Plan 21
4.8 Operations and Maintenance Plan (O&M Plan) 22
5.0 INSTALLATION OF PRELIMINARY MONITORING POINTS 24
5.1 Site Preparation, Survey, Permitting 24
5.2 Mobilization and Set-Up of Temporary Facilities 24
5.3 Drilling and Installation 25
6.0 ISTT REMEDY IMPLEMENTATION 28
6.1 Site Layout 28
6.2 Site Mobilization, Preparation, Surveying 28
6.3 Permitting 29
6.4 Site Security 29
6.5 Utilities 29
6.6 Abandonment of Existing Facilities 31
6.7 Heating Electrode, Vent and Temperature Monitoring Points 34
6.8 Soil Gas and Groundwater Components 36
6.9 Temperature Monitoring Points (TMP) 36
6.10 ERH System Construction and Controls 36
6.11 SVE Construction and Controls 38
6.12 Site Cap 40
6.13 System Testing and Commissioning 40
6.14 Operations & Maintenance (O&M) 40
6.15 Process Monitoring and Performance Testing 42

6.16 Process Data Collection and Distribution 43
6.17 Sampling and Analysis 44
6.18 Regulatory Compliance 44
6.19 Management of Fugitive Emissions 44
6.20 Contingency Management Plan 45
6.21 Reporting Plan 45
7.0 CONSTRUCTION QUALITY CONTROL PROCEDURES 46
7.1 Three Phases of Control 46
7.2 Receiving and Warehousing 47
7.3 QC Inspection Phases 47
7.4 QC Testing 48
7.5 Off-Site Control 49
7.6 Surveillance of Subcontractors' Operations 49
7.7 Completion of Work 49
7.8 Final Inspection and Test 50
8.0 PROTECTION OF HUMAN HEALTH AND ENVIRONMENT 51
8.1 Site Heath and Safety Plan (HASP) 51
8.2 Methods to Minimize Impact to Public and Environment 51
8.3 Management of Fugitive Emissions 51
8.4 Monitoring Offsite Migration 52
8.5 Waste Minimization 52
8.6 Groundwater Control 52
9.0 SYSTEM DEMOBILIZATION 53
9.1 Abandonment of ISTT Subsurface Components 53
10.0 PROJECT CLOSEOUT 54
10.1 Closeout Procedures 54

Tables

Table SMP-1 : Compounds of Concern (COCs) [in text]
Table SMP-2 : Concentration Criteria [in text]
Table SMP-3 : Preliminary Monitoring Points [Tables Tab]
Table SMP-4: Subsurface Utilities Abandonment Plan (in text)
Table SMP-5 : Pre-Commissioning Checklist [Tables Tab]
Table SMP-6 : Daily Log [Tables Tab]

Figures

Figure 1: Site Layout
Figure 2: Utility Location
Figure 3A-H: Electrode Designs, all zones
Figure 4A-B Temperature Monitoring Points, all zones
Figure 5: Site Cap

Appendices

Appendix A: Project Schedule
Appendix B: "Underground Utilities & Known Obstructions" CH2M Hill Figure

ABBREVIATIONS AND ACRONYMS

AMP	Ampere
APCD	Air Pollution Control District
BGS(or bgs)	Below Ground Surface
BMP	Best Management Practice
BTV	Base Treatment Volume
Cal/EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CEM	Continuous Emissions Monitor
CIH	Certified Industrial Hygienist
CFR	Code of Federal Regulations
CLIN	Contract Line Item Number
CMP	Contingency Management Plan
COC	Compound of Concern
CTO	Contract Task Order
DCDQCR	Daily Chemical Data Quality Control Report
DOT	Department of Transportation
DNAPL	Dense Non-Aqueous Phase Liquid
DQO	Data Quality Objectives
DTSC	Department of Toxic Substances Control
DTV	Designated Treatment Volume
DVE	Dual (Phase) Vacuum Extraction
EPA	(United States) Environmental Protection Agency
EPP	Environmental Protection Plan
ERH	Electric Resistance Heating
ESQ	Environmental, Safety, and Quality
EW	Groundwater Extraction Well
FRP	Fiberglass Reinforced Plastic
FS	Feasibility Study
FSP	Field Sampling Plan
FSS	Field Services Supervisor
GAC	Granular Activated Carbon

GPW	Groundwater Pumping Wells
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
HP	Horsepower
HSVE	Horizontal Soil Vacuum Extraction
ID	Inside Diameter
ISTT	In-Situ Thermal Treatment
LDR	Land Disposal Restriction
LEL	Lower Explosion Limit
LPGAC	Liquid Phase Granular Activated Carbon
MSB	Meter Stand Base
MW	Monitoring Well
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OD	Outside Diameter
OMP	Operation and Maintenance Plan
PC	Performance Criteria
PE	Professional Engineer
PG&E	Pacific Gas & Electric
PM	Project Manager
PMP	Process Monitoring Plan
PO	Purchase Order
PPE	Personal Protective Equipment
PSU	Power Supply Unit
PRG	Preliminary Remediation Goal
PWD	Public Works Department
QAPP	Quality Assurance Project Plan
RAMP	Remedial Action Management Plan
RCRA	Resource Conservation and Recovery Act
RDA	Remote Data Acquisition
RFP	Request For Proposal
RPM	Revolutions per Minute
RT(or FT)	Remediation Technician/Field Technician
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan

SCR	Silica Control Rectifier
SCADA	System Control and Data Acquisition
SPH	Six-Phase Heating
SSHO	Site Health and Safety Officer
STLC	Soluble Threshold Limit Concentration
SOP	Standard Operating Procedure
SMP	Site Management Plan
SQCC	Subcontractor Quality Control Plan
SVE	Soil Vacuum Extraction
SVOC	Semivolatile Organic Compound
TC	Thermocouple
TD	Total Depth
TCLP	Toxicity Characteristic Leaching Procedure
TMP	Temperature Monitoring Point
TPH	Total Petroleum Hydrocarbon
TSDF	Treatment, Storage, and Disposal Facility
TTLC	Total Threshold Limit Concentration
USDA	U.S. Department of Agriculture
VEU	Vacuum Extraction Unit
VOC	Volatile Organic Compound
VPGAC	Vapor Phase Granular Activated Carbon
VMP	Vapor Monitoring Piezometer
WMP	Waste Management Plan

SITE MANAGEMENT PLAN
IN-SITU THERMAL TREATMENT
FRONTIER FERTILIZER SUPERFUND SITE
DAVIS, CA

1.0 INTRODUCTION

The purpose of this Site Management Plan (SMP) is to provide an overall reference and guidance document for coordinating and implementing the Remedial Action Management Plan (RAMP) for the In-Situ Thermal Treatment (ISTT) at the Frontier Fertilizer NPL Site in Davis, California. This SMP is intended to comply with Specification 01400 Section 1.6 of the contract documents. Specific sections of this SMP will detail the performance criteria, site characteristics affecting ISTT, ISTT implementation logic steps and the impact on the project schedule per Specification Section 1.7, and key Subcontractor personnel, their responsibilities, and contact information. Moreover, this SMP will delineate the design, procurement, construction, operation and maintenance details necessary to plan, coordinate and implement ISTT. A complete set (both electronic and hard copy) of the Specifications shall be kept on-site for reference by field personnel.

Throughout this SMP, references are made to several other plans and design documents, which together with this SMP, comprise the complete RAMP.

This Site Management Plan (SMP) shall describe execution, scheduling, and control of the project to ensure that ISTT resources, materials, construction methods, and operation and maintenance (O&M) procedures result in the desired results and quality. Major activities to be described in this SMP include, but are not limited to:

- Synopsis of the Project
- Project objectives, personnel roles and responsibilities
- Define approach for implementing ISTT (base and optional items) by phase, category, and feature of work.
- General conditions of the Contract
- Submittals/implementation plans, including engineering design, remedy installation, and O&M
- Mobilization
- Site work and temporary facilities, including the requirements of Section 01500
- Furnishing and installing treatment system(s)
- Commissioning and testing of the treatment system
- O&M of remedy
- Performance testing
- Regulatory compliance
- Demobilization

- Proposed data deliverable formats with a description of the Subcontractor's strategy for data transmission and communication
- Proposed daily log format
- Weekly and monthly operations report outlines
- Details on the abandonment of wells installed specifically for treatment and monitoring of the remedy
- Project closeout

One of the major topics addressed in this SMP refers to the limitation of available electric power from within a reasonable timeframe that was imposed by the local utility, Pacific Gas and Electric (PG&E). In brief, the electric utility could only provide about half of the power required for Current Environmental Solutions (CES) to achieve the ISTT remedy according to the specifications. The Environmental Protection Agency (EPA), CH2M HILL and CES had numerous discussions between December 2008 and May 2010 regarding how to best utilize the available resources and what effects this may have on the specifications and the design. The primary focus of the discussion was how to remove as much mass of the Contaminants of Concern (COCs) as practical by efficient use of the available power and any budget constraints associated therewith. The service limitation was resolved in December 2009, and re-design of the ISTT system commenced in May 2010. A solar generation system has been installed for the EPA GW P&T system.

2.0 SYNOPSIS OF THE ISTT PROJECT

[Spec. 01400; 1.6.1]

The Frontier Fertilizer Site includes an 11.43 acre triangular parcel No 071-412-031 which is owned by Pine Tree Properties, and an adjacent 7-acre parcel that is part of a larger 10.98 acre property, known as the "Remainder Parcel." Previous land use circa 1970's and 80's included pesticide and fertilizer processing, storage and distribution. Rinsate from containers and tanks is the suspected cause of the subsurface contamination. EPA commenced groundwater pump and treat corrective actions in 1983 and 1994,and the groundwater is treated by granular activated carbon (GAC) prior to discharge to the City of Davis sanitary sewer system. More recent studies along with the documented successes of ISTT make this technology an attractive alternative for a permanent Site remedy.

2.1 Geology and Hydrogeology

The site is underlain by a heterogeneous mixture of gravel, sand, silt and clay of Quaternary alluvial origin. The upper 100 ft or so, and the main subject area for the ISTT remedy, is characterized by fine-grained deposits with discontinuous sand stringers to approximately 100 ft. below ground surface (bgs) while deeper horizons may reveal more contiguous sand units down to about 300 ft bgs. Subsurface investigations showed that COCs have been confined to the upper 155 ft bgs.

Water-bearing zones S-1, S-2, A-1, and A-2 characterize the shallow aquifer which is discontinuous and highly dependent on the presence of sand stringers. Zones S-1 and S-2 are targets for the existing pump and treat system and ISTT, yet these zones exhibit considerable variability in geophysical properties, such as vertical and horizontal permeability. Sampling and installation of the Preliminary Monitoring Components has provided EPA the opportunity to evaluate the geophysical characteristics of these zones in relation to the contaminant distribution therein such that final ISTT treatment volume has now been determined. Typical groundwater levels are 30 ft bgs in late summer and 10 ft bgs in late winter. Fluctuations are related to rain-dry seasonal fluctuations as well as agricultural irrigation.

The vadose zone extends from ground surface to between 10 and 30 ft bgs (season dependent). The shallowest water bearing zone, S-1, which extends from the piezometric surface to about 60 ft bgs, shows characteristic variability as hydraulic conductivities (K) have been measured in the range of 45 ft/day in some locations on site, though the portion of S-1 in the contaminant source area of the site has a significantly lower measured K in the range of 0.8 to 4.8 ft/day. Groundwater flows generally north-northeast. The next deeper water bearing zone, S-2, occurs from about 60 to 90 ft. bgs, and flows predominantly north-northeast like the S-1, albeit with slightly lower K which ranges from 0.2 to 3.7 ft/day. Present pumping affects the potentiometric surface in both the S-1 and S-2 zones. The A-1 zone extends from 90 to 140 ft bgs and is rather continuous across the general area of the Site. The A-1 is much more permeable than either the S-1 or S-2, having a K in the range of about 100 ft/day. Being a prolific water producer, this zone has a small gradient compared to the shallow zones, and it is popular for agricultural irrigation. The A-2 zone is also used for irrigation, but it occurs deeper than 140 ft bg and is not considered a target zone for this ISTT treatment.

2.2 Nature and Extent of Contamination

Elevated concentrations of the COCs and their daughter degradation compounds have been identified up to 95 ft bgs with the primary source zone from 0 to 40 ft bgs. Site investigations which commenced circa 1993 confirmed the subsurface contaminants were related to either pesticides or fertilizers. Soil samples and analytical results identified the former disposal basin as the primary source of contamination, with the highest COC concentrations occurring about 20 to 30 ft bgs and also some higher contaminated media between 60 to 80 ft bgs. It was theorized that the elevated groundwater concentrations in the S-2 zone resulted from the presence of Dense Non-Aqueous Phase Liquids (DNAPL), although the soil samples obtained from borings in this zone were not indicative of DNAPL. Nevertheless, the potential existence of DNAPL is expected, even though the petrophysical heterogeneity and analytical variability in the concentrations of the subsurface soils made the determination of DNAPL and contaminant mass difficult. Initial COC mass estimates were provided in Tables 1-2 to 1-5 of the Final Feasibility Study (RFP Folder 4/09_FS). Since then, mass estimates have been revised down, based on soil sample data from Preliminary Monitoring Point installation in the fall of 2008. Groundwater contamination is primarily found in the S-1 and S-2 zones. The main COCs are:

- 1,2-dibromo-3-dichloropropane (DBCP)
- 1,2-dibromoethane, {aka:“ethylene dibromide”} (EDB)
- 1,2-dichloropropane (DCP)
- 1,2,3- trichloropropane (TCP)

The following **Table SMP 1** summarizes the general occurrence and maximum concentrations of COCs historically detected in soil and groundwater (maximum groundwater concentrations have been updated with results for groundwater sampling of preliminary monitoring points in the treatment zone):

Table SMP-1
Compounds of Concern (COCs)

COC	MCL (ug/L)	Highest Groundwater Conc. (ug/L)	Soil Treatment Goal (mg/kg)	Highest Soil Conc. (mg/kg)
EDB	0.05	50,000	2.5	50,000
DCP	5	68,000	20	90,000
DBCP	0.2	800	10	1,000,000
TCP	0.005*	1,100	2.5	10,000

* Note: TCP concentration is reported as CA Dept. of Health Serv. Action Level. Detection limit was 0.5 ug/L).

2.3 Contaminant Fate & Transport

Factors relating to the fate and transport of the COCs in the subsurface involve a complex interaction of geophysical, physiochemical and biological phenomena in relation to the timing of the release of the compounds. The heterogeneity of the soils, variability of site hydrogeology and geochemistry, as well as the seasonal fluctuation of up to 20 ft in groundwater elevations, compounds the complexity and difficulty in defining the contaminant fate and transport. Specific contaminant properties: dissolution, diffusion, degradation (whether biological or abiotic through hydrolysis), all play a role in the contaminant distribution. As these primary COC compounds degrade, daughter products form, which interact differently with the properties of the subsurface media. Nevertheless, it is probable that certain degradation reactions, such as hydrolysis may be occurring at the site, and also probable that the rate of these reactions will benefit from heating via ISTT.

2.4 Stakeholders

The community of Davis is an active and sophisticated stakeholder in the Superfund process at this site. There is a great deal of interest on the part of the neighbors and developers to treat the source of the groundwater contamination, as they have watched interim measures and studies continue for two decades and supported a Brownfield Initiative Study as well. Community outreach in recent years has addressed many of the concerns of the past, and EPA is keenly aware of the importance of the ISTT to eliminate the ongoing source of groundwater contamination. ISTT promises to remove the vast majority of contaminant mass at the site and to significantly reduce the timeframe of groundwater pumping and treating. An important part of this project will be stakeholder outreach programs so the site can be remediated safely and effectively.

2.5 Project Objectives

The overall project objective is to safely treat the defined treatment volume as determined by EPA, using the ISTT technology known as “Electric Resistance Heating (ERH)” according to the performance standards while controlling all emissions and minimizing risk to human health and the environment. Contaminants shall be removed primarily by four mechanisms: 1) volatilization with ERH and vapor extraction, 2) groundwater extraction, 3) in-situ degradation by hydrolysis and 4) steam stripping. Contaminant mass balance is calculated based on initial average concentrations in

each soil layer and removed based on temperature dependent Henry's law partitioning and vapor extraction rates. The treatment area was revised after the installation of ISTT preliminary monitoring points in the Fall of 2008. The revised treatment area is shown in **Figure 1,** with the treatment zones defined by the black outlines. Certain treatment zones have been designated by CH2M Hill and EPA to target specific depth intervals (labeled 1 to 7), based on information obtained during the installation, as well as historical data.

After evaluating the preliminary soil sampling results, CH2M Hill and EPA revised the treatment volume of the source area into seven zones as follows:

- **5,270 ft^2** from 0 to 40 ft bgs in the center of the source zone containing the highest concentration of contaminants.
- **7,881** ft^2 from 0 to 80 ft bgs
- **1,140** ft^2 from 15 to 60 ft bgs
- **4,991** ft^2 from 15 to 80 ft bgs
- **1,106** ft^2 from 25 to 60 ft bgs
- **1,676** ft^2 from 25 to 80 ft bgs
- **1,722** ft^2 from 40 to 80 ft bgs

The total revised targeted heated volume is 52,478 yd^3. The ISTT design addresses that volume, but must heat a slightly larger volume due to the inherent requirements of the technology in terms of subsurface power density phase balancing, and electrode spacing. After detailed evaluations and several discussions (during February, March and April 2009) between CH2M Hill, EPA and CES regarding the power limitations and estimated treatment times for different volumes of soil, it was determined by CH2M Hill and EPA that boundary areas (i.e. the perimeter of the seven treatment areas) will not be required to reach the targeted treatment temperatures as this would require electrodes outside the perimeter, a much larger volume to be heated, and likewise, more time and power than was reasonably available. By mutual agreement, the ISTT design objective for this Final RAMP is to heat the target volume, and minimize additional volume that would otherwise be required to fully heat the perimeter, and CES will not be held responsible for performance specifications between the outer rows of electrodes and the treatment volume perimeter boundaries.

In reaching the concentration performance criteria there are two seemingly independent criteria: one for soil and the other for groundwater. These criteria are theoretically correlated, however, DBCP has the highest detected soil concentration (1,000,000 ug/kg in CPT-11 at about 25ft. deep) and the lowest maximum concentration in groundwater of the four COCs (800 ug/l). This difference cannot be explained by fate and transport mechanisms alone. In addressing various cost-effective treatment strategies, one must look at the maximum observed concentrations relative to performance criteria to determine the most cost effective approach and timeframe to achieve cleanup. Contaminant mass removal and costs are driven by the maximum concentrations observed at the site for each COC. These relative effects are summarized in **Table SMP-2** below:

Table SMP-2
Concentration Criteria & Clean-up

COC	Max. Soil Concentration (ug/kg)	Soil Cleanup Criteria (ug/kg)	Treatment Efficiency Required	Max. Groundwater Concentration (ug/l)	Groundwater Cleanup Criteria (ug/l)	GW Treatment Efficiency Required
EDB	50,000	2.5	98.995%	50,000	0.05	99.9999%
DCP	90,000	20	99.978%	68,000	5	99.99%
TCP	10,000	2.5	99.975%	1,100	0.5	99.95%
DBCP	1,000,000	10	99.999%	800	0.2	99.98%

A soil cleanup criterion pertains to the vadose zone to 10 feet bgs (ref. Record of Decision, Table 17, Remedial Action Objectives). Required treatment efficiencies and partition coefficients (Henry's constant)) predominately determine the rate limiting factors in meeting soil performance criteria at this site. Degradation rates (hydrolysis) may also play a roll. The most difficult criteria are those for DBCP, which has the lowest partition coefficient and least likely to hydrolyze. Therefore, based on these data, DBCP will be rate limiting with respect to soil cleanup objectives.

In groundwater, a similar effect is expected. While EDB requires the highest level of treatment (99.9999%) in groundwater, it has a partition coefficient that is 5 times higher and a much higher rate of hydrolysis than DBCP; therefore, EDB is expected to clean up faster than DBCP in groundwater. However, EDB has 200 times farther to go to reach cleanup objectives for groundwater ([1-99.98%] / [1-99.9999%] = 200). At the very low clean-up concentrations for EDB, it is difficult to assess the linearity of partition coefficients, soil particle diffusion, etc. Based on these data, the clean-up rate for DBCP or EDB may be controlling in reaching groundwater cleanup standards. Accordingly, modeling of the ISTT process was conducted on these two COCs (Appendix A).

One might assume that treatment to concentration based criteria will be met by simply continuing ERH longer as COC mass is removed at slower and slower rates. However, this assumption is not true for several reasons:

a. It is not cost effective since it requires the maximum amount of energy to be expended in recovering a much smaller amount of mass since contaminants may be slowly desorbed from soil particles, maintaining the groundwater concentrations above cleanup criteria for extended time periods;

b. The negative groundwater and vapor gradients towards the source area (as required by the RFP) will cause additional contaminants to enter the treatment zone, especially from the highly contaminated area just downgradient of the source area; and

c. Contaminants, in groundwater downgradient of the treatment area and above the cleanup objectives, could potentially migrate back into treatment area.

Because of these factors, it is not cost effective to continue heating until very low cleanup criteria are met, as it requires the maximum amount of energy to be expended to recover a small amount of mass. This approach would be especially unwise at a site where the amount of energy available is limited,

such as this site. Thus, the energy to the subsurface will be terminated when diminishing returns are reached, and the existing groundwater capture and treatment system (along with other attenuation process that will be occurring while the subsurface remains at elevated temperatures) is expected to address this remaining contamination.

Accordingly, a flexible operating program seems appropriate to attempt to reach the concentration based cleanup criteria. Based on the above described limitations of temperature or concentration performance criteria, a combined operational strategy will be used. The approach CES proposes to meet the source area treatment objectives at the Frontier Fertilizer NPL Site is:

1. Install every electrode with SVE/DVE capability.

2. Heat the DTV in three Stages, starting with Campaign 1 and utilizing 1 MW service as outlined in Section 2.5 until diminishing returns are observed, which will be further evaluated by the project team through vapor, temperature and groundwater monitoring. Stage 2 will combine Campaigns 2&3, utilizing 2.5MW service and the additional PSUs and the other equipment required, Stages 1&2 include utilization of shallow electrodes for heating the vadose zone. Operation (timing) of the shallow electrodes depends on 1) local resistivity (heating rate), and 2) local temperature trends (heating requirement) as compared to the rest of the electrode array (below 6 ft bgs). Once centroid heating in the main array has been established, power can be shifted to cap electrodes. Electrode segments are taken on and off line (time sequenced) to achieve roughly uniform energy deposition as needed to expedite the initial heat up of the entire campaign volume to treatment temperatures at all performance-point locations. Once performance points have reached target temperature, further power delivery is managed between 1) bringing the lagging upper, perimeter and lower temperature points up to target temperatures, 2) temperature maintenance and steam production in the performance region as need to achieve diminishing returns, and 3) expanding the treatment volume (via rolling campaigns). Because of light dissolved phase contamination and other factors, focused heating in lagging regions, including 0 to 7 ft bgs, will be the priority once all performance points are at target temperature. The cap electrodes would be energized as needed after the region from 10 ft bgs and below are up to temperature. All electrode segments are subject to numerous operational constraints such as power limitation, phase balance, and cable size. The cap electrodes have a maximum average power rating of 300 W/ft, which is more than sufficient for rapid heating. Above that power density they dry out. Because the cap and all other electrodes operate as parallel resistors, this places a constraint on operating voltage and therefore can limit overall power delivery. As a result, cap electrodes shall be connected as needed and as determined by electrical safety and cable capacity.

3. As target temperatures, which are as follows: 1) 100 degree C or the boiling point in the saturated zone; 2) 95 degrees C +/- 5 degrees C in the vadose zone extending from the saturated zone to 10 feet below the original datum surface; and 3) 90 degrees C +/- 10 degrees C extending from 10 feet below the original datum surface to the original datum surface (i.e. not including soil cuttings and the cap material), and energy input are evaluated, these data will be used to optimize power distribution and treatment. Decisions to terminate heating and/or direct heating to the more

problematic zones (i.e., areas indicating lower temperatures) will be made by the operations team based on the available operations data. This facilitates energy conservation as well as the opportunity for sampling groundwater.

4. Run the ERH at energy input rates required to maximize mass removal by using multi-level electrodes that can be focused on cold spots and highly contaminated zones.

5. Induce further energy input with the intent of producing more steam in areas of highest concentrations of COCs.

6. Monitor COC extraction rates in vapors to determine when diminishing returns are observed, as determined by the project team. The project team will utilize a "lines of evidence" approach to determine diminishing returns that will take into account temperatures achieved, initial concentrations of soil, groundwater and vapor and final vapor and groundwater concentrations, mass removed, operating time and other parameters that are deemed appropriate.

7. Utilize “rolling campaign” concept to transition power from clean areas of one treatment zone to begin applying power at adjacent electrode row of next zone or increase power where temperatures are low. For example, when Campaign 1 has reached diminishing returns, transfer power to the closest row of electrodes in Campaign 3, so that the entire zone between Campaigns 1 and 3 are heated towards target temperatures to provide treatment to diminishing returns for the entire DTV.

8. Adjust DVE to maintain hydraulic control by monitoring the perimeter monitoring points. After heating stops and extraction rates drop off, focus more aggressive DVE in areas where vapor or groundwater concentrations are high relative to other areas. With the high vapor partition coefficients of the COCs at elevated temperatures, continued reduction in soil and groundwater concentrations is expected and may continue to be cost effective for some time.

2.6 ISTT System Description & Principles of Operation

The technology to be used for ISTT at the Frontier Fertilizer NPL site is Electric Resistance Heating (ERH). The ERH technology is a thermally enhanced Soil Vacuum Extraction (SVE) technique that targets both contaminated soil and groundwater. When heating through the saturated zone, Dual Phase Vacuum Extraction (DVE) and/or groundwater extraction are specifically used by CES to maintain hydraulic control of the aquifer, control pressure gradients and steam capture/migration in heterogeneous media, and mitigate migration of contaminants. Depending on the specific geometry of different areas of the site, anywhere from three to six-phases electricity are imparted to the subsurface formations through specially designed electrodes. The electrical energy resistively heats soil and groundwater to the boiling point of water, or other temperature as might be appropriate. Contaminants are removed by direct volatilization, in situ steam stripping, and thermally accelerated in situ degradation. CES’s multi-faceted configurations are used because they produce an inherently

uniform and focused heating pattern and each electrical phase can be adjusted independently to match electrode voltages with subsurface conditions.

To achieve the mass removal, mitigate migration, and maintain hydraulic control of the S-1 and S-2 aquifers (i.e. movement of contaminants in the pressurized groundwater), CES will extract some amount of groundwater (i.e. Dual Vacuum Extraction or groundwater extraction) through specially designed electrode/extraction wells within and around the heated zone while heating the treatment volume to the target temperatures. These target temperatures are now defined as 1) 100 degree C or the boiling point in the saturated zone; 2) 95 degrees C +/- 5 degrees C in the vadose zone extending from the saturated zone to 10 feet below the original datum surface; and 3) 90 degrees C +/- 10 degrees C extending from 10 feet below the original datum surface to the original datum surface (i.e. not including soil cuttings and the cap material). Shallow electrodes have been installed in areas where contamination has been historically observed at depths less than 6 feet. Operations at these electrodes will allow temperatures to reach 90 +/- 10 C at 2 to 6 feet bgs in those areas. Direct volatilization and steam stripping will be the main driving mechanisms to remove the subsurface contamination.

The electrodes have been installed to treat to various depths per the defined treatment zones. The electrodes have the capability of heating deep or shallow zones, as well as the ability to extract vapors from the deep or shallower zones as required. This flexibility for heating is critical to address and control community concerns of contaminant migration through ISTT, and power may be adjusted to target zones independently from one another. More specifically, CES's specially designed electrodes act simultaneously as SVE wells and/or DVE wells that have proven effective in similar geological and hydrogeological settings as found at this site, and also ensures pneumatic control of steam and vapor.

An important element of CES's ERH system to mitigate off-site migration and accelerate clean-up is the flexibility to control groundwater and steam migration through groundwater extraction and DVE. The electrodes contain co-located extraction screen that are designed to intercept and capture steam and contaminant vapors generated by heating.

A robust soil vacuum extraction system (SVE) will ensure capture of the steam and vapors. The SVE manifold will be constructed from a combination of fiber reinforced plastic (FRP), temperature resistant CPVC pipe, and vacuum rated steam hose. The recovered contaminated steam will be processed through a condenser skid(s), which also includes a heat exchanger, cooling tower, tanks, pumps, and controls. Extracted water and the steam condensate will be transferred to a holding tank, pumped through granular activated carbon (GAC) for pre-treatment, then sent to the existing groundwater treatment system for further treatment before being disposed into the sanitary sewer under applicable permit. Cooled vapor will be treated by vapor phase GAC prior to discharge to atmosphere.

Heat management is an ongoing optimization process and shall be managed by CES's power supply unit (PSU) operating software that will interact with the thermocouple wells. Power can be directed to cool spots, decreased in hot spots, and controlled as necessary elsewhere. While the ISTT treatment need only vaporize about 35-50% of the pore water to achieve most clean-up objectives, and soil shrinkage or subsidence through ISTT is generally <1%, CES has witnessed, and has experience managing, these phenomena to a greater extent, especially in shallow heating regimes in very low permeable formations. Hence, rather than completely desiccate the soil during the operation, CES

intends to preferentially heat these critical areas only to the extent necessary to remove the contaminant to the desired level of treatment. Therefore, operations controls, along with a thorough temperature monitoring program will prevent any complications due to soil shrinkage or heterogeneities. Based on the evaluation of subsurface temperatures, extraction data, and other operating data in relation to particular areas, CES will be able to predict and automatically regulate subsurface temperatures. This valuable operating capability adds a level of safety and affords time for the CES team, CH2M HILL and EPA to discuss the advantages and disadvantages of lowering, raising or maintaining temperatures in any given area.

Thermal degradation of COCs may also play a significant role during the remediation. Since the power availability from the utility company is limited, the operating strategy will be adjusted for each treatment zone based on field observations and data derived during the ISTT. Of course, some of these compounds are increasingly more volatile than their parent compounds, and they will be removed concurrently during the vapor treatment. In addition, the electrodes will be designed so that specific vertical zones may be targeted, thereby optimizing the available energy input and COC recovery, yet reducing energy costs.

2.7 Remedial Action Management Plan (RAMP)

[Spec. 01400; 1.7.2.3.A]

The Remedial Action Management Plan (RAMP) is an integral set of documents that are used to coordinate and guide implementation of the ISTT. The RAMP is the compilation of plans, specifications, and drawings necessary to safely and efficiently implement ISTT. Below is a synopsis of the plans that are to be included in the RAMP document.

- Site Management Plan (this document)
- Project Schedule
- Design Drawings & Figures
- Health and Safety Plan (HASP)
- Environmental Protection Plan (EPP)
- Sampling and Analysis Plan (SAP)
- Subcontractor Quality Control Plan (SQCP)
- Waste management Plan (WMP)
- Process Monitoring Plan (PMP)
- Operation and Maintenance Plan (OMP)

2.8 Personnel Roles and Responsibilities

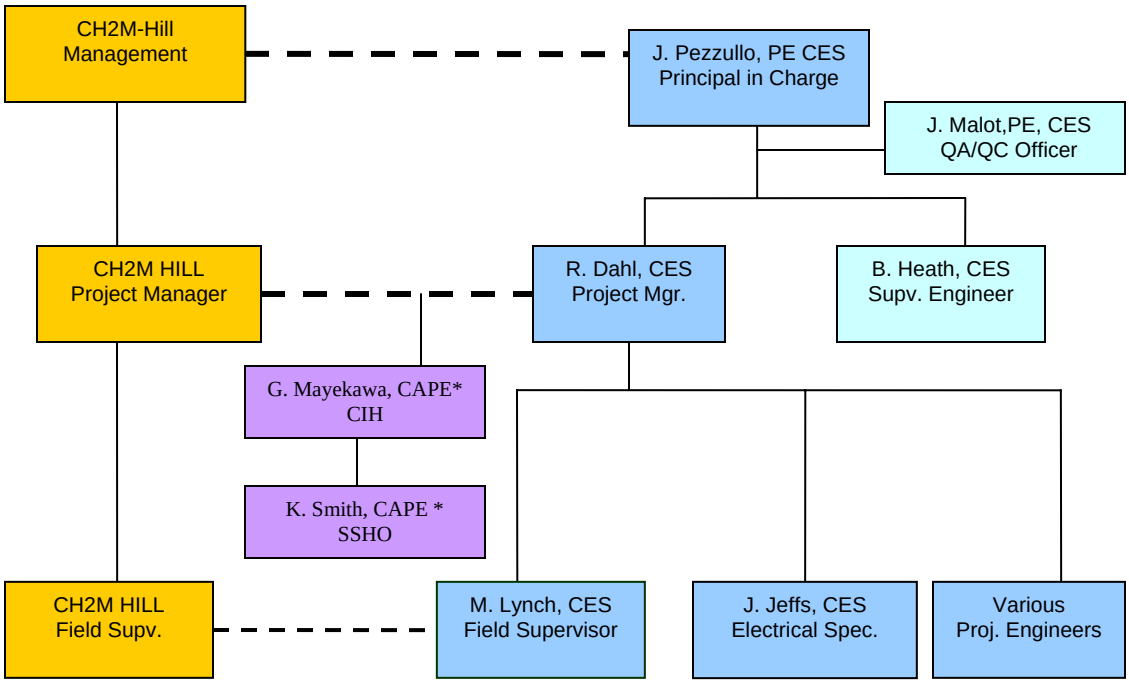
[Spec 01400; 1.6.1]

CES will provide sufficient personnel to satisfy all contract requirements. As a contingency, CES has identified alternate and assistant personnel within the major categories to ensure back-up project coverage in the case of unforeseen circumstances, such as illness or family emergencies. The assistant and alternate personnel shall be sufficiently familiar with the project functions as relates to their assignment. The CES and subcontractor personnel will be fully qualified by experience and technical

training to perform their assigned duties. Subcontractors and supplier personnel will be trained to ensure that they are qualified for the tasks expected of them. The following personnel have been identified for this project:

- **Joseph Pezzullo, PE -** Principal In Charge (PIC): Overall responsibility for project. Reports to CH2M-Hill Management.
- **James Malot, PE –** QA/QC Officer: Responsible for data validation and audit of the RAMP to ensure that the implementation of the plans and procedures will meet or exceed the contract requirements. Reports to PIC.
- **William Heath –** Supervising Engineer (SE): Responsible for overseeing design, modeling, engineering, field data gathering & validation, real-time data access, instrument programming, and reporting. Reports to PIC.
- **Robert (Tony) Dahl -** Project Manager(PM): Responsible for overall project tasks, including schedules, financial, personnel, Health & Safety (H&S), engineering, analytical, electrical, mechanical, administration, and subcontractor coordination. Responsible for project supervision, personnel management, and resource allocations and administration. Reports to PIC.
- **Jim Jeffs -** Electrical Specialist (ES): Responsible for equipment design, procurement, construction, field wiring. Reports to PM.
- **Glen Mayakawa**(CAPE) – Certified industrial hygienist (CIH) responsible for overall administration and audit of HASP. Reports to PM.
- **Kevin Smith**(CAPE) – Site Health and Safety Officer. Field administration of HASP. Reports to CIH.
- **Mike Lynch –** Field Service Supervisor (FSS): Manages and coordinates all construction, installation, set-up, testing, and O&M. Reports to PM.
- **Rick Somosky/Mike O'Brien –** Alternate Field Service Supervisors (FSS) and Draftsman: Manages and coordinates all construction, installation, set-up, testing, and O&M Also Responsible for drafting. Reports to PM.
- **Project Engineer(s)**: Various personnel. Assists with design, modeling, engineering, and reporting. Reports to PM.
- **Field Technicians (FT)**: Perform site construction, installation, set-up, testing, O&M under direction of FSS. Reports to FSS.

Below is a project organization chart:



CES Personnel Contacts

Joe Pezzullo, PIC Current Environmental Solutions (CES) P.O. Box 531139 Grand Prairie, TX 75053-1139 T: (972) 262-7855 F: (972) 262-6655 C: (267) 784-9234	**Jim Malot (PE)** Current Environmental Solutions (CES) 316 Avocet Ave Davis, CA 95616 C: (530) 848-9047
William Heath (Supv, Eng.) Current Environmental Solutions (CES) 120 Cimarron St. Richland, WA 99352 T: (509) 727-4276 F: (509) 627-4939 C: (509) 727-4276	**Robert (Tony) Dahl (Project Manager)** Current Environmental Solutions (CES) 191 Baldwin Ave. Crockett, CA 94525 T: (510) 787-9934 F: (510) 787-9962 C: (925) 864-9628

2.9 General Conditions of the Contract

[Spec 01400; 1.6.2]

A new*"Subcontract for Technical Services"* was executed between CH2M HILL and Current Environmental Solutions (CES) [the "parties] on March 27, 2008 followed by a Purchase Order (PO) that was executed on April 1, 2008. The PO was issued for Contract Line Item Numbers (CLINs) 0004 and 0005 which included a Change Order for in recognition of the added complexity of the ISTT design based on the increased number of treatment zones and volume above the BTV. The new PO also included CLINs 0006 through 00012, but only for the BTV. These CLINs has been amended accordingly as the project progressed based on the new treatment volume and final specifications determined by EPA. The contract contains the general terms and conditions (as amended) between the parties. The Copies of the contract are available in the offices of the parties at the following locations:

CH2M HILL
6 Hutton Centre Dr. Ste 700
Santa Ana, CA 92707
Attn: Elsa Cervantes

CES
909 NE 11th St.
Grand Prairie, TX 75050
Attn: Joe Pezzullo

The following are specific numbers and codes used by the parties for the purposes of managing the contract:

- CH2M HILL Purchase Order No. 932338
- CES's Vendor Number with CH2M-Hill : 273071
- CH2M HILL / EPA Prime Contract No: EP-S9-08-04
- Design Components Pre-Final: 384210.ID.01, Final 384210.FD.01
- Planning Components Designation: 385112.PP.04
- Schedule Components Designation: 385112.PP.04
- CES Project No: 78-0033

2.9.1 Applicable Patents and Indemnity

[Spec. 02182, 1.2.1.4]

The following patents broadly govern the use of ERH for ISTT and are commonly referred to as the "Heath Patents."

Title	Country	Patent No.	Date Issued
In Situ Heating to Detoxify Organic-Contaminated Soils (E-647/10279-E)*	U.S. Canada	4,957,393 1,322,106	Sept. 18, 1990 Sept. 14, 1993
In Situ Heating to Detoxify Organic-Contaminated Soils (E-647 DCFWC/10279-E)*	U.S.	5,316,411	May 31, 1994

Treating of Solid Earthen Material & A Method for Measuring Content & Resistivity of Solid Earthen Materials (E-1003/10756-E)*	U.S.	5,347,070	Sept. 13, 1994
Treating of Solid Earthen Material & A Method for Measuring Content & Resistivity of Solid Earthen Materials (E-1003 CIP/10756-E)*	U.S. Canada EP Germany France Great Britain Italy	5,330,291 2,123,410 0,612,273 69228194.0 0,612,273 0,612,273 0,612,273	July 19, 1994 Aug. 24, 1999 Jan. 13, 1999 Jan. 13, 1999 Jan. 13, 1999 Jan. 13, 1999 Jan. 13, 1999
Treating of Solid Earthen Material & A Method for Measuring Content & Resistivity of Solid Earthen Materials (E-1003 CIP2/10756-E)*	U.S.	5,545,803	Aug. 13, 1996

*These Patents arose under funding of the U.S. Government.

The following patents broadly govern the use of SVE/DVE and other technologies, and are commonly referred to as the "Terra Vac" Patents:"

Title	**Country**	**Patent No.**	**Date Issued**
Removal of Volatile Contaminants from the Vadose Zone of Contaminated Ground.	U.S.	4,593,760 4,660,639	June 1986 April 1987
Removal of Volatile Contaminants from the Vadose Zone of Contaminated Ground.	U.S.	RE: 33,102	October 1989
Process for Soil Decontamination by (In-Situ)Oxidation and Vacuum Extraction	US European Patent	5,615,974 EP 0741611	April 1997

To the extent applicable for the utilization of ERH for ISTT treatment at the Frontier Fertilizer NPL Site CES affirms that it maintains a fully paid-up world-wide license to apply these patents. Moreover,the *Heath* patents were funded by the US Government, and the prime contract is held with

the EPA. Hence, the US Government has a royalty-free unrestricted license to use these patents at NPL sites. Finally, CES' affiliate, Terra Vac, is the owner of the other patents, and likewise, CES has a royalty-free unrestricted license to use the "Terra Vac" patents.

To the extent these patents would be applicable for the utilization of ERH for ISTT treatment at the Frontier Fertilizer NPL site, CES shall indemnify CH2M HILL against claims, suits, losses, damages, costs, fees and expenses arising from the application of these or any other patents or licenses required by CES for the work.

3.0 PROJECT SCHEDULE

[Spec. 01400; Section 1.7]

An updated project schedule is included as **Appendix A.** The schedule has been revised from the *30% RAMP* due to the extended time required to finalize treatment volume, apparent power availability and resultant impacts on design. The schedule reflects expected installation of 2.5 MW power drop from the utility and is subject to change.

4.0 PLANS & SUBMITTALS

[Spec 01400]

There are numerous plans and submittals that are inherent to this SMP, such as an Environmental Protection Plan, the Subcontractor Quality Control Plan, the Site Health and Safety Plan Addenda, Operation and Maintenance Plan, Design document, Process Monitoring Plan and the Waste Management Plan. These plans are presented separately as stand-alone documents. Together, these set of plans comprise the RAMP, and shall be used to coordinate and guide the implementation of the ISTT. These sets of plans cover the engineering design, remedy installation, and operation and maintenance of the ISTT. The plans and submittals are briefly described below:

4.1 Engineering Design

The final engineering design is 99% complete for the defined treatment zones. Design elements have been developed based on availability of 2.5 mega-watt power that necessitates multiple heating campaigns. The design report accompanies this SMP as a stand-alone package. **Figure 1** depicts designed electrode layout for the entire volume, including the addition of shallow electrodes, as well as existing process monitoring points.

4.2 Site Specific Health and Safety Plan

[Spec. 01400; 1.8]

The Health and Safety Plan shall adhere to Specifications 01400-1.8.

All CES and CES's subcontractor personnel shall be trained according to OSHA 1910.120 as the requirements relate to the work. All personnel also participate in a medical monitoring program and respirator fit testing program that exceeds the OSHA requirements. A detailed site specific HASP for this work is a stand alone document that has been approved by a Certified Industrial Hygienist (CIH). Since ISTT is somewhat unique to the remediation industry, the HASP is developed to comply with CH2M HILL's overall site HASP and augmented by CES with enhanced HASP procedures specifically regarding ISTT electrical safety and for working in hot environments (e.g. steam). CES has retained an independent CIH and SSHO from Cape, Inc for this project.

The HASP includes the following sections at a minimum:

- Project Overview
- Project Personnel
- Site Description & History
- Scope of Work
- Hazard Assessment (Includes Chemical, Process, Drilling and Electrical Hazard Analyses)
- Site Control {Exclusion Zone, Contaminant Reduction Zone, Support Zone}
- Air Monitoring

- Personnel Protective Equipment
- Electrical Safety
- Working in Hot (e.g. steam) Environments
-

Specific procedures for sampling (soil and groundwater) in hot environments are included in the Sampling and Analysis Plan (SAP), which is a stand-alone document prepared by CH2M HILL with the support of CES.

4.2.1 HASP Submittals

[Spec. 01400; 1.8.3]

Training, monitoring and record keeping are paramount for the protection of human health and the environment. Samples of referenced forms and logs are included in the HASP. To this extent, the HASP shall include the following submittals:

- HAZWOPER Certifications: Both 40 hr and 8 hr annual updates and medical monitoring certificates shall be maintained on-site for each worker performing field activities with potential for unacceptable occupational exposure. These certifications shall be approved and signed by the SSHO and the occupational physician, indicating that workers meet the training and medical surveillance requirement of the contract.
- ACTIVITY HAZARD Analyses – A table of the work to be performed, the associated hazards, and the corrective measures.

- Monitoring/Sampling Results: Personnel exposure monitoring/sampling results shall be submitted as part of the Daily Chemical Data Quality Control Reports (DCDQCRs) which is part of the Daily Log. Personnel exposure monitoring/sampling shall be in accordance with the exposure monitoring/air sampling program. These results shall be submitted monthly as part of the monthly report. Personnel protective equipment (PPE) upgrades or downgrades will be described along with any action taken (e.g. such as engineering controls).

- Safety Conference Meetings: Records of pre-installation, installation, and O&M safety meetings conducted during the ISTT remedy shall be maintained and submitted with the monthly reports. Each of CES's project personnel and CES's subcontractor personnel shall be required to read the HASP and sign a form acknowledging their understanding and acceptance. Daily tailgate safety meetings are the norm for CES, and these meeting minutes shall be signed by all attendees.

4.3 Environmental Protection Plan (EPP)

[Spec 01400; 1.9]

The Environmental Protection Plan (EPP) shall govern site activities related to pollution prevention and minimization, spill control and reporting, stormwater management, noise and dust control, and compliance with federal water, wastewater, air, and solid waste regulations. The purpose of the EPP is to present a comprehensive description of known or potential environmental issues that CES and CES's subcontractors will address during ISTT remedy implementation.

4.3.1 EPP Submittals – Spill Response

[Spec. 01400; 1.9.3]

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 st. seq.), CES shall notify CH2M HILL immediately. CES's on site personnel shall clearly record the event, it's cause and response taken in the Daily Log. The SSHO and PM shall coordinate a detailed debriefing meeting with on-site personnel to review the event and establish or revise procedures to prevent its reoccurrence.

Typically CES's ISTT field activities do not consist of storing, treatment or transport of quantities of hazardous substances which exceed reporting thresholds, but in the event they do, and the spill or release exceeds the regulated threshold, CH2M HILL shall be immediately notified as above, and appropriate measures to report the spill or release to appropriate authorities shall be initiated by CH2M HILL. It is the QC Officer's responsibility to investigate, respond and report the incident to the appropriate authorities and CH2M HILL in the event a reportable quantity has been released at the site.

4.4 Sampling and Analysis Plan (SAP)

[Spec. 01400; 1.10]

The Sampling and Analysis Plan (SAP) is a stand-alone document that has been prepared by CH2M HILL with the assistance of CES. The SAP delineates ISTT sampling and analysis tasks appropriate for a Quality Assurance Project Plan [QAPP] (EPA QA/R-5, the latest version), and it includes a Field Sampling Plan [FSP], and a Data Management Plan. The SAP QAPP elements describe the project objectives and organization, functional activities, and quality assurance/quality control (QA/QC) protocols that shall be used to achieve the desired Data Quality Objectives (DQOs). The DQOs reflect use of analytical methods for identifying contamination and assessing performance and compliance monitoring, including QA/QC. The SAP FSP elements define sampling and data collection methods that shall be used for the project. The SAP also includes sampling objectives; sample locations and frequency; sampling equipment and procedures; sample handling and analysis. The SAP considers the use of all existing data and justifies the need for additional data whenever existing data will meet the same objective. The SAP is written so that a field sampling team unfamiliar with the site would be able to gather the samples and field information required. Both field measurements and analytical laboratory analysis may be necessary for soil, soil gas, and water analysis needed for screening and process monitoring. The SAP delineates the data requirements and methods for data management. Additional specific sampling methods required during operations will be described in the O&M plan.

4.5 Subcontractor Quality Control Plan (SQC)

[Spec. 01400; 1.11 and 01451]

The SQC plan covers ISTT system implementation, both onsite and offsite, including work by lower-tier subcontractors, fabricators, suppliers, and purchasing agents. The SQC plan is designed to guide the scheduling, organization, certification, management, control, reporting, and verification of ISTT

activities on a task level basis such that the implementation of the ISTT results in the highest possible quality. The SQC is a stand alone document that is briefly summarized in **Section 7**.

4.6 Waste Management Plan (WMP)

[Spec. 01400; 1.12]

The Waste Management Plan (WMP) identifies necessary regulatory requirements applicable to the characterization and disposal of soil, soil gas, groundwater, personal protective equipment (PPE), and other materials generated during installation, operation and maintenance (O&M) of the ISTT.

The WMP details the waste management practices, documentation, and training requirements necessary to ensure proper waste handling, transportation, and disposal. In addition, the WMP provides guidance regarding waste minimization practices to be followed during the project to reduce the volume of waste generated, stored, and removed from the site for disposal.

4.6.1 WMP Submittals

[Spec 01400, 1.12.3]

The WMP includes the following submittals:

- Notices of Non-Compliance and Notices of Violation
  In the rare case CES receives a notice of non-compliance or violation from a federal, state, or local regulatory agency, CES shall notify CH2M HILL immediately. CES shall furnish relevant documents and coordinate it's response to the incident with CH2M HILL.

- Recordkeeping
  For any hazardous materials to be transported and disposed by CES, CES shall record information necessary to file EPA biennial reports or California EPA annual waste generator reports. CES shall include a cover letter with its records submittals which includes the contract number, CES's contact information, and project location.

4.7 Process Monitoring Plan

[Spec 01400; 1.13, 1.14 and 01840]

The Process Monitoring Plan (PMP) is an integral portion of the Operations and Maintenance Plan (O&M Plan) relating to the actual operations and performance monitoring of the ISTT. These plans shall be designed as field reference guidance documents for the operating personnel, and as such shall be as succinct as possible to provide the operations personnel with clear instructions. Since the *Process Monitoring Plan* and O&M Plan are critical to the successful operations, maintenance and monitoring of the ISTT remedy, the Process Monitoring Plan will become part of the O&M Plan.

4.8 Operations and Maintenance Plan (O&M Plan)

[Spec. 01400; 1.14]

O&M begins following installation and includes primary startup, shakedown and primary commissioning of the ISTT system. The O&M Plan includes monitoring of all system components and sampling and analysis of key operating parameters, including potential emissions sources. The Process Monitoring Plan described above is an integral part of the O&M Plan. The O&M Plan shall follow Specification 01400, 1.14.2 and its content is briefly summarized below.

CES maintains a detailed internal O&M manual for its ISTT systems, including routine maintenance checks for electrical and mechanical and rotating equipment, interlocks, alarms, controls, calibration procedures, Quality Assurance/Quality Control Assessments, H&S, and routine site audits by senior management. A detailed site specific O&M manual will be prepared for this site. CES's standard operating procedure (SOP) is to perform the little things so that the big complicated things do not occur. Routine maintenance will be scheduled monthly but will occur more often under abnormal conditions (e.g. excessive dust). Background air quality tests are inherent to CES's SOP and the PMP. CES will coordinate with CH2M HILL for conducting ambient air quality monitoring.

System shutdowns and alarms are routinely tested during normal O&M events. CES will coordinate with the local authorities, i.e., fire and police departments as necessary, so that they are aware that the tests are being conducted.

Process and Safety interlock circuits and instrumentation will be provided to remove electrode power in the event of:

- The exclusion area access gate being opened.
- Motion detection in exclusion zone.
- Hi temperature or over amperage of the SVE blower(s).
- Failure of the condensate collection system (because of a full condensate collection tank or failure of the condensate transfer pump).
- Over-pressure condition in primary SVE manifold, indicating a loss of vacuum.
- Hi-Hi Level in V/L Separator Tank.
- Hi-Hi level in secondary containment.
- Opening of doors at transformers/psu.
- One-push Emergency stop safety switch at entrance to treatment area.

A minimum of one (1) CES representative shall be on-site during startup at all times 8 hrs/day, 5 days/week, and as needed during operations and maintenance, and on-call 24/7.

Site personnel are highly trained in the routine O&M of the ISTT utilizing ERH, Soil Vacuum extraction (SVE) and Dual Phase Vacuum Extraction (DVE) systems to minimize complications. The

on-site technician(s) will be on call via their cell phone 24 hrs/day in case of such circumstances and will respond immediately to the alarm condition.

A safety SVE system will automatically start up in the case of a power outage or primary VEU failure, and this will alarm the technician who will go to the site to diagnose and correct the situation, if possible. CES shall have no control over a power outage, so the back-up SVE system shall operate on generator power until site power is restored.

If the shutdown is due to the primary VEU, and it cannot be repaired, operations will continue with the back-up VEU and provisions for shipping a replacement primary VEU to the site will be made within 24 hours. Since operation of the VEU is critical to control of emissions, a backup unit will be stored on site for rapid deployment, if necessary.

Normal spare and replacement parts such as oil, filters, belts, TCs, PLC boards, spare pumps, valves, instruments, and other items will be maintained on-site for rapid response and replacement if necessary.

4.8.1 O&M Plan Submittals

[Spec. 01400; 1.14.2]

Records and reporting mechanisms include daily operating logs, laboratory records, records for operating costs, emergency reporting, personnel and maintenance records, and reports to CH2M HILL, EPA, and its designees, and the Department of Toxic Substances.

O&M reports, data, and photographs shall be transmitted in electronic format to CH2M HILL. O&M Data shall also be transmitted in hard copy as part of the O&M Reports. Reports shall be transmitted in Microsoft Word or Excel format. Instrument data shall be transmitted in the same method or by ASCII delimited text file. Reports shall be submitted in draft and final versions on CD and native and PDF formats. All submittals shall be clearly designated when subject to the confidentiality and intellectual property ownership terms of the contract.

Additional detail on daily, weekly and monthly submittals is presented in the O&M Plan.

5.0 INSTALLATION OF PRELIMINARY MONITORING POINTS

Final treatment volume was determined based on sample data from the installation of Preliminary Monitoring Points in the fall of 2008. The initial intent was to combine temperature monitoring points (TMPs) with pressure monitoring points while conducting soil sampling for further definition of contaminants in soil and groundwater. Due to the importance of COCs in groundwater as indication of localized soil impacts, EPA and CH2MHill directed that preliminary monitoring points were converted to groundwater monitoring wells and no TMPs were installed.

5.1 Site Preparation, Survey, Permitting

[Spec 01500, 01720]

Figure 1 depicts the locations of preliminary monitoring points installed in the fall of 2008. Those locations are designated with double letters, AA-1 through GG-4. **Table SMP-3** gives descriptions for purpose, construction and sampling at each location. Prior to mobilization, CES visited the site along with CH2M HILL and the selected drilling company to determine the condition of existing fence, site access roads, and whether or not the grass required mowing. CH2MHill coordinated clearing the site of weeds and leveling a hump of soil approximately 10x30x 3 feet high in preparation for drilling.

Existing site infrastructure as depicted in ***RFP Folder 4/02, Figure 15, "Source_Zone_Equipment,"*** was re-checked against the boring locations and a magnetic survey . If any of the boring locations overlapped an existing infrastructure, the boring was relocated to the next nearest acceptable location, as determined by consultation between CES, CH2M HILL and EPA.

5.1.1 Permitting

[Spec 02215; 1.1.2]

Drilling permits were obtained by CES prior to mobilization. In addition, CES secured a fire hydrant use permit and a meter from the City of Davis fire department. No other permits were required for this phase of the work.

5.2 Mobilization and Set-Up of Temporary Facilities

[Spec 01500]

Mobilization for installation of the preliminary monitoring points included the following:

- Demarcation of the Exclusion Zone, Contaminant Reduction Zone and Support Zone as described in the HASP by erecting orange temporary fencing. (Spec 01500; 1.6.1,
- Demarcation of the employee parking area. (Spec 01500; 1.11.2)

- Mobilizing a work trailer, temporary power generator and temporary wiring (Spec 01500; 1.9.1, 3.2.1)
- Constructing a decontamination pad in the transition area, together with a trash pump and decontamination water storage vessel (1000 Gallon poly tank).
- Establish an equipment and materials storage and staging area in the support zone [Spec. 01500; 1.7,
- Temporary water hook-up for decontamination water, grout mix, and dust control
- Set-up temporary sanitation facility [Spec. 01500;1.8]
- Set-up administrative infrastructure in the work trailer (Files, record keeping, etc)
- Erect bulletin board and signs [Spec. 01500; 1.10 et al.]
- Establish security provisions for temporary facilities [Spec. 01500; 1.12]

5.2.1 Easement and Access Requirements

[Spec. 01400; 1.5.1.A.8]

Each day onsite, CES staff and any subcontracted staff logged in and logged out in CH2M HILL log book located near the site entrance.

Easements and access requirements are fairly straightforward at the site since EPA controls the site directly. Access will be limited in the exclusion zone to only authorized CES, CH2M HILL and subcontractor personnel.

5.3 Drilling and Installation

[Spec 02215]

The borings shown in **Table SMP-3** were installed in a logical sequence determined between CES, CH2M HILL, EPA and the driller. A pragmatic plan was developed based upon Health and Safety issues regarding Level B PPE, the EPA and CH2M HILL preferences for data collection and sample analyses in specific areas of the site.

During installation, engineering controls were shown to be sufficient to justify Level C PPE. In order to determine whether engineering controls would allow a downgrade from Level B requirements, drilling began at locations with historically high concentrations of COCs within the BTV in Level B, instituting engineering controls such as fans in the breathing zone, while members of the drilling crew wore 3M 3500 organic vapor monitoring badges. This was done over the first several days and upon completion of those wells, drilling was shifted to wells outside of the BTV while awaiting results of

the analyses of the badges. Analytical results for the badges were below detection limits for all COCs. Drilling continued with Level C PPE and engineering controls.

Prior to drilling, all site personnel reviewed the HASP, paying particular attention to the Action levels for Personal Protective Equipment (PPE) and the Jobsite Hazard Analysis. CES required the driller to comply with all the drilling requirements of Spec 02215; Part 3.

5.3.1 Groundwater, S-1, S-1 Monitoring Wells

The boring designated on Table SMP-3 as "Well Types GW, S-1, S-2" were advanced to the depth identified for each boring. Each boring was continuously cored (pilot bored) every 4 ft using a 3 in. OD core barrel. Cores were handled, logged (ASTM D 2487, D 2488, Spec 02215; 1.2, 3.7], and aliquots of the cores were collected, stored and analyzed according to the SAP. The total depth (TD) was determined in the field but generally about 10 ft below where the S-2 was encountered, and no greater than 94 feet bgs. The expected number of soil samples per boring are presented on **Table SMP-3**.

Following the completion of the coring, the borings were overdrilled to 5 in OD and completed in zone S-1 or S-2 as MWs, though it was decided that no TMPs would be installed. MWs consists of 10 ft of 0.01 in. slotted stainless steel (SS 304) well screen with and FRP riser to surface. Completion details have been provided in well logs under separate cover.

5.3.2 Vapor Monitoring Piezometers (VMPs)

The initial coring and sampling for the borings where VMPs were installed proceeded in the same manner as described above. Each of the 2" or 4" groundwater wells installed in this event included a VMP. The VMPs consisted of two feet of hand slotted CPVC screen at 5 to 7 feet bgs in pea gravel, with grout from 0-4 feet. Construction details have been provided in well logs previously submitted.

5.3.3 Groundwater Pumping Wells (GPWs)

Once again, the pilot boring were advanced with cores collected, stored, and sampled in the same manner as other borings according to **Table SMP-3 .** Construction details have been shown in well logs previously submitted. The GPW had a 10 ft section of 4 in ID 0.01 in slotted SS304 well screen in the S-2, or the S-1, coupled to 4 in ID CPVC riser to surface. The annular space in the S-2 was backfilled with silica sand pack to 2 ft above the well screen. A 2 ft thick bentonite seal was placed atop the sand pack, and the well grouted to 7 ft bgs, where a VMP was installed as described above.

5.3.4 Well Development

[Spec 02215, 3.4]

All grout seals were allowed to set for a minimum of 72 hours prior to well development. The S-1, S-2 MW's and GPWs were developed using an air lift method. Development water was collected, treated through carbon and used for dust control at the site**.**

5.3.5 Sampling and Analysis

The soil samples collected during the installation of the borings were sent for analyses independently by CH2M HILL according to the SAP. CES also retained selected samples for in-house analyses of parameters such as soil resistivity, as well as groundwater samples. CH2M HILL also elected to collect groundwater samples from the S-1, S-1 MW's and GPWs at their discretion.

5.3.6 Decontamination

[Spec 02215; 3.2]

Decontamination of drilling equipment was performed prior to the rig mobilization, between each core and boring, and prior to demobilization. Decontamination was performed only in the zone demarcated for its purpose and in strict compliance with Spec 02215; 3.2 and the HASP. Decontamination water was collected and stored pending treatment and disposal according to the WMP.

5.3.7 Demobilization

[Spec 02215; 3.1.2]

At the completion of the boring and installation of preliminary monitoring points, the drilling rig and all temporary facilities and soil, liquid and solid wastes were removed from the site according to applicable specifications and the WMP. A similar protocol shall be applied during the demobilization of ISTT components.

6.0 ISTT REMEDY IMPLEMENTATION

This portion of the SMP has been compiled at a final completion level.

6.1 Site Layout

Figure 1 shows the site electrode layout designed to treat the defined treatment volume, now consisting of seven zones of differing targeted treatment depths. 125 shallow electrodes have been added in zones 1&2 where historical sample data indicated COCs present at two feet bgs. A 6ft. barbed-wire security fence that satisfies Spec 01500; 3.1.1.2 will encircle the final treatment area on all sides. All manifold lines and electric cable running to the electrodes will be completed above grade within the fenced area. No unescorted person will be permitted to enter the fenced area unless they read and sign the HASP and have attended the CES ERH safety training program which will be conducted on site prior to start up of the system. Visitors who do not attend the safety training program are not allowed inside the fenced area without a CES escort. Under no circumstances may anyone other than CES personnel enter the treatment area while the ISTT remedy is in operation.

6.2 Site Mobilization, Preparation, Surveying

[Spec 01500, 01720 and 01720]

Site preparation includes the surveying for placement of temporary infrastructure facilities including office trailer and storage buildings [Spec 01500; 1.9], sanitary facilities [Spec 01500; 1.8], barricades [Spec 01500; 3.1.1.1] and fencing [Spec 01500; 3.1.1.2]. Signs will be placed per Spec 01500; 3.1.1.3. Existing access roads have been evaluated for durability throughout the ISTT remedy and shall either be re-graded and graveled with 1 inch minus clean gravel or optionally paved (at the discretion of CH2M HILL/EPA), if necessary. During drilling, the exclusion zone, Contaminant Reduction Zone and Support Zones (per the HASP) have been delineated with warning tape, flagged with rope and barricades. After intrusive work was completed, the site cap was installed, ready for equipment placement. CES has provided a generator for temporary power prior to the installation and completion of the site power drop.

Figure 1 depicts the locations of the installed electrodes, vents, monitoring points and temperature monitoring points (TMPs, as well as equipment locations).

Existing site infrastructure as depicted in **RFP Folder 4/02, Figure 15, "Source_Zone_Equipment,"** was re-checked against the boring locations. Several electrode locations were adjusted due to proximity to pumping wells. In addition, abandonment of those subsurface elements that may impact or be impacted by the ISTT system was conducted during electrode install program.

6.3 Permitting

If possible, electrical, water, and drilling permits will be obtained prior to Mobilization, while provisions for compliance with air standards will be made. Superfund designation does not require that air permits, or well permits, be obtained, but that appropriate permit conditions be complied with. The permitting process shall commence soon as possible to allow federal, state and local regulators sufficient time to evaluate, respond and approve the ISTT RAMP and permits.

Drilling/well permits for drilling events were secured through the Yolo County Hazardous Materials Department.

Though an air discharge permit is not required to be issued through the Yolo-Solano Air Quality Management District (YSAQMD), the design has been reviewed by YSAQMD.

The EPA holds the sewer permit under which the groundwater extraction system discharges treated water. Discharge from the ISTT system will be pre-treated and pumped to the existing groundwater treatment system and thence to the sewer under the existing permit.

6.4 Site Security

[Spec. 01500; 1.12, 3.1.1.1, 3.1.1.2, 3.1.1.3, 3.1.1.4, 3.2.1,]

As described above, a security fence will encircle the treatment area and the equipment compound. The fence will be will be 6 feet high constructed of 12-gauge chain link, and will include three strands of barbed wire. Gate locations are shown in **Figure 1.** The fence will be installed after the site cap and equipment is in place. Prior to fence installation, 20 or 40 foot storage containers will be used to secure materials. Signs indicating possible dangers will be posted in conspicuous areas for safety concerns. Perimeter sentry alarms or motion detectors, along the treatment area fence will shut down the power to the electrode field when broached. Security motion-activated flood lighting will be mounted on temporary poles or equipment. EPA has considered erecting security cameras in strategic locations at the site, but this has yet to be confirmed.

6.5 Utilities

Temporary utility connections shall be made for:

- Electric Power
- Sewer
- Phone and DSL
- Water

A major impact on design and this SMP concerned the availability and capacity of power that the utility provider, PG&E, could supply within a reasonable time-frame. After the completion of the Preliminary Remedial Action Management Plan, Installation of Preliminary Monitoring Points in November 2008, and evaluation of the new soil and groundwater characterization data to determine the final designated treatment volume (DTV) beyond the BTV, CES recommended a design with the

assumption that PG&E would provide 6 MW of power to the site. CH2M HILL concurred with the recommendation and directed CES to proceed with the site design on this basis. CES proceeded with the 6 MW site design between March 2009 and May 2009. In late May 2009, CES was informed by CH2M Hill that only 1 MW of power could be delivered by PG&E in the summer and 5 MW could be delivered in the winter, and then CH2M Hill directed CES to re-design the site for 1MW. CES then proceeded to re-design the site using only 1MW of available power, although discussions regarding the variable Summer/Winter power availability continued throughout the Summer of 2009. CES maintained that a year-round constant power would be more desirable for both technical and economic reasons.

The Final 1 MW design was delivered to CH2M Hill by CES in September 2009. In that 1 MW design CES provided a preliminary evaluation of the potential for PG&E to supply 3 MW of constant power. In such case, CES estimated that up to three of the campaigns that were planned to occur sequentially with 1 MW of power could be heated simultaneously using 3 MW of power. Heating with 3 MW of power would theoretically reduce the treatment duration from about 3 years to about 1 year, if the 3 MW was delivered continuously. CES provided a preliminary evaluation of an Electric Resistance Heating system utilizing 3 PSUs, which would require approximately 3 MWs of power. CES indicated that it would be theoretically possible to treat the DTV in about 18 months using a staged approach. To supplement electrical power service delivered by PG&E during peak power demand period, which is May 2 through August 31, EPA was investigating alternative sources of power to supplement the 1 MW available during the peak Summer season including: on-site solar electric power generation and storage, partnerships with nearby power users to reduce demand on the grid and make available more power during the peak season, and natural gas powered generators. Due to challenges presented by these alternate electric power resources, it was agreed by all parties that the design based on 1 MW was the best approach.

Then, in December of 2009, PG&E identified to EPA and CH2M Hill that they could deliver 3 MW of continuous power; however PG&E did not have an appropriately sized step-down transformer. PG&E indicated that two separate services could be provided; one 2,500 KVA transformer and one 1,000 KVA transformer to supply the 3 MW service. The 3 MW power drop design was finalized by PG&E on February 8, 2010, and costs for the two required service installations were provided to EPA.

Between February 8 and March 22, 2010, at EPA's request, CES re-evaluated the need for two separate electrical services. CES promulgated that, if possible, combining all electrical equipment loads onto a single 2,500 KVA service would cut a large portion of the PG&E site electrical installation costs in half. While seeking potential cost savings, EPA also wanted to avoid causing a lengthy re-design process by PG&E.

Working with an electrical subcontractor, CES proposed that PG&E connect the 2,500 KVA service to a 4,000 A main power panel (Meter Stand Base or "MSB"), with separate circuit breakers for the three PSUs and VEUs. PG&E concurred that this would provide adequate protection for the PG&E 2,500 KVA service transformer, and this would also avoid the need to re-design the primary high voltage line, because it was already sized for a 4,000 A secondary service. Thus PG&E concluded that equipment and costs for the second 1,000 KVA service installation could be eliminated, and this change could be handled as a field design notation rather than formal re-design process by PG&E which could have taken an additional six to eight weeks.

The single power panel consists of a 4,000 A main breaker equipped with the following load-side breakers: three 1,200 A breakers (one per PSU), three 100 A breakers (one per VEU) and a spare 100 A breaker. The loads on each 1,200 A breaker are three 350 A SCR power controllers and up to 100 A in various motor loads and convenience power. The loads on each 100 A breaker are a 52 A blower motor and small pump motors. With this installation the ERH equipment can operate at full current capacity without tripping panel breakers. Implicit in the PG&E site installation design and service agreement is that power will be available on the local power grid to provide greater than 3,000 A at 480/277 VAC at the secondary as required to operate the ERH equipment under variable load conditions.

Accordingly, based on the power limitations described above, the approach that CES proposes to optimize the utilization of the 2.5 MW continuously available power is contained in the final 2.5 MW design documents as well as Section 2.5 above.

Figure 2 shows the planned location of the power drop at the 2,500 KVA transformer.

Pre-treated water from the ISTT system will be sent to the onsite EPA treatment system for ultimate discharge to the sewer. Permitted hookup to a fire hydrant may be utilized for water.

6.6 Abandonment of Existing Facilities

[Spec 01110; 1.5.2 and 02679; 3.1.2.1, Table 02679-1]

An existing groundwater system is located at the Site, and this system includes active subsurface piping that is shown in the CH2MHILL figure “Underground Utilities and Known Obstructions” for Frontier Fertilizer NPL (included in Appendix B). Active subsurface piping does not cross the treatment zones, but the proximity of electrical controls and power at pumping well X-1A just outside of the ISTT Volume will cause problems for the ERH system and must be removed and replaced with a non-electrically driven downhole pump. Other apparently inactive piping does cross treatment zones. Damage to the piping is not a problem but the potential for a conduit for steam must be considered. If any metal pipe is present in a zone, electrical shorting could also occur.

Based on available information, the following **Table SMP-4** lists utilities located or presumed within the heated area and the abandonment plan that was followed:

Table SMP-4: Subsurface Utilities Abandonment Plan

Utility Number	Action	Rationale
1. Inactive 1.5" hose contained in PVC conduit (Line H, see Appendix B) that cuts across treatment Zones 6 and 7, but at least 20 feet above the heated zone.	None	Utilities are at least 20 feet above heated zone so no impact is expected.
2.Inactive 2" PVC single wall Pipe that cuts across Zones 1, 2, 3 and 6, which presents a potential steam conduit for Zones 1, 2 and 3.	PVC piping was daylighted at the ends of Treatment zones 1, 2 and 3, cut open and ends filled with cement. Approximately 130 LF.	Contains potential lateral steam pathway at ends of treatment zone. Impact of heat on PVC is not considered significant. In zone 6, piping is at least 20 feet above heated zone, so no impact is expected.
3.Active underground conduit or rigid PVC along northern edge of Zone 7, but at least 30 feet above heated zone.	None	Utilities are at least 20 feet above heated zone so no impact is expected.
4.Active high density polyethylene (HDPE) 2" carrier line with 4" containment along northern edge of Zone 6, but at least 30 feet above heated zone.	None	Utilities are at least 20 feet above heated zone so no impact is expected.
5. Inactive 2" ABS lines that cut across southeast corner of Zone 1 and within potentially heated area of eastern edge of Zone 2 and near IW-2, just outside of southwest corner of Zone 1. (112 LF + 14 LF for branch to IW-4, for line crossing SE corner. Line at IW-2 to remain).	ABS piping to former injection wells was daylighted at the ends of Treatment zones 1 and 2, cut open and ends filled with cement. (112 LF + 14 LF for branch to IW-4). Capped at end north of IW-3.	Contains potential lateral steam pathway at ends of treatment zone. Impact of heat on ABS in not considered significant. In zones 3 and 6, piping is at least 20 feet above heated zone, so no impact is expected.

Utility Number	Action	Rationale
6.Inactive Suspected Utility Line (based on geophysical survey, potential former leach line of septic system) from eastern edge of Zone 2 to southern edge of Zone 2 and touching northern portion of Zone 1. Approximately 112LF based on figure provided.	Not found to 5 ft depth.	Geophysical anomaly may not be related to any conduit that would impact heating or steam/VOC recovery. If found, cement should prevent lateral steam pathway at ends of treatment zone.
7. Inactive Suspected Utility Line (based on geophysical survey, potential former leach line) just outside southern boundary of Zone 1. (Unknown length skirting treatment zone).	Not found to 5 ft depth.	Geophysical anomaly may not be related to any conduit that would impact heating or steam/VOC recovery. If found, cement should prevent lateral steam pathway at ends of treatment zone.
8.Undefined geophysical anomaly in northwest corner of DTV.	Each electrode or borehole in this area was hand augered to 5 ft. deep.	Geophysical anomaly may not be related to any conduit that would impact heating or steam/VOC recovery. If found, cement should prevent lateral steam pathway at ends of treatment zone.

The existing pre-thermal treatment wells that are constructed of PVC must be abandoned according to the requirements of Yolo County and California Department of Water Resources Bulletins 74-81 and 74-90. Originally, existing wells AW-2A, IW-2, IW-4, AW-2b, and MW-4C were considered within the expected treatment area, as specified in **Spec. Table 02679-1**, and to be abandoned per Spec 02679;3.1.2.1. The treatment area is now defined in such a way that wells AW-2A and AW-2B are well outside the treatment area, and IW-2, IW-4, and MW-4C are at the periphery and need not be abandoned. Wells GG-3, and EE-1 were located within the treatment area, and very close to electrode locations. In addition to heat potentially impacting the CPVC well construction, the grout column above the screen interval is conductive and will interfere with the ERH operations of those adjacent segmented electrodes. For these wells, Specification 2679, section 3.1.2.1, outlining pressure grouting as well abandonment requirements, are not conducive to ISTT system operations. Consequently, these wells were abandoned by overdrilling and filling with bentonite to the surface, which is in compliance with CDWR Bulletins 74-81 and 74-90. There is 25-40 feet of bentonite seal above the heated zones at those locations.

6.7 Heating Electrode, Vent and Temperature Monitoring Points

[Spec 01400; 1.3.2 and 02215]

The final ISTT volume consists of seven areas with differing treatment zone depths. The electrode designs are specific for each of the areas. **Figures 3 (7 sheets) , 4 (2 sheets) and 5** illustrate the construction details of the electrode, vent, TMP system for each of the treatment zones of the defined treatment volume. Figure 3H shows the design for shallow electrodes installed in specific areas of zones 1 and 2. Dual Vapor Extraction (DVE) utilizes an entrainment tube from the SVE system that is advanced to the water level to extract groundwater and lower the water table. DVE will be conducted in the primary electrodes to maintain hydraulic control along with continued pumping of downgradient extraction wells. The primary electrodes are shown with diamonds around the circle locations. Each Electrode Well is capable of simultaneously heating and extracting vapors and steam via SVE in vadose zone and DVE below the static water table.

The full ERH design for the entire volume incorporates 111 electrodes (based on 16 ft spacing) distributed throughout the seven treatment zones, plus 125 shallow “puppy” electrodes in zones 1 and 2. The 2.5 MW available power requires three sequential treatment stages. Due to power and phase balancing requirements, various zones may be treated in portions. CES has applied a numerical model to compute the required number of electrodes based on optimum spacing for power density for the treatment area, size of electrodes, and soil conductivity.

Each electrode has up to five conductive intervals. Each electrode/SVE/DVE well is constructed with temperature resistant materials that are installed in a nested fashion. A three to six foot grout seal extends below ground starting at 3 feet bgs. From 3 ft bgs to the surface, the well is completed with gravel and a shallow vent line for fugitive emissions and cap ventilation. Each electrode DVE/SVE vent is equipped with a control valve, and a pressure and sample monitoring port. The vacuum level applied to any specific well will vary based on actual pressure generated during heating. Preliminary 10% modeling of the BTV showed a rough spacing of Electrode-DVE wells of 17-20 ft. Subsequent modeling of the deeper S-1 and S-1 horizons for the purposes of locating the preliminary monitoring points discussed above resulted in CES, CH2M HILL and EPA reaching agreement for a

preliminary spacing of 16 ft. Modeling for the final treatment volume confirmed the 16 foot spacing. A 12 inch OD hole was required for the design of a full depth DVE well and multi-level electrodes.

CES will use DVE and existing pumping wells to maintain hydraulic control in the treatment zone by extracting water and vapor from as many as 17 perimeter electrode vent wells in Stage 3. Hydraulic conductivity at the site indicates that the multiple wells at the 32 foot spacing will be more effective than would the locations of groundwater wells installed with the preliminary sampling event. Although the buoyancy effects of hot vapors and steam would generally cause them to rise vertically where they can be captured by the DVE/SVE system, complex lithologies can trap this steam and vapors beneath lower permeable lenses causing them to migrate laterally as opposed to vertically. Field experience at several sites has proven that even a nominal amount of groundwater extraction by DVE can effectively control the soil pore pressure.

6.7.1 Drilling

The borings for electrodes and TMPs shown in Figure 1 were installed in a logical sequence determined between CES, CH2M HILL, EPA and the driller. A pragmatic plan was developed based upon Health and Safety issues regarding Level B PPE, the EPA and CH2M HILL preferences for data collection and sample analyses in specific areas of the site. During preliminary installation, engineering controls were shown to be sufficient to justify Level C PPE. Construction of electrodes, vents and TMPs was as illustrated in Figures 3 and 4.

Prior to drilling all site personnel reviewed the HASP, paying particular attention to the Action levels for Personal Protective Equipment (PPE) and the Jobsite Hazard Analysis. CES required the driller to comply with all the drilling requirements of Spec 02215; Part 3.

6.7.2 Soil Cuttings

Soil cuttings from areas where sampling indicates COCs in concentrations below or near cleanup goals, such as those shallow zones above a designated treatment depth, were dispersed within the ISTT Volume. Other cuttings will be dispersed at the surface of Zone 1 & 2, for additional treatment under the insulated cap. Soil samples from the preliminary sampling event in the base treatment volume, with the exception of TCP, averaged under or near residential PRGs. The average concentration for DBCP equaled the cleanup goal. Details are outlined in the Waste Management Plan (Appendix A).

6.7.3 Decontamination

Decontamination of drilling equipment occurred prior to the rig mobilization, and prior to demobilization. Decontamination occurred only in the zone demarcated for its purpose and in strict compliance with Spec 02215; 3.2 and the HASP. Decontamination water was collected and stored pending treatment or disposal according to the WMP**.**

6.8 Soil Gas and Groundwater Components [Spec. 01400-1.3.2]

CES's electrode design includes a co-located SVE/DVE well of temperature resistant FRP, as well as a shallow vent for capture of near surface emissions at the wellhead. In addition, a surface cap of gravel and HDPE (or equivalent site cap) will collect other potential emissions between electrodes. Soil vapor will be treated with granular activated carbon (GAC). The layout of the site cap is shown in **Figure 5**.

CES will use DVE and the existing groundwater extraction system to maintain hydraulic control of the S-1 zone in the treatment area. Fluorinated Ethylene Propylene (FEP) tubing will be extended to and below the water table down each of the fiberglass vent lines of the primary electrodes. The vacuum system can then be utilized to entrain and remove water at each electrode. The system is designed for a total of 31 wells to be equipped with DVE system components. The number of these wells that are online at any given time will be dependent on where power is being applied. Other electrodes are equipped for SVE operations.

6.9 Temperature Monitoring Points (TMP)

Figure 4 shows the construction details of the Temperature Monitoring Points (TMP) for each of the treatment zones. Nineteen TMPs, each containing type T thermocouples for TMPs that extend above and below targeted treatment depth as shown, shall be installed throughout the final treatment volume. These will be used to feed back to the system software and control power to the electrode field.

The TMPs will consist of 2-inch ID FRP with a lower end cap. The annular space of the TMP well will be grouted from TD to 6-12 feet from surface, depending on zone, with a cement-silica grout mixture that conforms to Spec 02215-3; 2.1.2. Grout can be electrically conductive, so completion to 1 ft below surface is with sand, and then grout to surface.

In addition, as a means of verifying hydraulic control, thermocouples will be placed in existing monitoring wells and pumping wells AA-1, CC-1, DD-1, CC-6, EE-5, GG-1, MW7A, MW-7B, X1A, X1B, X-6A and X6B.

6.10 ERH System Construction and Controls

Once the subsurface ISTT components are completed and RAMP documents approved, surface construction shall commence. This phase of work includes the set-up and wiring of the following components:

- Power Supply Units (PSUs)
- Output Transformers
- System Control and Data Acquisition system (SCADA)
- Field Wiring
- Electrode wetting system

- Thermocouples (TCs) in the TMPs
- Thermocouple Monitoring Boxes
- Continuous Emissions Monitor (CEM)
- Safety Interlocks

Several safety features are designed into the ISTT system by CES and are summarized below.

6.10.1 ERH System Interlocks

Numerous and redundant safety interlocks consisting of both physical and software programmable logic controllers shall provide safety and security for protection of human health and the environment. There are seven redundant safety measures in CES's ERH systems:

1) 1200 Ampere Breaker - Physical disconnect located on main feed of each output transformer, a physical breaker would trip if current exceeds this value.

2) 1200 Ampere Fused Disconnect - Physical fuses in each disconnect circuit that would blow if output power exceeds 1200 Amperes on any given leg of the 3-phase power.

3) 1000 Ampere over current limit: Set at 83% of the breaker limits above, this software will trip the output Silica Control Relays (SCRs) that send power to the electrode field.

4) Tap-Specific Current Limit on Transformer Secondary: The main transformers that send power to the electrodes have several physical "taps" for voltage range controls. Each of these taps have their own safety overloads on the secondary windings.

5) Power Range Adjustable SCRs: The SCRs themselves have adjustable power ranges that are set well below the 1000 ampere current limit mentioned in #3 above. The SCRs are very expensive devices, so they are carefully protected.

6) Average Current Adjustable Limits on Silica Control Rectifiers (SCRs): The SCRs are programmed to shut down power to the electrodes if the "average" current varies excessively.

7) Individual Cable Current Limits: CES' software has the capability to monitor the current through every electrode cable by using a set of current transducers (CTs). Programmed to National Electrode Codes (NEC), this software will shut-down the PSU if any individual electric cable exceeds the maximum amperage specified by the NEC for any given cable size.

8) Exclusion Zone Gate: Turns off power if gate is opened to treatment area.

9) Motion detectors within exclusion zone fence line will shut off power when tripped.

10) Emergency Shutdown Switch: Located nearby the office trailer in the support zone, this switch is a master shut-off that can be used by site personnel, police or fire departments in the case of a site emergency.

6.11 SVE Construction and Controls

Construction of the SVE components proceeds concurrently with the ERH construction. The SVE components consist of:

- Vacuum Extraction Unit (VEU)
- Condensate Control System
- Backup Generator (in case of power loss) and SVE unit
- Vapor Phase Granular Activated Carbon (VPGAC) for vapor treatment
- Liquid Phase LPGAC for water treatment

6.11.1 Vacuum Extraction System

Based on 2.5 MW power availability and sequential treatment campaigns, steam, vapors, and entrained groundwater (via DVE) shall be driven by up to two 40 hp Vacuum Extraction Unit (VEU) per heating campaign. A 3rd 40 hp unit is available for redundancy, and a smaller, 10 hp backup unit to be powered by a generator, is available during power outages. The 40 hp units will be a Duroflow Model 4512 (or equivalent Sutorbuilt 7ML) positive displacement blower, and each unit is constructed in a noise dampened aluminum or steel enclosure containing the following controls:

- Class 1, Div 2 Explosion Proof Control Box
- Vacuum Relief Safety Valve
- Inlet Filter
- Noise Silencer
- Over ampere safety interlock
- Bypass air valve

CES maintains a Standard Operating and Maintenance Procedure (SOP) for all of its process equipment in the form of an operator "Field Reference Manual." Spare parts, such as blower oil, bearing grease, filters and drive belts are maintained on-site as a normal business practice. Maintenance occurs monthly at a minimum or more often as conditions may dictate.

6.11.2 Condensate Control System

Extracted steam and vapor will be processed through two vapor/liquid separator (V/L) tanks and then pass through the condensing unit. From here, the condensate is pumped to a holding tank pending treatment through GAC before discharge to the onsite groundwater treatment system.

The V/L tanks are 500 gallon tanks that measure 3 ft in diameter and approximately 8 ft. tall. They will be equipped with level controls and pump capable of removing liquid and pumping to a storage tank. The separator will remove any entrained water from the from the main DVE manifold. Following the separator, vapor and steam will pass through the condensing skid. The condenser skid features a plate-type heat exchanger that uses water from a cooling tower to condense steam. The water and steam are maintained in separate flow channels arranged in a conventional cross-flow

configuration. The heat-exchanger outlet incorporates a mist eliminator to remove over 99 % of water droplets that exceed 10 micron followed by a second knockout pot. The condensed water is then passed to the separator for pumping to the storage tank and GAC treatment system.

6.11.3 Vapor Treatment

Once through the condenser skid, the contaminant-laden vapors will be treated with vapor phase granular activated carbon (VPGAC). If mass removal rates are consistent with the total COC mass estimates in the Final Feasibility Study (CH2M HILL, June 2006) then carbon usage should be about 10,000 lbs. (about 1000 lbs of COCs at 10% loading rate on carbon). More recent sampling lead CH2M HILL to conclude that much less mass is present within the ISTT Volume. Design now reflects that COC mass may be as little as 100 pounds. The carbon system had been designed for four 1000-pound units, two as primaries and two as secondary carbon vessels to provide 100% redundancy, both as backup and for mass loading. A third set has been added for additional redundancy. The 2.5 MW system will duplicate that system so that there are twelve 1000-lb carbon units online once Stage 2 commences. Breakthrough at the secondary carbon (<95% capture efficiency) will trigger a carbon exchange. An additional pair of carbon units for each train will be available onsite. Spent VPGAC shall be sent offsite for reactivation at a licensed resource recovery facility.

The VPGAC is on the *inlet* side of the SVE vacuum pump. This configuration has been used successfully at more than 2,000 SVE sites worldwide, and carbon adsorption efficiencies under this configuration have been shown to be at least as good or greater than designs that place the carbon on the outlet of the SVE unit (e.g. 10% – 20%). There are four important advantages with this design. First, if there are any leaks that develop in the SVE manifold(s), the entire system is under vacuum, so only fresh air can enter the system while no discharge of contaminated vapors is possible. Secondly, VPGAC adsorption must be done at temperatures less than 38°C (100° F). Since the temperatures at the outlet of an SVE unit can approach 180° C (350° F), SVE designs which have the VPGAC after the VEU must incorporate a heat exchanger. This piece of equipment is not necessary with CES's design. Third, VPGAC treatment after the VEU is done under pressure, and hence, there is always the risk that a failed fitting, valve or other pressure failure in the manifold will result in contaminated vapors escaping to the atmosphere. Lastly, lubricating oil in the VEU would come into contact with the COCs if VPGAC was on the discharge side and therefore, generate more hazardous waste.

The VPGAC treatment system will consist of pairs of primary, secondary and tertiary vessels with a vapor monitoring port between the vessels. The tertiary carbon is designed to assure no emissions even if the secondary carbon becomes spent. Spent carbon shall be sent for reactivation at a site in compliance with the CERCLA Offsite Rule. Certificates of destruction will be obtained to verify destruction of COCs and reuse of carbon at this site.

6.11.4 SVE Backup System

A backup SVE system will be installed as an additional safety feature. The backup SVE system will be powered by a diesel generator. An interlock in the power control system will automatically start the generator and back-up SVE system if site power is lost or the primary SVE unit shuts down for any reason. Hence, there should be no loss in SVE operations for any reason throughout the project.

The safety back-up SVE system will be a 10-15 Hp vacuum blower capable of 200 CFM at 15 in Hg. Capacity is sufficient for vapor control at the cap and vent lines. The generator will be driven by an engine under 50 hp, under permit requirements of California.

6.12 Site Cap

A site cap shall be installed over the treatment area as per **Figure 5**. The cap system shall consist of 6 inches of pea gravel, contiguous with electrode shallow vents, and additional air intake vents. Areas where there was historical shallow contamination, insulation board and HDPE liner will cover the gravel to limit heat loss at the surface. The cap ventilation system is separately manifolded to the SVE system equipment and it is also connected to the back-up SVE system, which will start up on generator power if the site power is lost.

6.13 System Testing and Commissioning

CES's pre-commissioning checklist is included in **Table SMP-5**. Testing and commissioning consists of start-up and shakedown of all system components and sampling and analysis of key operating parameters, including potential emissions sources.

Any subsurface piping designed for pressurized operation will be pressure tested according to manufacturers guidelines prior to backfilling. Once the installation has been completed, CES will inspect the system for any system deficiencies. CES will also test all equipment interlocks for proper operation.

Once energy is applied to the soil, CES will monitor the site for hazardous voltages so that may be identified and isolated or removed. CES typically starts a low voltage and then ramps the system up to the planned operating voltage. Once the initial voltage has been set and power is being applied to the ground, a local or remote operator will collect subsurface temperature data and power input daily. Relevant SVE information will be collected.

CES personnel and the SSHO will remain on-site daily until the safe and efficient operation of the system is confirmed. Typically, this is a period of two weeks into the operation, but may be more or less depending upon operating efficiency and any troubleshooting that may be required. Otherwise, CES will monitor the site remotely 8 hrs/day, 5 days/week, or as otherwise determined necessary between EPA, CH2M Hill and CES, with on-site presence as required. The vacuum extraction unit and power supply unit will undergo routine maintenance on monthly basis. Vapor samples will be collected to determine mass extraction rates. The vapor sample data will be essential in determining the mass of contaminants removed, treatment capacity and carbon loading.

6.14 Operations & Maintenance (O&M)

[Spec. 01840]

O&M begins following startup, testing and commissioning of the ISTT system components. The O&M Plan includes monitoring of all system components and sampling and analysis of key operating parameters, including potential emissions sources. The PMP described above in **Section 4** is an integral part of the O&M Plan. Since the final design has not been completed or approved, the O&M

Plan will continue to be updated in terms of equipment information, catalog cuts, or manuals In any case, the O&M Plan shall follow Specification 01400, 1.14.2 and CES's general operating strategy for the treatment volume is summarized below.

6.14.1 ISTT Operating Strategy

The 30% design was based on cleanup of the BTV with adequate power delivered to the site. The model predicted the performance objectives would be met within 250 days of operations. However, due to the increased volume and complexity of the DTV and the limited power available to the site, the DTV will be completed in stages or campaigns. There were many approaches evaluated to determine which approach would be cost effective for the pre-final design.

With the availability of 2.5 MW power, the approach judged to be most effective is three sequential treatment stages, with some overlap utilizing a "rolling" campaign strategy. If a portion of the area under treatment has achieved the diminishing returns goal, then power to those electrodes in that area may be shifted to the next treatment area. This approach allows the maximum amount of energy density, which results in a more controlled treatment process and less heat losses. It allows parts of the site to clean up faster. This approach results in a more efficient operation since there is one operation that can be essentially repeated three times on the site. What is learned during the first campaign (ie, in-situ hydrolysis rates) can be applied to the next campaign. Monitoring of groundwater and vapor concentrations over time are less time consuming per event, so there are less power shut downs to perform this intrusive work in the active treatment area.

The ERH design for the full volume will use 111 electrodes for the seven treatment zones, and 125 additional shallow electrodes, as needed, in the first two zones. Available power of 2.5 megawatts will allow us to use three 750 kW PSU, though scheduling needs may result in starting with one on the initial campaign. One 750 kW PSU is equivalent to three 250 kW PSUs, having three separate 300 kVA output transformers controlled by three separate 350-A Silica Control Rectifiers (SCRs). This power delivery design provides the flexibility to operate the treatment zones at a constant power or constant temperature, using the numerous thermocouple signals as feedback. The TMPs are strategically located for utilization as temperature control feedback for electrode power. The PSU and electrodes can also operate in a peak/offpeak utility mode for energy savings. For example, operating the PSUs only at night during off-peak hours has proven cost effective on other projects. By adjusting deadband and setpoint temperatures in the operating software, the rate of heating and steam production in each zone can be controlled. This means that the power delivery during all phases can be maximized (100% power) during off peak electrical rate periods and minimized (maybe 40% during heat-up, 0% during treatment) during daily peak rate periods, using the existing SCR control software.

Each electrode will have conductive intervals as depicted in the design. Electrode length determines power density, so the longer segments will receive a higher power density. Overall, CESs modeling predicts that the temperature criteria of the boiling point of water or >100C in the saturated zone, and 90+/-10C at <10 ft bgs, can be achieved with a power density of about 45W/yd^3, and that the total power input to achieve the concentration criteria will be about 248 kw-hrs/yd^3.

Each CES electrode will contain extraction well screen that supports both DVE or SVE type extraction. Each electrode borehole will contain an extraction vent and a cap vent. The primary

extraction vent consists of a FRP pipe slotted as shown for the appropriate zone depth. This allows flexibility to independently control both SVE and DVE during periods of water table fluctuation, which is up to 20ft annually at this site. A second shallow vent ("puppy vent") is CPVC well screen, screened from just below the surface to about 4 ft bgs. This puppy vent is a safety factor placed to intersect rising steam into the shallow zones and to capture from the site cap.

Operations strategy is limited by available power, yet to utilize the available power effectively, the heating campaigns could basically proceed as follows: With the PSU interacting automatically through computer software with the TMPs, each treatment zone would be operated first in constant temperature mode set to a target temperature of 80°C (for example) with the feed-back from the TMPs controlling power delivery. In this SCR temperature controlled power mode, the PSU delivers full power (80% duty cycle) until the target temperature is reached, then power is automatically reduced to maintain the TMPs at target temperature for as long as desired. This approach would meet the temperature milestones as quickly as possible with minimum electrical energy.

To maintain efficient heat-up rates, it is possible that one or more electrode sections would need to be operated in DVE mode to achieve hydraulic control. It is also possible that the hot water within the treatment region would not need to be extracted, other than by placing an entrainment tube a fixed height above water to limit hot water vertical mounding during steam production. The perimeter wells could be operated on an as-needed basis during heating using TMP thermocouple responses as a guide. Hence, once the target temperatures are achieved in any given area, the ongoing operations can focus on other more difficult zones while maintaining the temperature in the heated areas. Following this procedure, once portions of the treatment zones reach diminishing returns, the electrodes and extraction vents in that portion can be taken off line, enabling the remaining power and extraction capability to be focused on successively smaller volumes containing residual VOCs, and thus accelerating completion of the ISTT.

6.15 Process Monitoring and Performance Testing

[Spec 01840]

Process monitoring and performance testing consists of both manual and remote data acquisition monitoring of the ISTT system according to the PMP described above in **Section 4.7.** A sample of a site Daily Log appears in **Table SMP-6.** This monitoring program is included in the Operations and Maintenance Plan and is designed to provide daily feedback to operating personnel on the performance of the ISTT.

6.15.1 Groundwater Level Monitoring

[Spec 01840, Tables 1 and 2]

In lieu of groundwater level monitoring, additional thermocouples have been installed in monitoring or extraction wells outside the perimeter of the treatment area. Temperatures will be monitored to determine if hydraulic control measures are adequate to prevent heated groundwater from flowing outside the treatment area.

6.15.2 Temperature Monitoring

Nineteen TMPs are installed in the DTV, designed for each treatment zone. Each TMP contains multiple thermocouples, located at appropriate depths for each treatment zone. The TCs will be Type "T" thermocouples handcrafted by CES. The TMPs will be constructed with FRP pipe. The TCs will be connected to field voltage isolation boxes and then transferred to the site SCADA computer for real-time data logging. In Zones 1 & 2, the shallowest thermocouple is at 2 ft bgs, and remaining thermocouples are located at 5 ft intervals from 5 ft bgs to total depth. Zones 3&4 have TCs from 5 ft or 10ft to well depth, at 5 ft intervals. At zones 5&6, the first TCs are at 20 ft and continue at 5 ft intervals to well depth, and at zone 7, TCs start at 30 ft down to well depth. In addition, TC will be installed in several perimeter monitor wells and pumping wells downgradient of the ISTT Volume (see final design). TC temperatures will be recorded at a minimum of three times daily by the SCADA control system. The information is maintained in the on-site computer as well as remote back-up databases maintained at CES offices.

6.15.3 Vacuum

Subsurface vacuum is critical to monitoring performance of the ISTT system, managing fugitive emissions, and protection of human health and the environment. No additional SVE wells will be installed since vapors are collected from electrode wells and shallow vents. In addition, the combined influent manifold, will be equipped with a vacuum gauge to verify negative pressure at the wells. Each of the electrodes will have capability of vacuum measurement. Manifold gauges will have a range of 0 to -30 inches Hg and a resolution of 1 inch Hg. Subsurface vacuum gauges will have a range of 0 to -100 inches of water with a resolution of 0.25 inches of water. A u-tube water manometer will be used where vacuum readings are expected to be less than 10 inches water column.

6.16 Process Data Collection and Distribution

[Spec 01840, Table 2]

CES will provide access to real-time system monitoring information to the CH2M HILL and EPA through remote DSL access, or web site communication data manager. Data access for personnel other than CES will be for viewing purposes only, and only CES personnel will have access to the software programs and the ability to alter site parameters remotely. This is for safety purposes so that others cannot inadvertently change site operating parameters without CES's knowledge. Data access may be temporarily unavailable during O&M events or while CES is making upgrades or alterations to the operating software.

Data available for viewing will include, but not be limited to:

- Operating power (volts and amps on electrodes)
- Total energy applied
- Subsurface Temperatures at TMPs
- Status of various equipment (VEU, pumps, etc.)
- Interlock and Alarm status

6.17 Sampling and Analysis

[Spec 01840, Table 2]

Vapor and groundwater samples, will be collected, stored and packaged appropriately according to the SAP. Samples requiring laboratory analyses will be overnight shipped, or couriered locally to certified laboratories in accordance with applicable regulations and with appropriate Chain of Custody documentation. The scope and frequency of the monitoring is prescribed in the PMP.

6.18 Regulatory Compliance

[Sect. 01400-1.5.1.A.7]

Due to the NPL status of the site, permits are not required; however, substantive requirements of applicable permits must be met. Accordingly, typical permits required for such a site would normally include well permits, air permits, water discharge permits and potentially construction permits. The substantive requirements of the well permits are to register wells with coordinates and supply boring logs to local regulators. The air permit requirements are driven by discharge standards listed in Specification 01840, Table 01840-3 and are expected to be met by pneumatic control, collection of gas emitted from the ISTT volume, and containment and treatment of emitted and extracted gas with granular activated carbon, so emissions of chemicals from the exhaust stack are at/or below the standards. The Yolo-Solano County Air District will determine compliance requirements based on typical application information for final design. Water discharge requirements of the City of Davis are expected to be met with the pre-treatment by activated carbon within the ISTT system and further treatment by the existing EPA groundwater treatment system. While construction permits may be applicable to local electrical work, the requirements are that work be done according to the national and state electric codes.

6.19 Management of Fugitive Emissions

CES expects no fugitive emissions and believes our redundant design with three levels of vent safety (electrode, puppy and site cap vent), monitoring plan and interlock design plan thoroughly covers this contingency by incorporating several redundant back-up and safety systems in its design:

- Back-up SVE system which is not reliant on site power for its operation.
- SVE surface vapor collection system in addition to the vertical SVE wells.
- VPGAC adsorption on the inlet of the VEU preventing any pressurized contaminants.
- Routine and customary background air quality checks with hand held photoionization detector (PID).
- Back-up generator to operate the backup SVE system during power outages.

6.20 Contingency Management Plan

A contingency management plan is an inherent part of the OMP. The following contingency management items, at a minimum, are either included in the OMP or other plans such as the Environmental Protection Plan and the Health and Safety Plan:

- Emergency Response
- Interlock and Alarm troubleshooting
- Fire and smoke
- Equipment failure
- Power failure
- Mechanical failure (pipes, valves, etc)
- Water runoff
- Storms, flood, & other acts of God
- Heaving & subsidence
- Fugitive air emissions
- Personnel H&S
- Environment H&S

6.21 Reporting Plan

[Spec. 01400; 01780]

The OMP contains report details. These include

- Daily site logs when CES personnel are present
- Weekly letter update reports
- Monthly Reports
- ISTT Completion Report

7.0 CONSTRUCTION QUALITY CONTROL PROCEDURES

The quality control (QC) procedures will be carried out to ensure continued compliance with workmanship and project schedules. This Section contains a synopsis of the QC plan**.**

7.1 Three Phases of Control

The QC Manager will perform sufficient control phases and tests of all work, including that of subcontractors to ensure conformance to applicable specifications and drawings with respect to the materials, workmanship, construction, finish, function performance, and identification.

The QC organization will perform at least three phases of control for all definable features of work as follows:

a. Preparatory Phase – Performed prior to the start of work. Notify the client and other appropriate persons at least 24 hours in advance of the meeting.

- Review contract requirements.
- Check to assure that all materials and/or equipment are on hand and have been tested, submitted, and approved as required.
- Check to assure that provisions have been made to provide required control testing.
- Examine work area to assure that all preliminary work has been accomplished.
- Review hazard analysis.

b. Initial Phase – Performed at the beginning of a definable feature of work. Notify the client and other appropriate persons at least 24 hours in advance of the meeting.

- Check preliminary work.
- Check new work for compliance with contract documents.
- Review of control testing.
- Establish level of workmanship.
- Check for use of defective or damaged materials.
- Check for omissions and resolve any differences of interpretation with the government representative.
- General check of dimensional requirements.
- Check safety compliance.

c. Follow-Up Phases – Perform daily checks to assure continued compliance with workmanship established at the initial phase.

- Assurance of continuous compliance with contract drawings and specifications
- Daily control testing.

7.2 Receiving and Warehousing

Inspection of permanent construction materials received will be performed by the QA/QC Manager, Field Supervisor or other QC personnel. Visual inspections will be made for:

- Identification
- Damage
- Completeness
- Evidence of compliance with approvals
- Proper documentation

Results of receiving inspection will be recorded on an appropriate report form and will be made available to the client.

7.3 QC Inspection Phases

CES will log construction deficiencies from identification through corrective action. The QC representative will conduct a complete inspection of the work and develop a "punch list" of items that do not conform to the contract requirements. The QC representative will make a second completion inspection to ascertain that all deficiencies have been corrected. The government will be notified that all corrective actions have been completed. The completion inspections and any deficiency corrections will be accomplished within the time stated for completion of the work.

7.3.1 Materials Certification

Copies of all purchase order or subcontracts requiring inspection will be given to the QC Manager or his designate for receiving and record purposes. When the purchase order requires vendor certification of materials, equipment, or supplies, such certification shall be verified as to accuracy and conformance and may be used in lieu of a test for those properties covered by the certification. Copies of all certification received will be maintained in the QC folder and will be available to the government upon request.

7.3.2 Workmanship Inspection

Workmanship items will be inspected by the QC Manager. The QC Manager shall verify by signature that all items installed are in accordance with the contract drawings and specifications prior to the placement of concrete or covering. Any corrective action required will be recorded. All construction work will be conducted in accordance with the RAMP drawings and documents. All rework or changes that change existing engineering drawings or specifications must be authorized. All construction work will be recorded on the QC Manager's report. Work found in compliance with the drawings and specifications will be noted.

If discrepancies are found in quality, workmanship, materials, equipment, supplies, and/or unauthorized deviations from engineering requirements or specifications can be called to the attention of the responsible supervision personnel.

a. Discrepancies will be recorded on the field logs. Each discrepancy will be assigned a number by the recording QC Manager. A concise statement locating the discrepancy and description of the discrepancy will be filled in by the QC Manager.

b. When material, equipment, supplies, or workmanship that does not conform to the drawings or RAMP specifications are rejected, the QC Manager will initiate a discrepancy report and immediately furnish copies to the project manager.

c. Upon reviewing the discrepancy report, the project manager or his representative and the QC Manager will examine the rejected items. If in their opinion, any of the rejected items can be reworked to a usable condition, the discrepancy report will be so noted. However, if, in their opinion, the item cannot be reworked, either from a practical and economical standpoint, the item shall be scrapped and an entry made on the discrepancy report concluded to that effect.

d. Upon completion of rework on items specified for rework, the QC Manager will be notified and he will re-inspect the item to the original requirement plus the rework information on the discrepancy report. If it is found acceptable, the discrepancy report will be so noted. From this point on, the item will be handled in the normal manner. If, however, the item is still not acceptable to the QC Manager due to poor workmanship, etc., arising from the rework, we will treat this item as a first time rejection and this will be resubmitted for inspection only after further rework.

The discrepancy report log will be periodically reviewed by the project manager with the QC Manager to formulate a disposition of each listed uncorrected discrepancy. They will establish timetables for final resolution of all discrepancies.

7.3.3 Calibration of Equipment

All contractor-furnished measuring and test equipment shall be calibrated and maintained to traceable government standards. Records of these calibration certifications will be maintained by the QC Manager and made available to the government upon request.

a. Each instrument will be plainly and permanently numbered, the equipment will be operated only by those persons directly responsible for the equipment or personnel under their cognizance.

b. Each piece of equipment will be checked for accuracy as recommended by the manufacturer for frequency of calibration. Required calibration of measuring and test equipment will be conducted by a certified laboratory.

Measuring and test equipment that is dropped, damaged, or believed to be inaccurate will be removed from services and will be recalibrated.

7.4 QC Testing

QC testing is performed to determine whether construction procedures are producing the desired contractual product. CES will establish and maintain a system to track verification, control, and acceptance tests. Each planned test type and frequency will be entered into the tracking system prior

to beginning work. Results and dates of individual tests will be added to the system as they are performed. Any failing test results will have retests performed, will be entered into the system and cross referenced. The tracking system must be reviewed frequently to assure that any activity underway is having all planned tests performed as scheduled.

7.5 Off-Site Control

Facilities of off-site fabricators and suppliers will be surveyed as required to assure that all requirements of the contract drawings and specification are met and maintained and to assure delivery of quality products. The results of each survey will be recorded on an appropriate form and will be made available to the client. The fabricator or supplier will be notified of any deficiencies and will be required to submit a report of corrective actions taken. CES will inform the client of off-site surveys.

7.6 Surveillance of Subcontractors' Operations

Surveillance of the subcontractors' operations is the responsibility of the QC Manager. Major discrepancies that come to the QC Manager's attention will be recorded and transmitted to the related subcontractor. The QC Manager has authority to act directly with subcontractor representatives on routine QC activities. If the discrepancy is related to a concrete placement or will be covered by preceding operation, a resolution will be made prior to the item being covered. Major discrepancies will be followed up on a daily basis, upon correction of the major discrepancy, the date corrected will be noted and by whom.

7.7 Completion of Work

Near the completion of all work, the following activities will be performed:

Contractor Punch-Out: CES will prepare a punch list and make corrections. CES will correct deficiencies promptly so that the project schedules are met. All major deficiencies noted during this contractor punch-out inspection must be corrected prior to the pre-final inspection.

Pre-Final and Final Inspections: QC personnel will assure that all deficiencies noted during the pre-final inspection are corrected prior to the final inspection, and report the status of corrective actions to the client. Any deficiencies noted at these inspections by user personnel, whether design or construction related, will be examined by the client and CES will be notified if corrective action is required under the terms of the contract.

Complete As-Built Drawings: As-built drawings are updated continually throughout the project. During the final stages of construction, QC personnel will review and complete these drawings. While the status of as-built drawings is a concern throughout the project, it is of particular significance, as the project comes to an end, to prevent any loose ends.

O&M Manuals: QC personnel will assure submittal of all required O&M data in accordance with scheduled submittal dates.

Instruction and Training Procedures: If the contract requires O&M training of customer personnel, the QC personnel will make certain all specified training has been conducted by qualified instructors.

Materials Turnover: QC personnel will verify that all required keys, spare parts and materials have been sorted, identified, and demonstrated to be usable prior to final inspection.

Submittal of Warranty Information: The QC personnel will ensure that all warranty information is provided. Procedures for warranty notification and correction should be in place.

7.8 Final Inspection and Test

Prior to final inspection, all systems being inspected or tested shall be completed and accepted by the QC Manager. After this acceptance, the final inspection and test may proceed in accordance with the following steps:

a. Verify the test personnel have a working knowledge of the special characteristics of the instruments being used.

b. Note the particular inspection or test requirements and criteria for successful completion of the required inspection or test.

c. Upon satisfactory verification of these requirements, the test may proceed. Each reading will be verified and documented by the QC Manager. All functional validations or tests will be performed by the QC personnel unless otherwise noted. No functional test will be accepted without properly authorized and approved test procedures.

d. The general requirement of final acceptance may include the following:

- General appearance
- Workmanship
- Cleanliness of areas and equipment
- Identification of equipment
- Painting
- Removal of unused material and temporary facilities
- Condition of job files and completion of paperwork

8.0 PROTECTION OF HUMAN HEALTH AND ENVIRONMENT

[Spec. 01400-1.3.2]

Safety and protection of human health and the environment are critical to the success of the project. CES has developed several plans and specifications that promote safe operations and mitigate risks, including several presented below.

8.1 Site Heath and Safety Plan (HASP)

The HASP developed to comply with CH2M HILL's overall site HASP and augmented by CES with enhanced HASP procedures specifically regarding ISTT safety, and for working in hot environments (e.g., steam) is provided under separate cover.

8.2 Methods to Minimize Impact to Public and Environment

[Spec. 01400-1.5.1.A.4]

Control of COCs in the air and groundwater are the primary focus of mitigating risk of exposure to people and the environment. These efforts include control of potential emissions with a robust vacuum extraction system, including backup systems in the event of a power outage. In addition, control of groundwater by maintaining hydraulic gradients to the treatment area will assist in minimizing impact to the public and environment. Furthermore, specification and control of the exclusion zone is critical to minimizing impact to the public. There will be two levels of protection for excluding the public: 1) the perimeter fence around the site and 2) a specially located fence and gate that is monitored so that shutdown of the electrode heating process occurs if the gate is opened, or if motion is detected within fence perimeter.

Dust control shall be conducted in the form of engineering controls using water spray. Noise control shall be conducted according to local regulations.

8.3 Management of Fugitive Emissions

CES expects no fugitive emissions and the redundant design with three levels of vent safety (electrode, shallow vents and cap vent), monitoring plan and interlock design plan thoroughly covers this contingency by incorporating several redundant back-up and safety systems in its design:

- SVE surface vapor collection system in addition to the vertical SVE wells.
- GAC adsorption on the inlet of the VEU preventing any pressurized contaminants.
- LEL interlocks in main manifold and continuous emissions monitor.
- Routine and customary background air quality checks with hand held photoionization detector (PID).
- Back-up generator to operate the back-up SVE system during power outages.

8.4 Monitoring Offsite Migration

The objective of CES's unique design and operating protocols is to mitigate any migration of contaminants outside the treatment area. A thorough monitoring program shall confirm this and indicate any potential problem areas that might require operational adjustments. The monitoring program includes:

- Temperature Monitoring Points (TMPs) within the treatment area
- Temperature monitoring outside perimeter of treatment area
- Subsurface pressure monitoring at the perimeter
- Sampling at perimeter sampling points.

An important element of CES's ERH system to help mitigate off-site migration is the flexibility to control groundwater and steam migration through DVE and the existing groundwater extraction system. Since CES's electrodes double as DVE wells, the electrodes will be screened and used to intercept and capture steam and contaminant vapors generated by heating. Screening the entire electrode interval will take advantage of the secondary porosity layers throughout the treatment volume to capture rising steam.

8.5 Waste Minimization

CES is committed to waste minimization throughout the project, so to the extent acceptable to CH2M HILL and EPA, the following are expected to be utilized:

- Water: irrigation for dust control/evaporation.
- Soil cuttings from electrode installation will remain onsite to be treated under the site cap.

8.6 Groundwater Control

CES will use DVE, augmented by the existing groundwater pumping system, in order to expedite heating and to maintain hydraulic control in the DTV. Although the buoyancy effects of hot vapors and steam would generally cause them to rise vertically where they can be captured by the SVE system, complex lithologies can trap this steam and vapors beneath lower permeable lenses causing them to migrate laterally as opposed to vertically. Field experience at several sites has proven that even a nominal amount of groundwater extraction by DVE can effectively control the soil pore pressure.

9.0 SYSTEM DEMOBILIZATION

[Spec. 02679, 01780]

At the conclusion of the O&M period and after the remedy has achieved its objective, decommissioning and demobilization (D&D) of the site shall occur. Normal D&D activities include:

- PSU shutdown.
- SVE operations maintained on fresh air for a approximately one(1) day to decontaminate process piping & equipment.
- SVE shutdown.
- Electrical lock-out/tag-out on PSU, VEU, and field cables.
- Decontaminate (as necessary).
- Remove rented equipment.
- Disconnect and remove field electric cables.
- Remove major equipment.
- Remove & dispose of process piping (according to WMP).
- Abandon electrodes, TMPs, piezometers .
- Remove temporary building and office trailers.
- D&D utilities.
- Site Restoration.

9.1 Abandonment of ISTT Subsurface Components

[Spec 02679; 3.1.2.2, 3.2.1.3 and 02679; 1.4]

Following completion for the ISTT, and upon approval of CH2M HILL and EPA, the subsurface ISTT components shall be abandoned in accordance with **Spec 02679; 3.1.2.1** and abandonment records maintained per **Spec 02679; 3.2.1.3.** Submittals regarding the abandonment of ISTT subsurface components shall be made to CH2M HILL according to **Spec 02679; 1.4.**

10.0 PROJECT CLOSEOUT

[Spec 01780]

The project closeout consists of the requirements for final reporting, cleaning and inspection necessary to finalize the contract.

10.1 Closeout Procedures

CES will conduct records closeout in accordance with contract requirements. Closeout procedures can include the submission of documents such as the following:

- As-built drawings complete
- Record of materials
- Utility as-built drawings and decommissioning certifications
- Equipment/product extended warranty tags
- Monthly project waste summary reports
- Hazardous material reporting
- Punch out / “punch list”
- Final inspection list
- Deficiency correction and verification
- Site Restoration
- ISTT Completion report (Re; Section 3.8.1.4)
- Final budget review, evaluation, invoicing.

TABLES

TABLE SMP-3
FRONTIER FERTILIZER REMEDIATION DELINEATION SAMPLING PLAN

drilling date	BORING/ WELL ID (X-SECTION LINE -#)	ZONE, Relative Location[5]	WELL TYPE	Boring Size	SOIL OBJECTIVES: Source definition: Edge	Source definition: Top	Source definition: Bottom	Hydro-geology: S-1	Hydro-geology: S-2	VOCs w/TPH-G as TICs, SOIL SAMPLING: SOIL SAMPLE START DEPTH (ft.)	VOCs: SOIL SAMPLE STOP DEPTH (ft.)	VOCs: FREQUENCY OF SOIL SAMPLES (ft/sample)	VOCs: NUMBER OF SOIL SAMPLES	TPH-D, SOIL SAMPLING: SOIL SAMPLE START DEPTH (ft.)	TPH-D: SOIL SAMPLE STOP DEPTH (ft.)	TPH-D: FREQUENCY OF SOIL SAMPLES (ft/sample)	TPH-D: NUMBER OF SOIL SAMPLES	GW Monitoring Target Zone[8]: S-1	GW Monitoring Target Zone: S-2	GW: Potential Control	SG monitoring: Vadose zone	GW SAMPLES: NUMBER GW SAMPLES	QA/QC SAMPLES: SOIL: DUP	QA/QC SAMPLES: GW: DUP	COMMENTS
17-Oct	AA-1	A, P	GW S1/2- 4"& SG 5' bgs	8"	x	x	x		x	5	90	5	18	5	90	5	18		yes	yes	yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
3-Nov	BB-1	A, B	GW S1/2- 1"	5"	x	x	x		x	5	90	5	18	5	90	5	18		yes			1	1		single screen GW well in most permeable material
22-Oct	BB-2	A, B	GW S1/2- 1"	5"		x	x	x		35	90	5	12	35	90	5	12	yes				1	1		single screen GW well in most permeable material
6-Nov	BB-3	A, B	GW S1/2- 1"	5"	x	x	x		x	5	90	5	18	5	90	5	18		yes			1	1	1	single screen GW well in most permeable material
17-Nov	CC-1	A, P	GW S1/2- 4"& SG 5' bgs	8"	x	x	x		x	5	90	5	18	5	90	5	18		yes	yes	yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
12-Nov	CC-2	A-B, B	GW S1/2- 1"	5"	x	x	x	x		5	90	5	18	5	90	5	18	yes				1	1		single screen GW well in most permeable material
4-Nov	CC-3	A-B, B	GW S1/2- 1"	5"		x	x		x	35	90	5	12	35	90	5	12		yes			1	1		single screen GW well in most permeable material
31-Oct	CC-4	A-B, B	GW S1/2- 1"	5"	x	x	x		x	5	90	5	18	5	50	5	10		yes			1	2	1	single screen GW well in most permeable material
17-Nov	CC-5	A-B, B	GW S1/2- 1"	5"		x	x	x		35	90	5	12	35	90	5	12	yes				1	1		single screen GW well in most permeable material
14-Nov	CC-6	A-B, B	GW S1/2- 1"	5"	x	x	x	x		5	90	5	18	5	90	5	18	yes				1	1		single screen GW well in most permeable material
10-Nov	DD-1	B, P	GW S1/2- 2"& SG 5' bgs	6"	x	x	x		x	5	90	5	18	5	90	5	18		yes		yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
11-Nov	DD-2	B, P	GW S1/2- 2"& SG 5' bgs	6"	x	x	x	x		5	90	5	18	5	90	5	18	yes			yes	1	2		single screen GW well in most permeable material & SG at ~5' bgs
30-Oct	DD-3	B, B	GW S1/2- 1"	5"	x	x	x	x		5	90	5	18	5	90	5	18	yes				1	1		single screen GW well in most permeable material
29-Oct	DD-4	B, B	GW S1/2- 1"	5"	x	x	x		x	5	90	5	18	5	90	5	18		yes			1	1		single screen GW well in most permeable material
22-Oct	DD-5	B, P	GW S1/2- 4"& SG 5' bgs	8"	x	x	x		x	5	90	5	18	5	90	5	18		yes	yes	yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
18-Nov	DD-6	B, P	GW S1/2- 2"& SG 5' bgs	6"	x	x	x	x		5	90	5	18	5	90	5	18	yes			yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
24-Oct	EE-1	B-C, P	GW S1/2- 4"& SG 5' bgs	8"	x	x	x		x	5	90	5	18	5	90	5	18		yes	yes	yes	1	2		single screen GW well in most permeable material & SG at ~5' bgs
28-Oct	EE-2	B-C, B	GW S1/2- 1"	5"	x	x	x		x	5	90	5	18	5	90	5	18		yes			1	2		single screen GW well in most permeable material
15-Oct	EE-3	B-C, B	GW S1/2- 1"	5"	x	x	x	x		5	87	5	17.4	5	50	5	10	yes				1	2		single screen GW well in most permeable material
13-Oct	EE-4	B-C, B	GW S1/2- 1"	5"	x	x	x		x	5	90	5	18	5	50	5	10		yes			1	2		single screen GW well in most permeable material
5-Nov	EE-5	B-C, B	GW S1/2- 1"	5"	x	x	x	x		5	90	5	18			5	0	yes				1	2		single screen GW well in most permeable material
11-Nov	FF-1	C, B	GW S1/2- 1"	5"	x	x	x	x		5	90	5	18			5	0	yes				1	1	1	single screen GW well in most permeable material
10-Nov	FF-2	C, B	GW S1/2- 1"	5"	x	x	x		x	5	90	5	18	5	50	5	10		yes			1	1		single screen GW well in most permeable material
7-Nov	FF-3	C, B	GW S1/2- 1"	5"	x	x	x	x		15	90	5	16	5	50	5	10	yes				1	2		single screen GW well in most permeable material
7-Nov	GG-1	D, P	GW S1/2- 2"& SG 5' bgs	6"	x	x	x		x	25	90	5	14			5	0		yes		yes	1	2		single screen GW well in most permeable material & SG at ~5' bgs
6-Nov	GG-2	D, P	GW S1/2- 2"& SG 5' bgs	6"	x	x	x		x	25	90	5	14			5	0		yes		yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
12-Nov	GG-3	D, P	GW S1/2- 4"& SG 5' bgs	8"	x	x	x		x	25	90	5	14			5	0		yes	yes	yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
14-Nov	GG-4	D, P	GW S1/2- 4"& SG 5' bgs	8"	x	x	x		x	25	90	5	14			5	0		yes	yes	yes	1	1		single screen GW well in most permeable material & SG at ~5' bgs
28 Locations					28	28	28	11	17			TOTAL	467			TOTAL	338	11	17			28	37	3	
												dups	47			dups	34								
												blanks	15			blanks	8								
												TOTAL	529			TOTAL	380								
													140035												

note:

1 continuous soil sampling in all borings
2 only drill to maximum depth of 5 ft. below S-2 sandy layer
3 sample to 95 ft.
4 conduct permeability test on potential hydraulic control wells

CURRENT ENVIRONMENTAL SOLUTIONS
SIX PHASE HEATING
PRECOMMISSIONING QA/QC CHECKLIST
PERFORMANCE CHECKLIST

DATE _____

Project Number: 78-0033

Site: Frontier Fertilizer NPL Site

To be completed prior to first application of power:

What is the expected electrode voltage? _____

What is the voltage rating of the cables? _____

What is the electrode spacing? _____

What is the electrode diameter? _____

What is the electrode conductive interval? _____

List and describe all subsurface conductive materials that pass through the field: _____

_____

_____

_____

_____

How is the SPH system grounded? _____

_____

☐ Are there ground rods?
Distance from field? _____
☐ Is the current to ground monitored?
☐ Is there an automatic SPH shutdown for excessive ground current?
_____ What is the shutdown setpoint?

☐ Is there a surface exclusion zone?
☐ Have personnel who will enter the exclusion zone signed the acknowledgement?
☐ Is there a personnel exclusion fence?
☐ Does the fence have barbed wire?
☐ Does the fence have embedded posts?
☐ Is the fence connected to utility ground?
☐ Are there "Danger - High Voltage" signs posted?
☐ Are these signs at 20 foot spacing on all sides?
☐ Does a fence separate the equipment from the field?
☐ Does this fence have an interlocked access gate?
☐ Does the fence have a surface grid?
What is the grid material? _____
☐ Is the fence connected to the grid?
_____ At what interval?
☐ Is the grid covered?

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_____ What is the grid covered with?

☐ Are there boundaries of the exclusion zone that use existing fences/walls?
Describe these fences/walls:

_____

☐ Are the electrode heads insulated?
Describe the electrode head insulation:

_____

☐ Is any part of the field not covered by an exclusion zone?
☐ Is there a subsurface neutral zone?
_____ What depth interval is the neutral zone? _____
_____ What is the depth to water? _____
_____ What is the depth to known utilities? _____
_____ What is the neutral zone material? _____
_____ What gauge is the neutral wire? _____
☐ Is the neutral connected to utility ground? (not recommended)
☐ Is the amperage monitored?
☐ Is there a surface grid?
What is the grid material?
_____
☐ Is the grid connected to any vaults or other surface metal?
☐ Is the grid covered?
_____ What is the grid covered with?
☐ Are there electrode vaults?
☐ Do the vaults lock?
☐ Are the vaults connected to utility ground?
☐ Can the vaults flood?
☐ Are the electrodes insulated?
☐ Is a "Danger - High Voltage" sign in each vault?
☐ Are there any monitor wells in the field?
What material are the monitor well casings?
_____
☐ Are the monitor wells in vaults?
☐ Are the vaults locked?
☐ Are the vaults connected to the surface grid or utility ground?
☐ Is a "Danger - High Voltage" sign in each vault or on each well?
☐ Has the company responsible for monitoring been notified of danger by letter?
_____ Date of letter
☐ Are there "Danger - Buried High Voltage" signs?
☐ Are these signs at 50' spacing?
☐ Has the property owner been notified of subsurface voltage by letter?
Date of letter
_____
☐ Is the site open to the public?
☐ Is there a ground rod grid around the field?
☐ Are these ground rods at 3' spacing?
☐ Do the ground rods come within one electrode spacing of an electrode?
☐ Can the current of each ground rod be monitored?
_____ Ground rod length?

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VACUUM EXTRACTION SYSTEM

VEU ID Number(s)? _____

Voltage rating of Motor Starter? _____

Maintenance Logs in Unit(s)? _____

- ☐ Oil Level? _____
- ☐ Spare Oil? Type, Qty. _____
- ☐ Filters Checked? _____
- ☐ Spare Filters? Type, Qty _____
- ☐ Oil Level ? _____
- ☐ Filters? _____
- ☐ Bleed Valve? _____
- ☐ Kunkle Valve? _____
  - ☐ What vacuum Is Kunkle set for? _____
- ☐ Ampere check? _____
- ☐ Rotation? _____
- ☐ Level? _____
- ☐ Belt Condition? _____
- ☐ Belt Alignment Type of Belts? _____ NO: _____
- ☐ Motor Pully Dia. _____
- ☐ Blower Pully Dia. _____
- ☐ Squirrel Cage OK? _____
- ☐ Cooling Fan Function? _____
- ☐ Instrumentation ? _____
  - ☐ Pressure _____
  - ☐ Vacuum _____
  - ☐ Flow - Annubar _____
  - ☐ Flow Rotameter _____
  - ☐ Other _____
- ☐ LEL Detector(s) _____
- ☐ Manual Valves? _____
- ☐ Solenoid valves? _____
- ☐ Leak Tests on piping? _____
- ☐ VPGAC _____
- ☐ CATOX _____
- ☐ Tools? _____
- ☐ Diapers? _____
- ☐ Noise Insulation? _____

V/L Separator

- ☐ L/H/HH level Controls? _____
- ☐ Transfer Pump Motor Size _____ Power _____ Phase _____
- ☐ Filter/strainers _____
- ☐ Pressure switch _____
- ☐ Condensate Holding Tank _____
  - ☐ L/H/HH switches _____
  - ☐ Level Indicator _____
  - ☐ Secondary Containment _____

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DATA ACQUISITION

- ☐ Wiring Checked? _____
- ☐ Wireless Checked? _____
- ☐ Tel/DSL/Cable/Satellite? _____
- ☐ Sensors Calibrated? _____
- ☐ Programming Logic Checked? _____
  - ☐ Sotware type/Version? _____
- ☐ Remote Shutdown/Start-up? _____
- ☐ Remote Adjustment? _____
- ☐ Security/Passwords? _____

The site is ready for the application of power.

Project Manager _____ date _____ Independent Reviewer _____ date _____

To be completed prior to first unattended operation:

What is the typical electrode voltage? _____

How long as the system been operating at this voltage? _____

What is the amperage to ground? _____

What is the highest observed amperage in a neutral wire? _____

What is the voltage from neutral to ground? _____

☐ Has a step-and-touch voltage survey log sheet been prepared?
☐ Does the log sheet refer to a plot plan that shows measurement locations?
(attached copy shows survey results)
☐ Has a voltage to utility ground survey been conducted?
(attached copy shows survey results)
Describe any anomolous measurements (electrodes with high or low currents, unusual voltages, etc.)

_____

What changes were made is response to the anomolies? _____

_____

(attach a copy of the post-change voltage survey)
☐ Has the Autodialer been tested and confirmed to dial proper numbers upon shutdown?

The site is ready for unattended operation.

Project Manager _____ date _____ Independent Reviewer _____ date _____

Copy of this form must be sent to CES Richland, WA Date Sent _____

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TABLE SMP-6

CES DAILY ISTT FIELD LOG
Frontier Fertilizer NPL Site, Davis, CA.

Contract: No: EP-S9-08-04/Task Orders 002,007

Project Name: *Frontier Fertilizer NPL Site* Date: _____ Page ___ of ___
Project Number: *78-0033* Field Supervisor: _____ Weather: _____
Site Address: 3901 Second Street, Davis, CA Temp:
Field Staff: High:
CES Rental Equipment: Low :
Subcontractor Crew and Equipment:
Impacts to Project Schedule:
Samples Collected:
Client Contact: Paul Seday Client Phone Number: *916-286-0266*

TIME:	DESCRIPTION

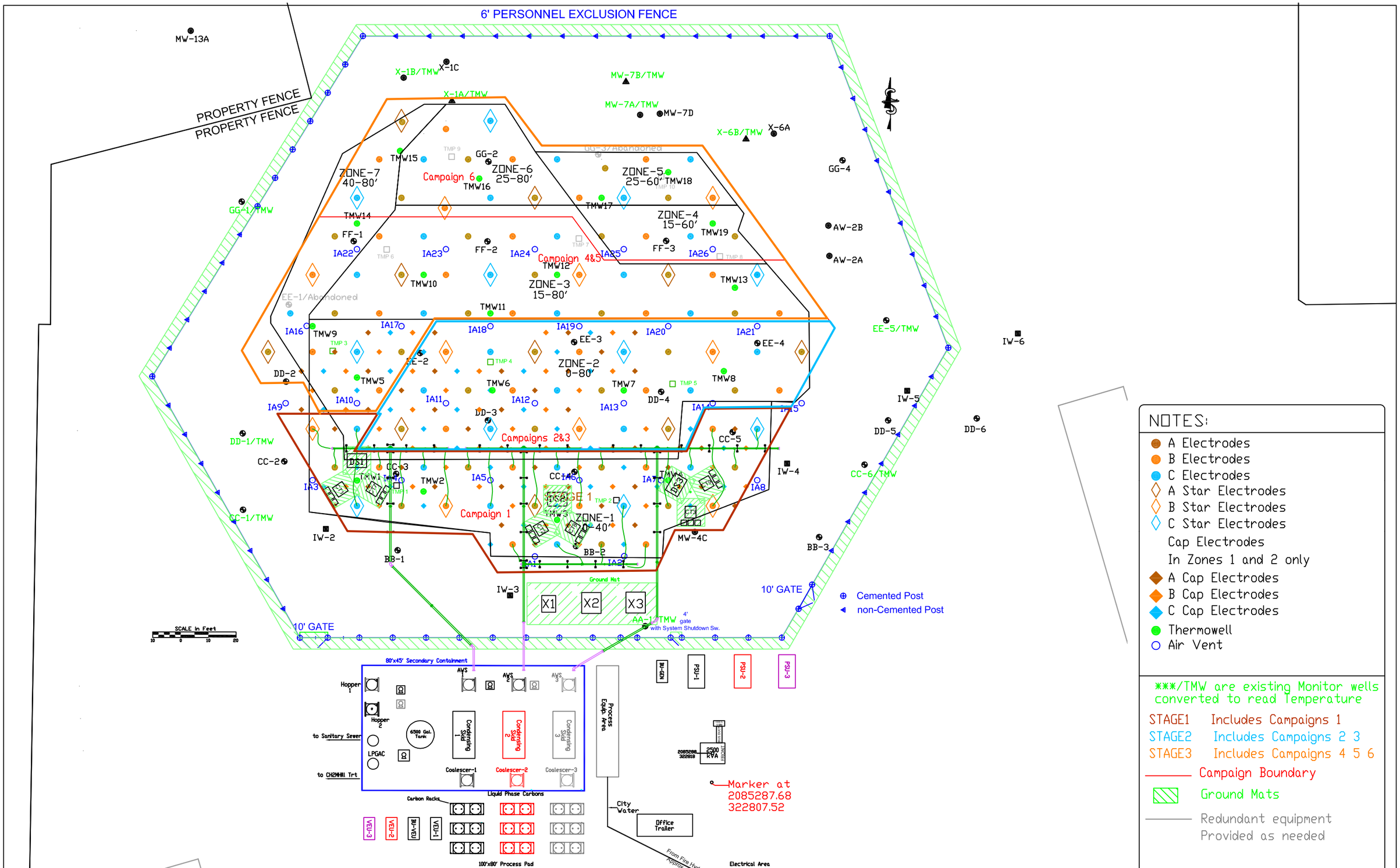
Comments:

QA/QC Report:

Field Staff:

CES F/S Signature: ***Date:***

FIGURES



CURRENT ENVIRONMENTAL SOLUTIONS

316 AVOCET AVE
DAVIS, CA 95616

CH2M HILL Contract: EP-S9-08-04 Task Order: 002 Project Number: 385112.pp.04

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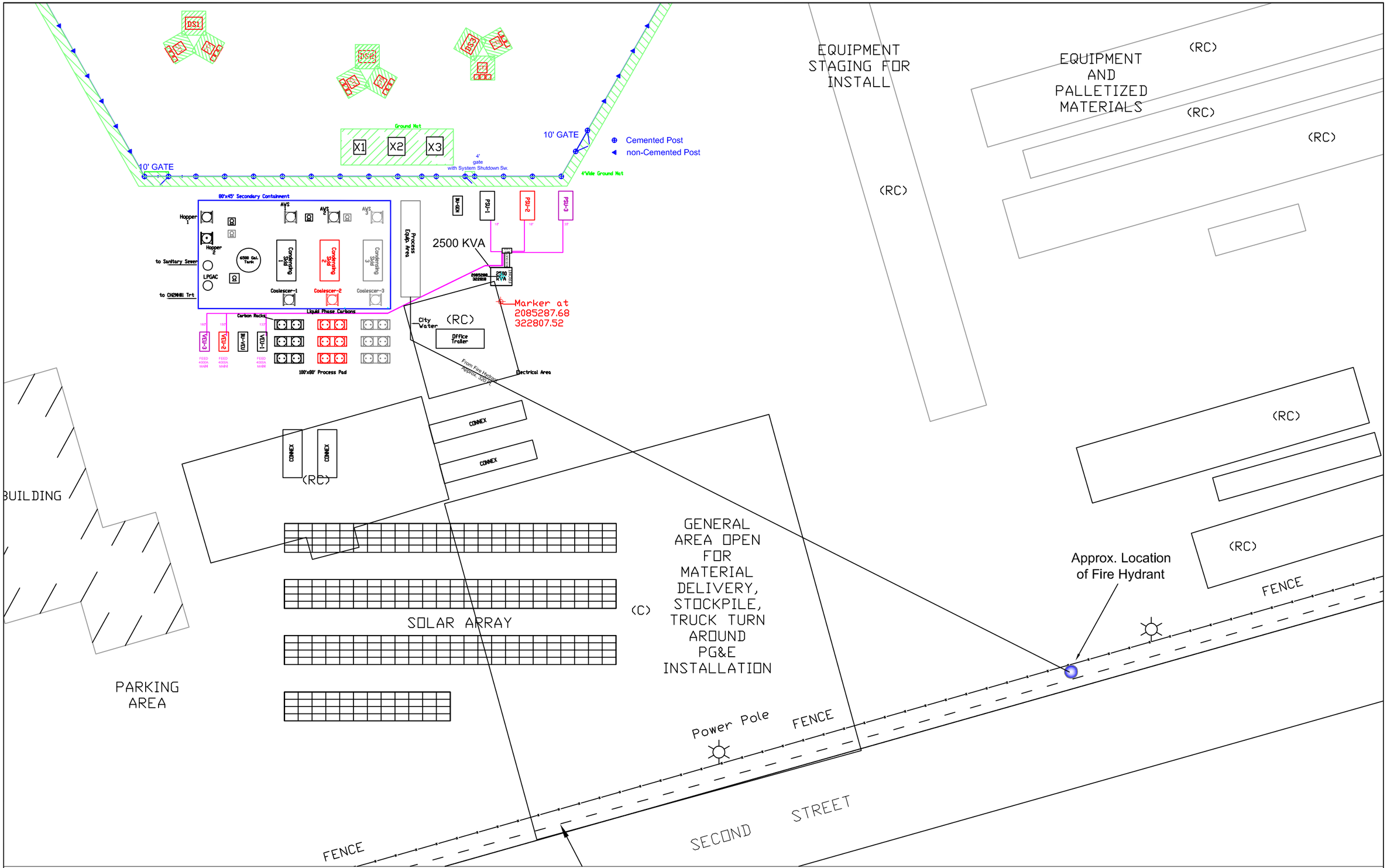
Scale: as shown
Date: 05/13/2010
Drawn By: Mike OBrien
Designed By: William Heath
Approved By: Jim Malot PE
PE #CA59088 _____

EQUIPMENT LAYOUT STAGE 1

ISTT, FRONTIER FERTILIZER NPL SITE

Project# 78-0033

Figure# 1



CURRENT ENVIRONMENTAL SOLUTIONS

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DAVIS, CA 95616

CH2M HILL Contract: EP-S9-08-04 Task Order: 002 Project Number: 385112.pp.04

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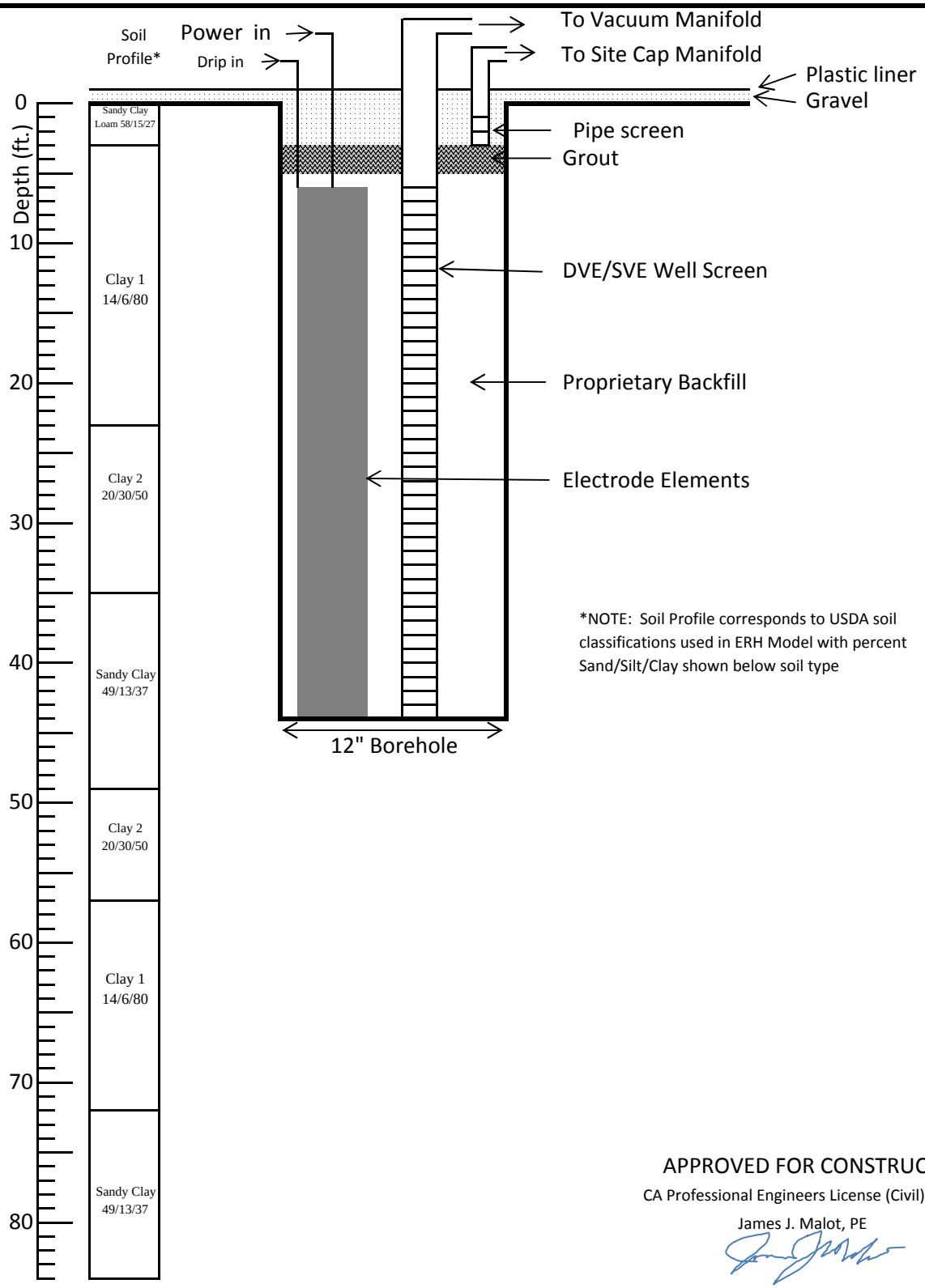
Date: 05/13/2010
Drawn By: Mike OBrien
Designed By: William Heath
Approved By: Jim Malot PE
PE #CA59088 _____

UTILITY LOCATION PLAN

ISTT, FRONTIER FERTILIZER NPL SITE

Project# 78-0033

Figure# 2



*NOTE: Soil Profile corresponds to USDA soil classifications used in ERH Model with percent Sand/Silt/Clay shown below soil type

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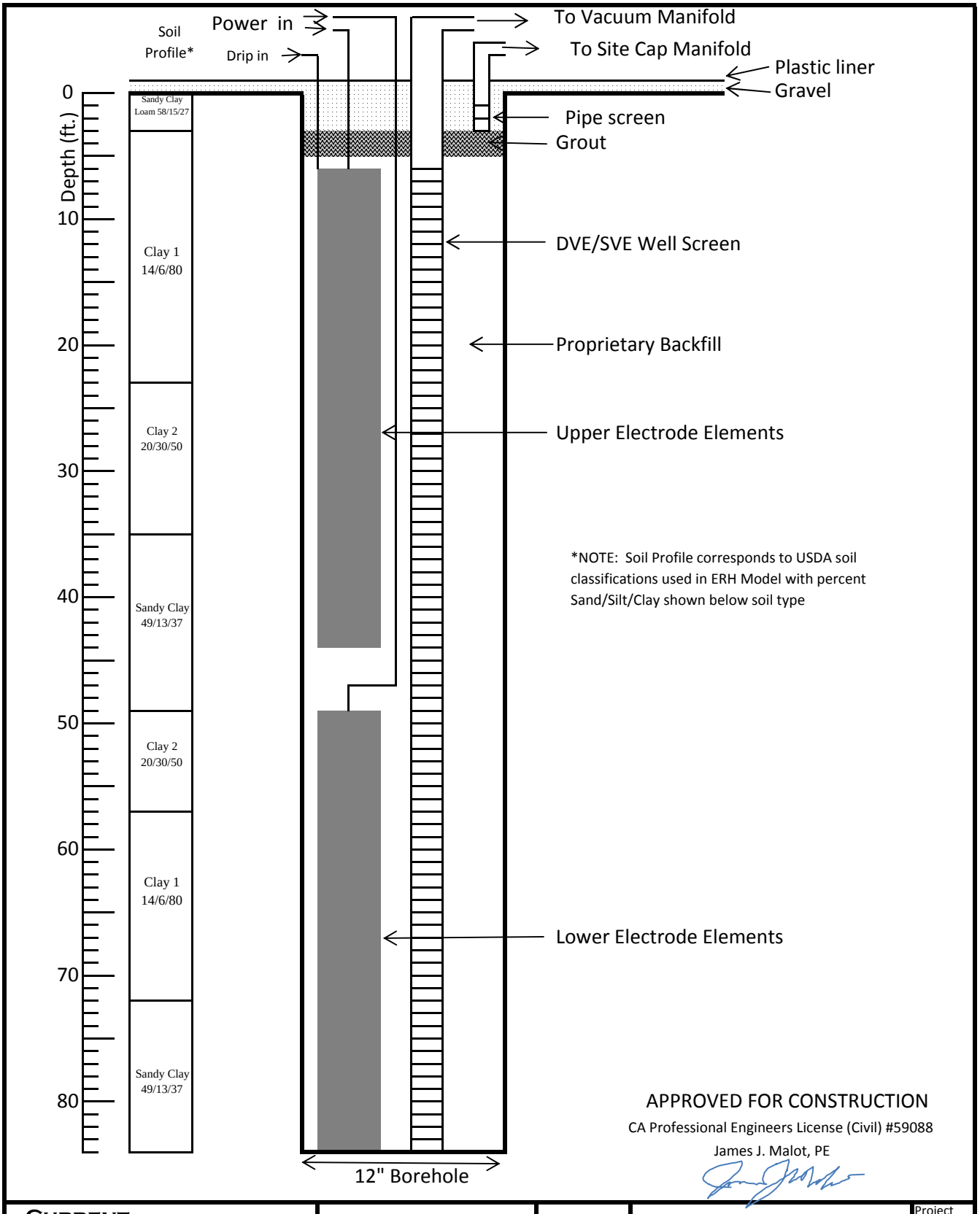
James J. Malot, PE

CURRENT ENVIRONMENTAL SOLUTIONS	CH2M HILL Contract: EP-S9-08-04 Task Order 0002 CH2M HILL Project: 384211.FD.01	Scale: NTS Date: 6/25/09 Drawn by: JM Checked by: TD	ELECTRODE -- ZONE 1 ISTT, FRONTIER FERTILIZER NPL	Project 78-0033 **Figure 3A**



*NOTE: Soil Profile corresponds to USDA soil classifications used in ERH Model with percent Sand/Silt/Clay shown below soil type

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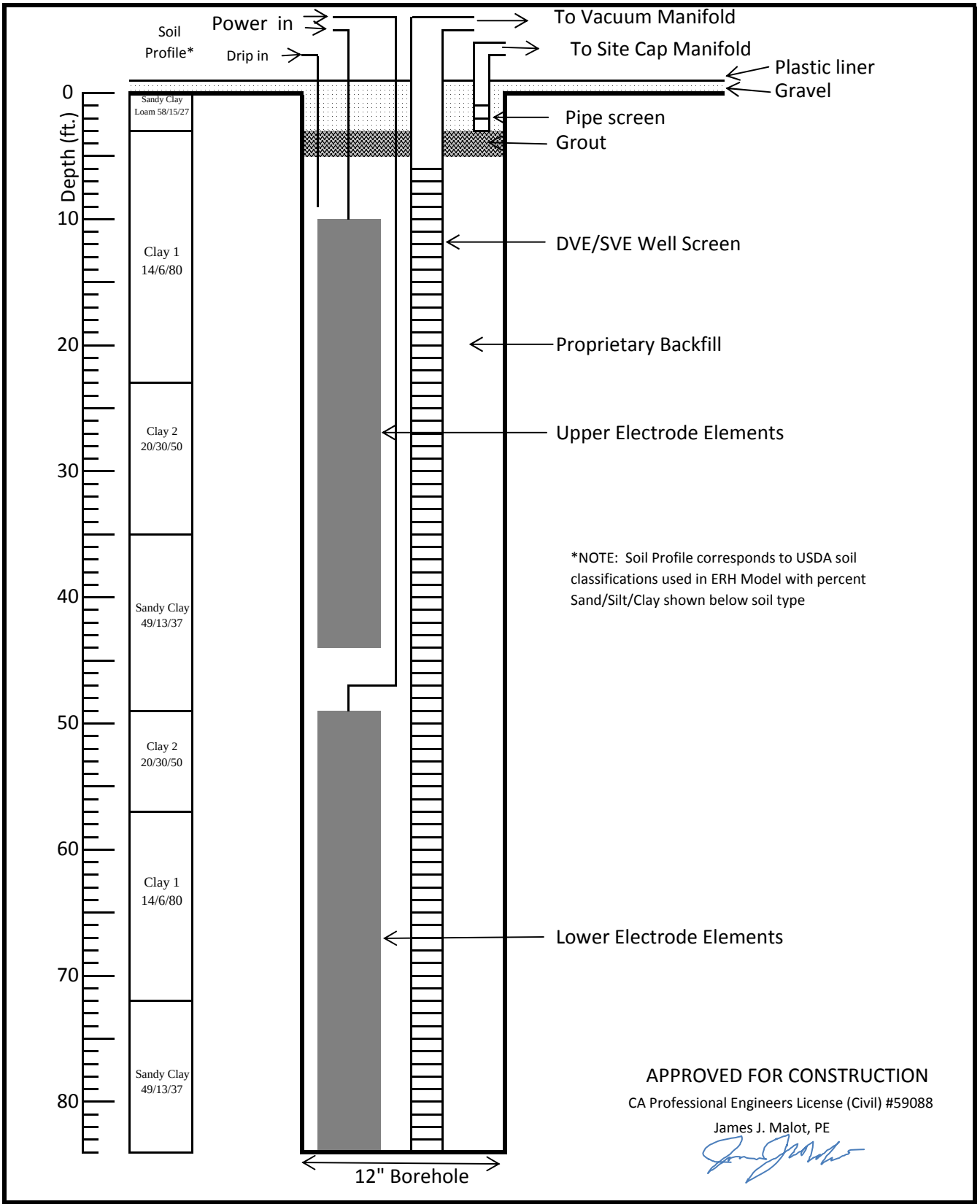
CURRENT ENVIRONMENTAL SOLUTIONS	CH2M HILL Contract: EP-S9-08-04 Task Order 0002 CH2M HILL Project: 384211.FD.01	Scale: NTS Date: 6/25/09 Drawn by: JM Checked by: TD	ELECTRODE -- ZONE 2 ISTT, FRONTIER FERTILIZER NPL	Project 78-0033 **Figure 3B**



*NOTE: Soil Profile corresponds to USDA soil classifications used in ERH Model with percent Sand/Silt/Clay shown below soil type

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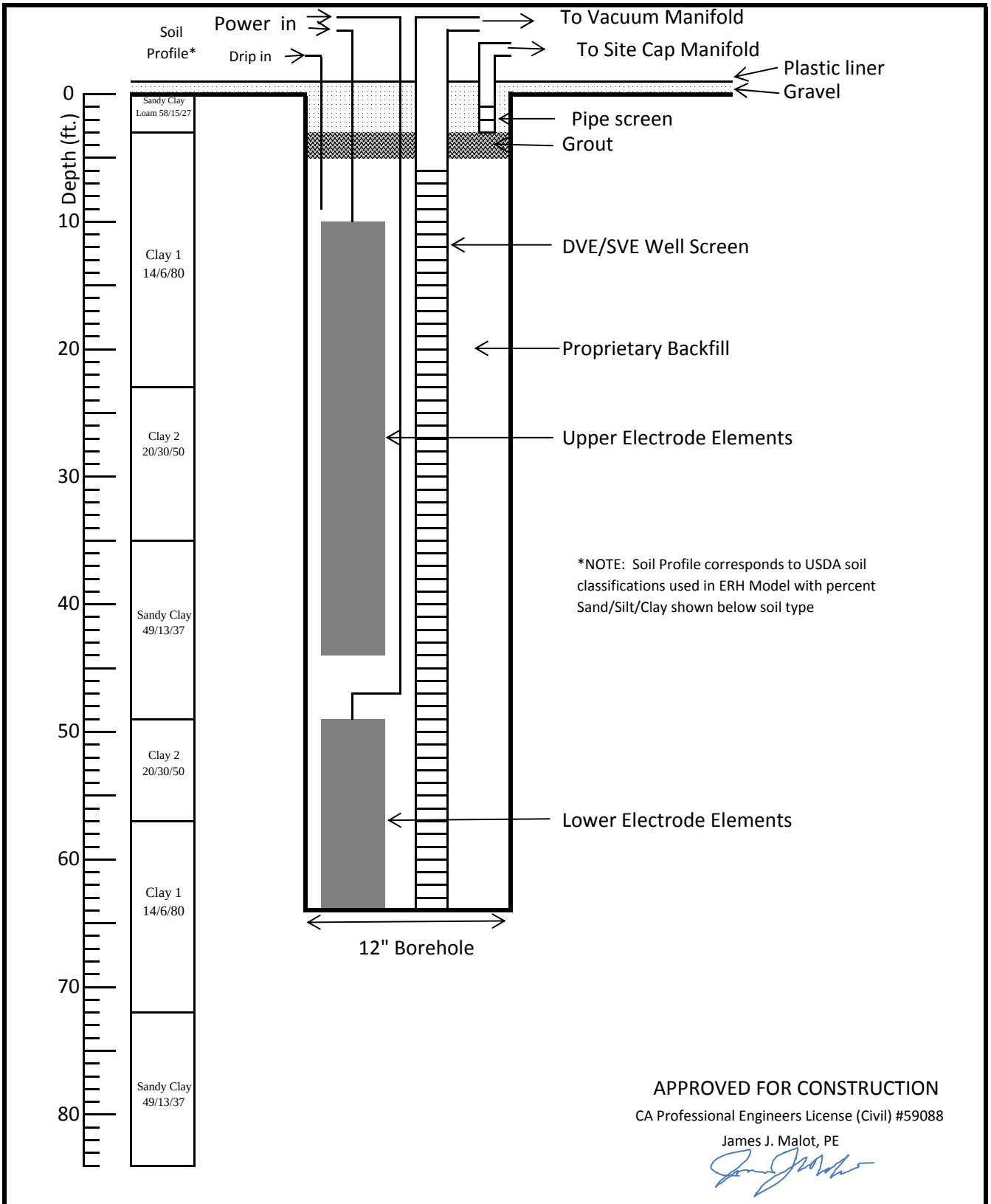
CURRENT ENVIRONMENTAL SOLUTIONS	CH2M HILL Contract: EP-S9-08-04 Task Order 0002 CH2M HILL Project: 384211.FD.01	Scale: NTS Date: 6/25/09 Drawn by: JM Checked by: TD	ELECTRODE -- ZONE 3 ISTT, FRONTIER FERTILIZER NPL	Project 78-0033 **Figure 3C**



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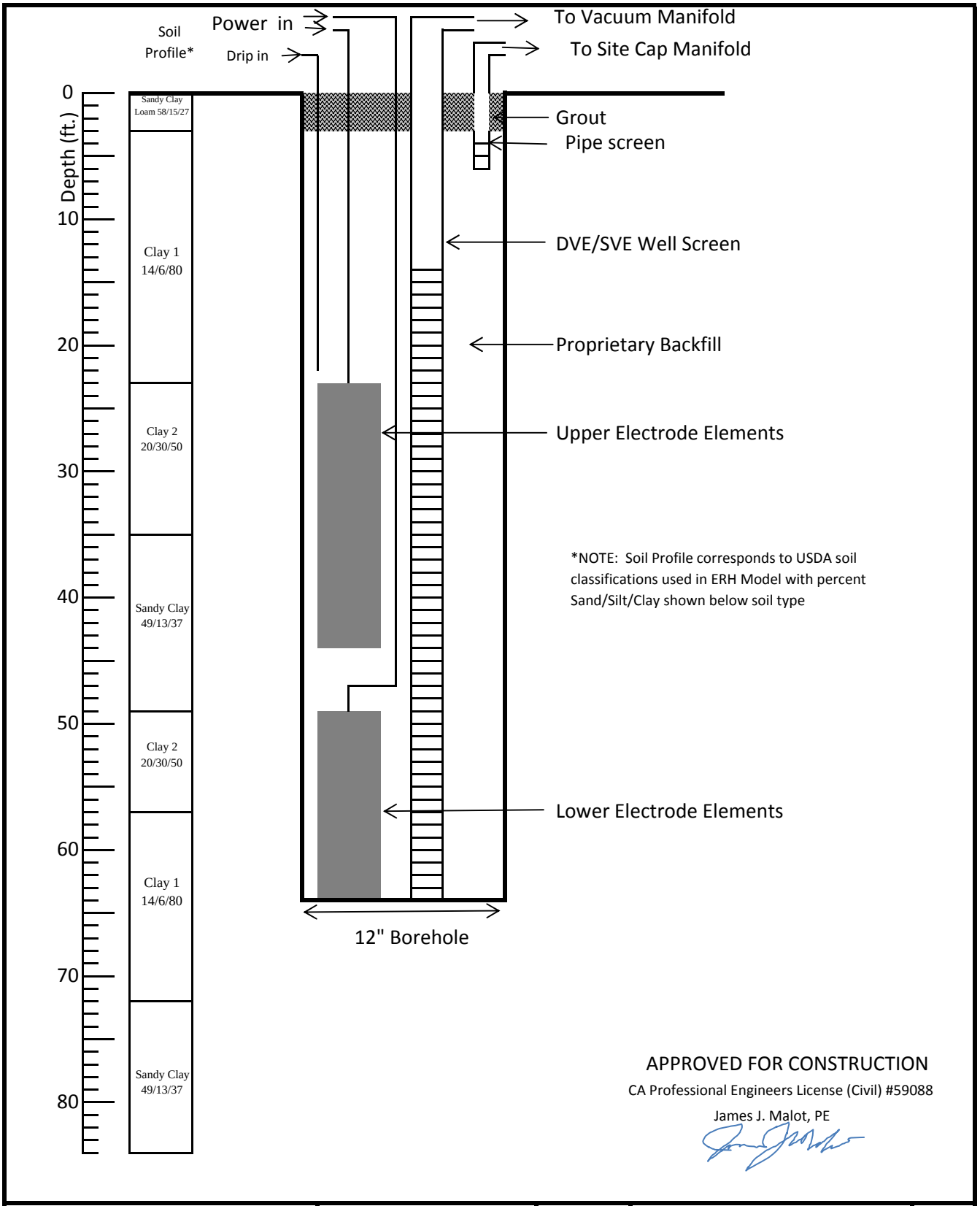
CURRENT ENVIRONMENTAL SOLUTIONS	CH2M HILL Contract: EP-S9-08-04 Task Order 0002 CH2M HILL Project: 384211.FD.01	Scale: NTS Date: 6/25/09 Drawn by: JM Checked by: TD	ELECTRODE -- ZONE 4 ISTT, FRONTIER FERTILIZER NPL	Project 78-0033 **Figure 3D**



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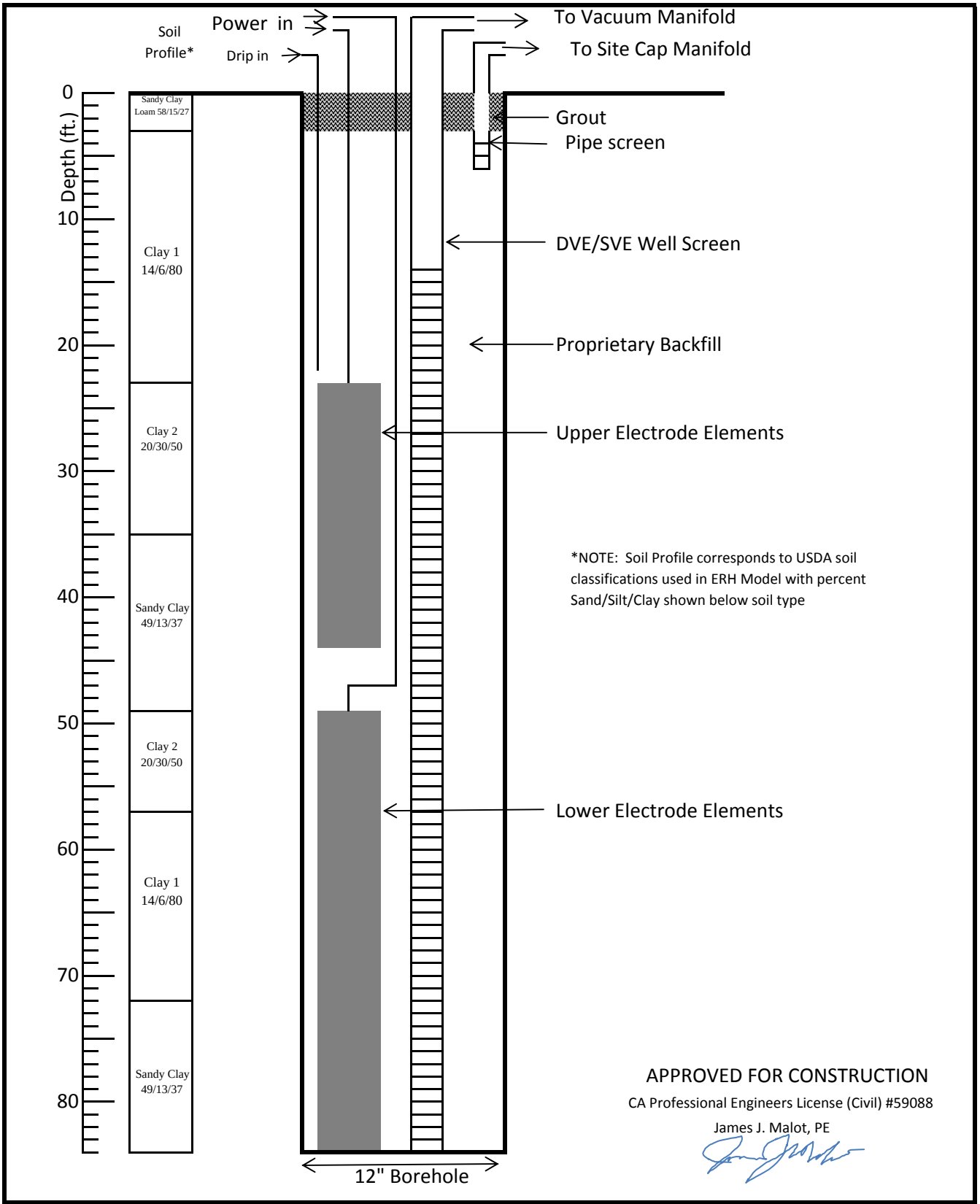
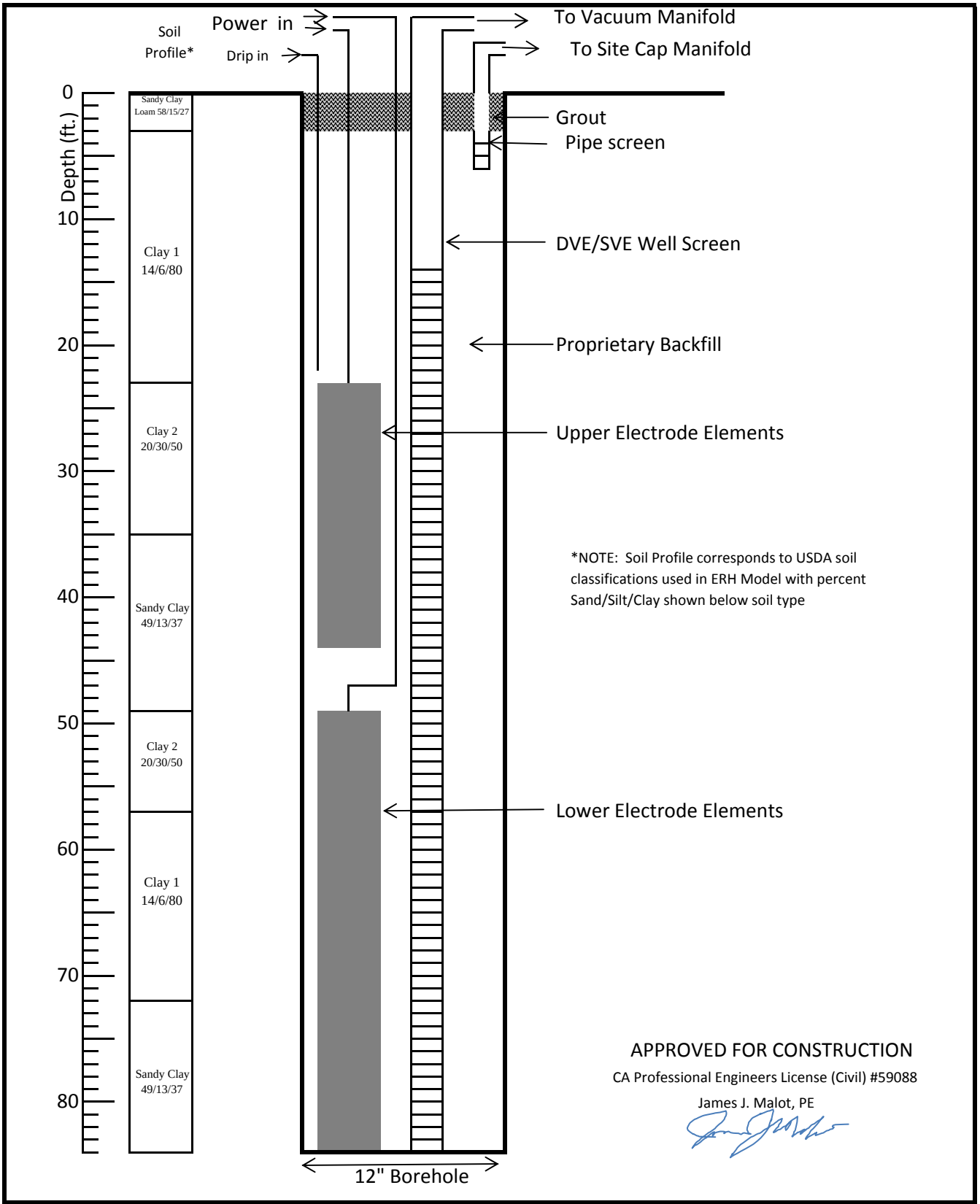
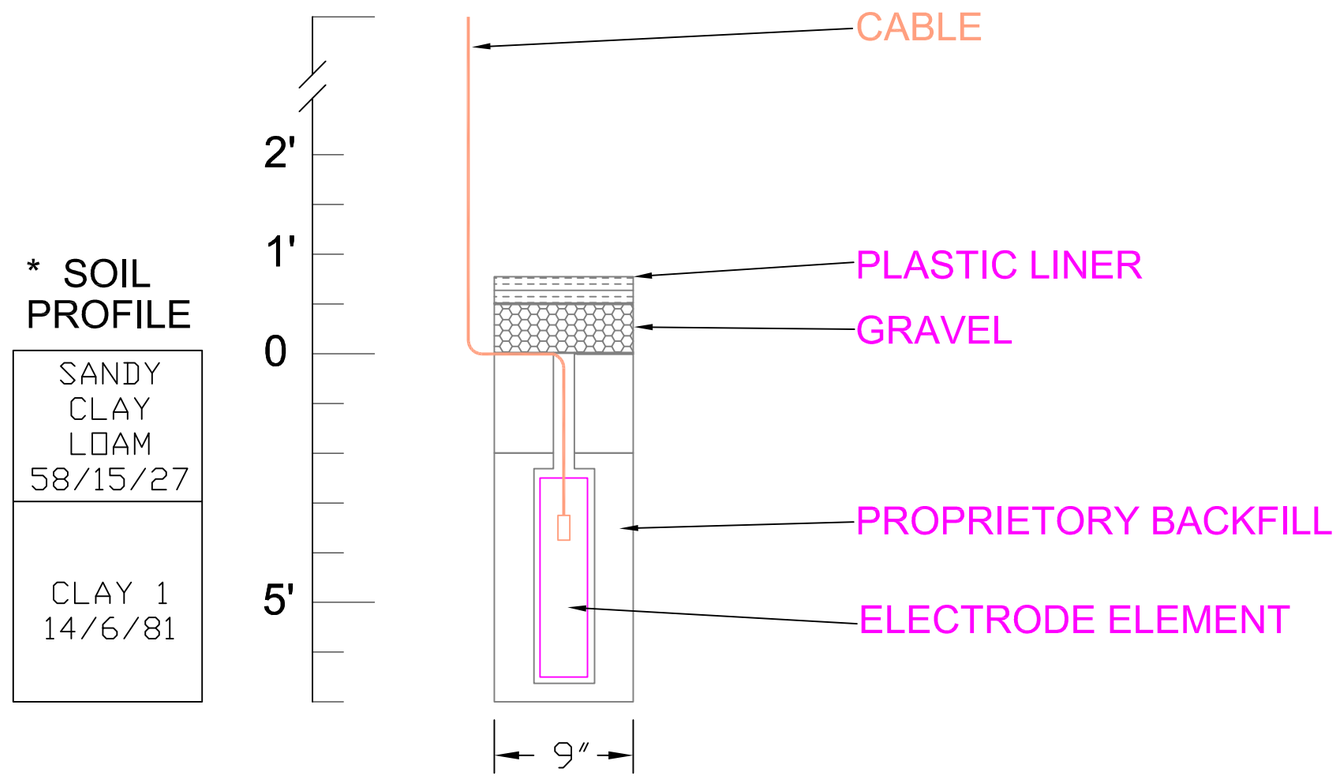


CURRENT ENVIRONMENTAL SOLUTIONS	CH2M HILL Contract: EP-S9-08-04 Task Order 0002 CH2M HILL Project: 384211.FD.01	Scale: NTS Date: 6/25/09 Drawn by: JM Checked by: TD	ELECTRODE -- ZONE 6 ISTT, FRONTIER FERTILIZER NPL	Project 78-0033 **Figure 3F**



CURRENT ENVIRONMENTAL SOLUTIONS	CH2M HILL Contract: EP-S9-08-04 Task Order 0002 CH2M HILL Project: 384211.FD.01	Scale: NTS Date: 6/25/09 Drawn by: JM Checked by: TD	ELECTRODE -- ZONE 7 ISTT, FRONTIER FERTILIZER NPL	Project 78-0033 **Figure 3G**

CAP ELECTRODE



* Soil Profile corresponds to USDA soil classifications used in ERH model with percent sand/silt/clay shown below soil type.

CURRENT ENVIRONMENTAL SOLUTIONS
316 AVOCET AVE
DAVIS, CA 95616

CH2M HILL Contract: EP-S9-08-04 Task Order: 002 Project Number: 385112.pp.04

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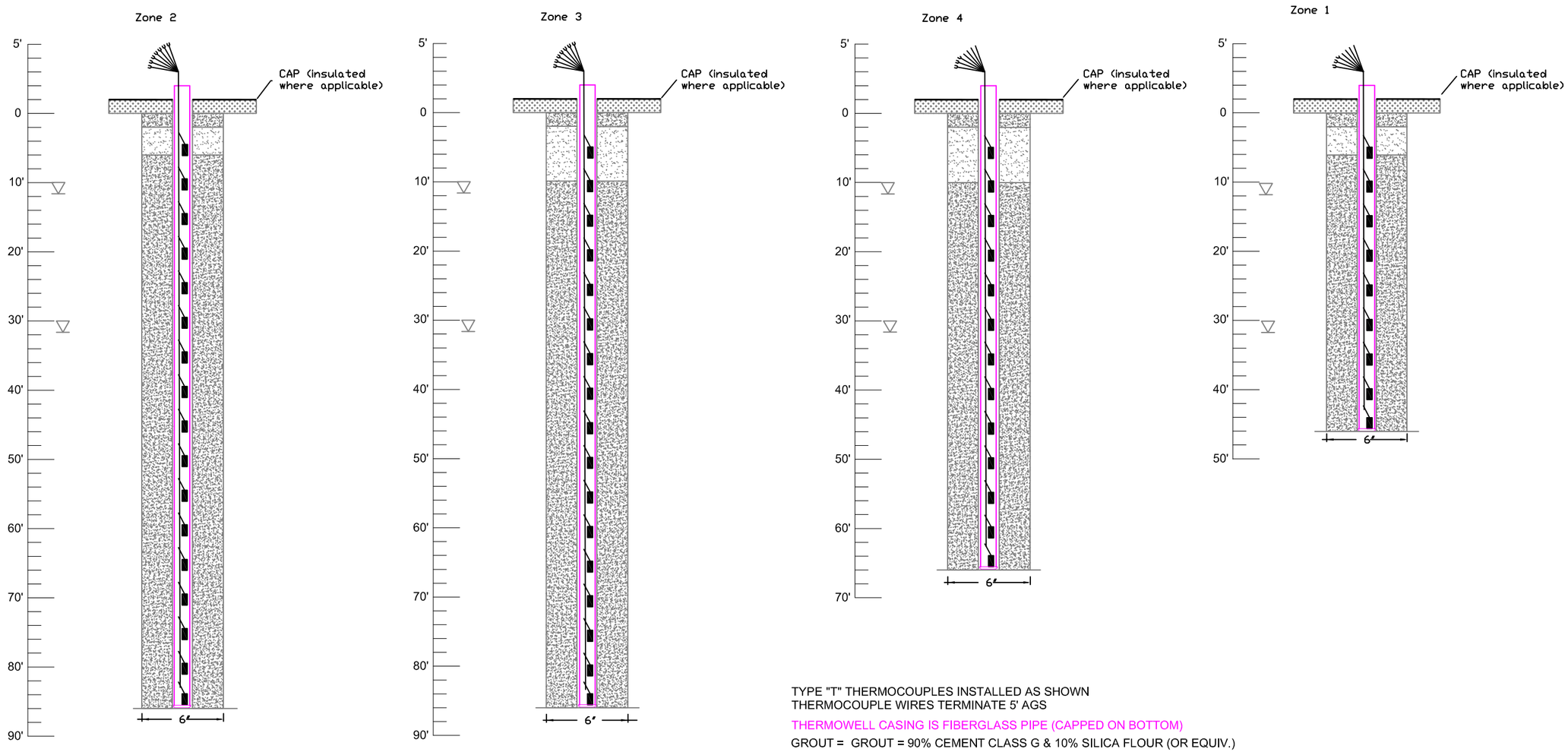
SHALLOW ELECTRODE ZONES 1&2

ISTT, FRONTIER FERTILIZER NPL SITE

Project# 78-0033

Figure# 3H

THERMOWELL DETAIL
ZONES 1-4 (TYPICAL)



TYPE "T" THERMOCOUPLES INSTALLED AS SHOWN
THERMOCOUPLE WIRES TERMINATE 5' AGS

THERMOWELL CASING IS FIBERGLASS PIPE (CAPPED ON BOTTOM)

GROUT = GROUT = 90% CEMENT CLASS G & 10% SILICA FLOUR (OR EQUIV.)

GROUT - FROM GRADE TO DEPTH AS SHOWN
- FROM BELOW GRADE TO DEPTH AS SHOWN

FINE CLEAN SAND FROM 2' TO DEPTH AS SHOWN

CURRENT ENVIRONMENTAL SOLUTIONS
316 AVOCET AVE
DAVIS, CA 95616

CH2M HILL Contract: EP-S9-08-04 Project No: 385112.pp.04

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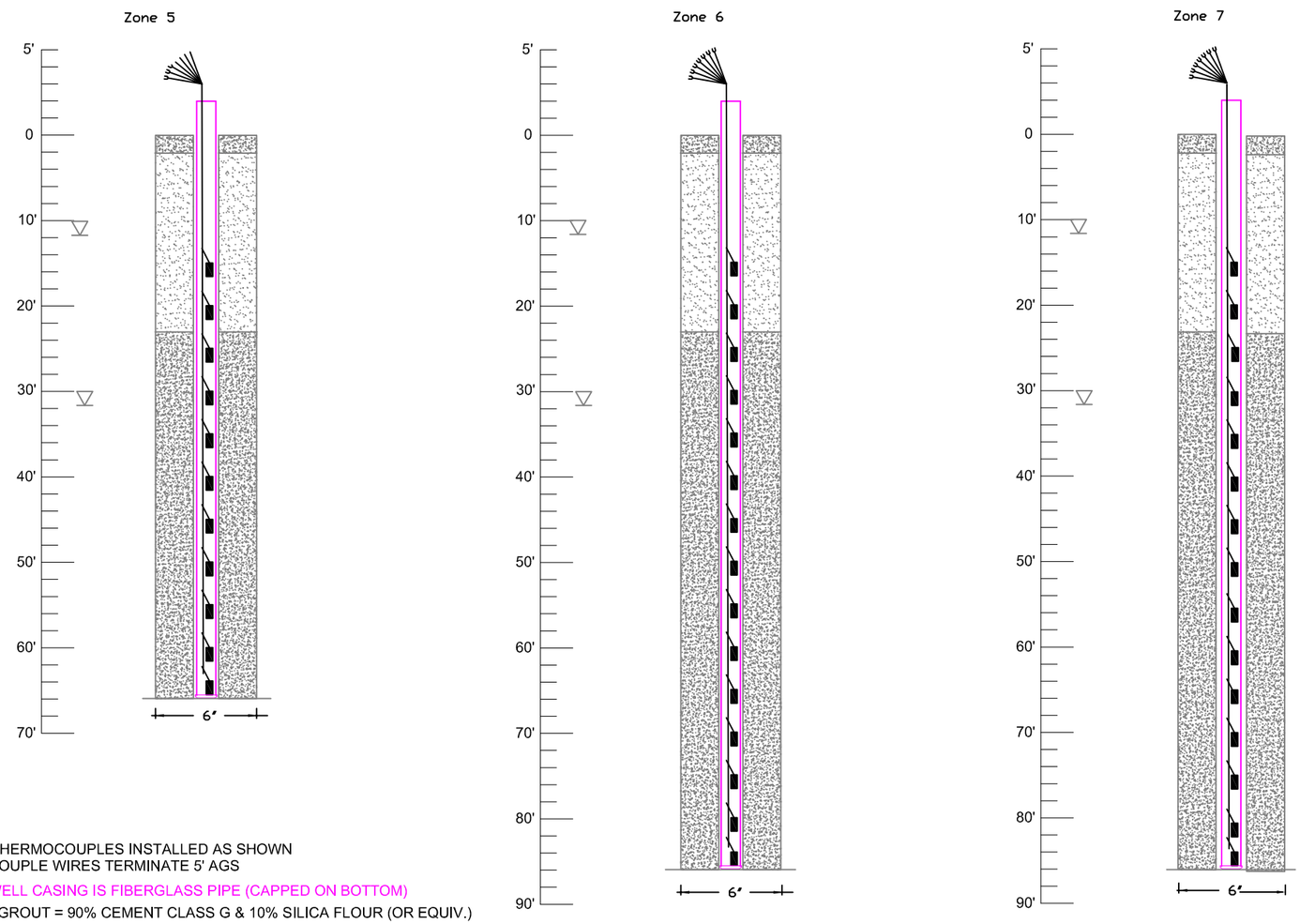
THERMOWELL DETAIL ZONES 1-4

ISTT, FRONTIER FERTILIZER NPL SITE

Project# 78-0033

Figure# 4A

THERMOWELL DETAIL
ZONES 5-7 (TYPICAL)



TYPE "T" THERMOCOUPLES INSTALLED AS SHOWN
THERMOCOUPLE WIRES TERMINATE 5' AGS

THERMOWELL CASING IS FIBERGLASS PIPE (CAPPED ON BOTTOM)

GROUT = GROUT = 90% CEMENT CLASS G & 10% SILICA FLOUR (OR EQUIV.)

GROUT - FROM GRADE TO 2' AS SHOWN
- FROM 23' TO DEPTH AS SHOWN

FINE CLEAN SAND - FROM 2' TO 23' AS SHOWN

CURRENT ENVIRONMENTAL SOLUTIONS

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DAVIS, CA 95616

CH2M HILL Contract: EP-S9-08-04 Project No: 385112.pp.04

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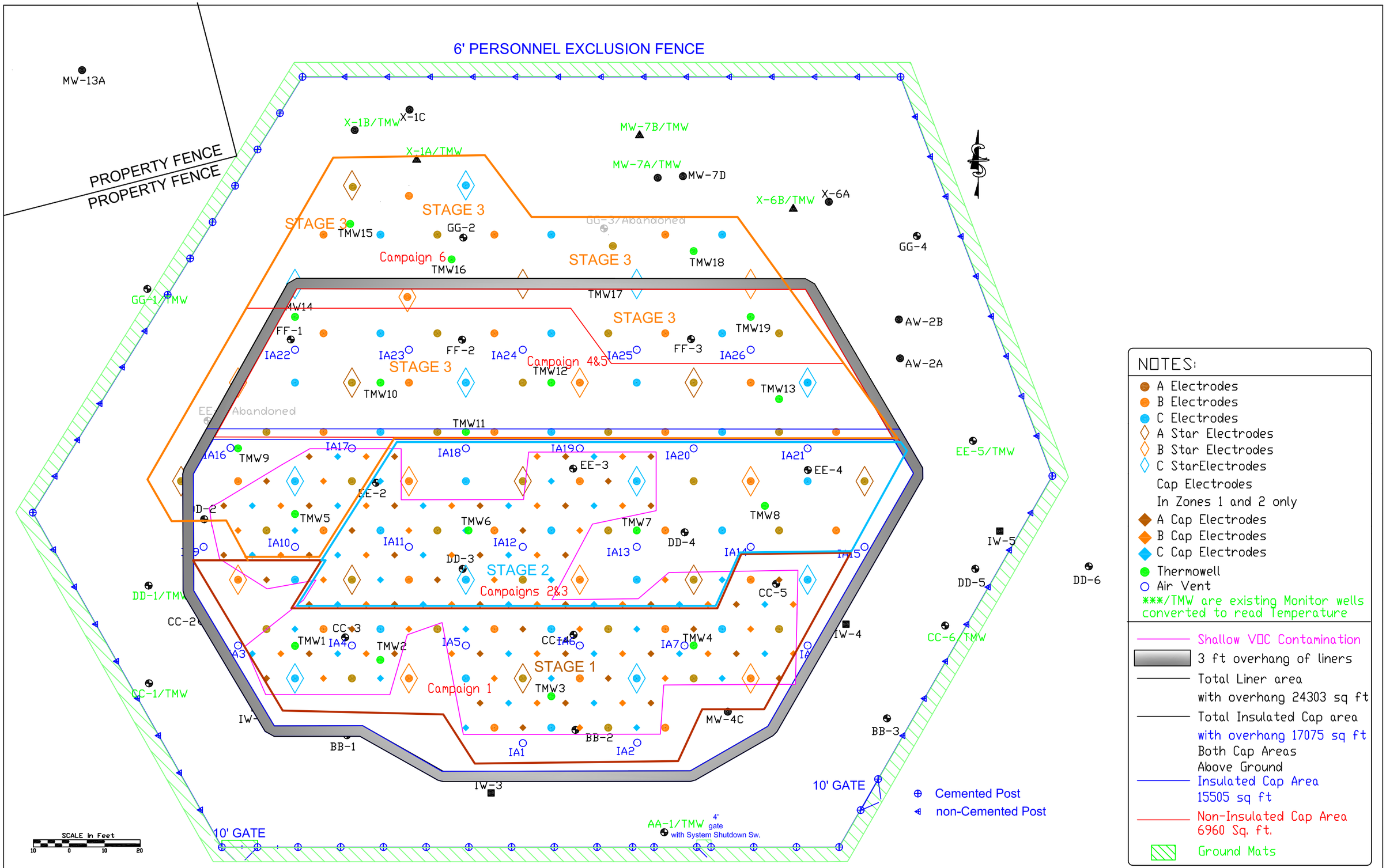
THERMOWELL DETAIL ZONES 5-7

ISTT, FRONTIER FERTILIZER NPL SITE

Project# 78-0033

Figure# 4B



CURRENT ENVIRONMENTAL SOLUTIONS

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CH2M HILL Contract: EP-S9-08-04 Task Order: 002 Project Number: 385112.pp.04

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Approved By: Jim Malot PE
PE #CA59088

CAP LAYOUT

ISTT, FRONTIER FERTILIZER NPL SITE

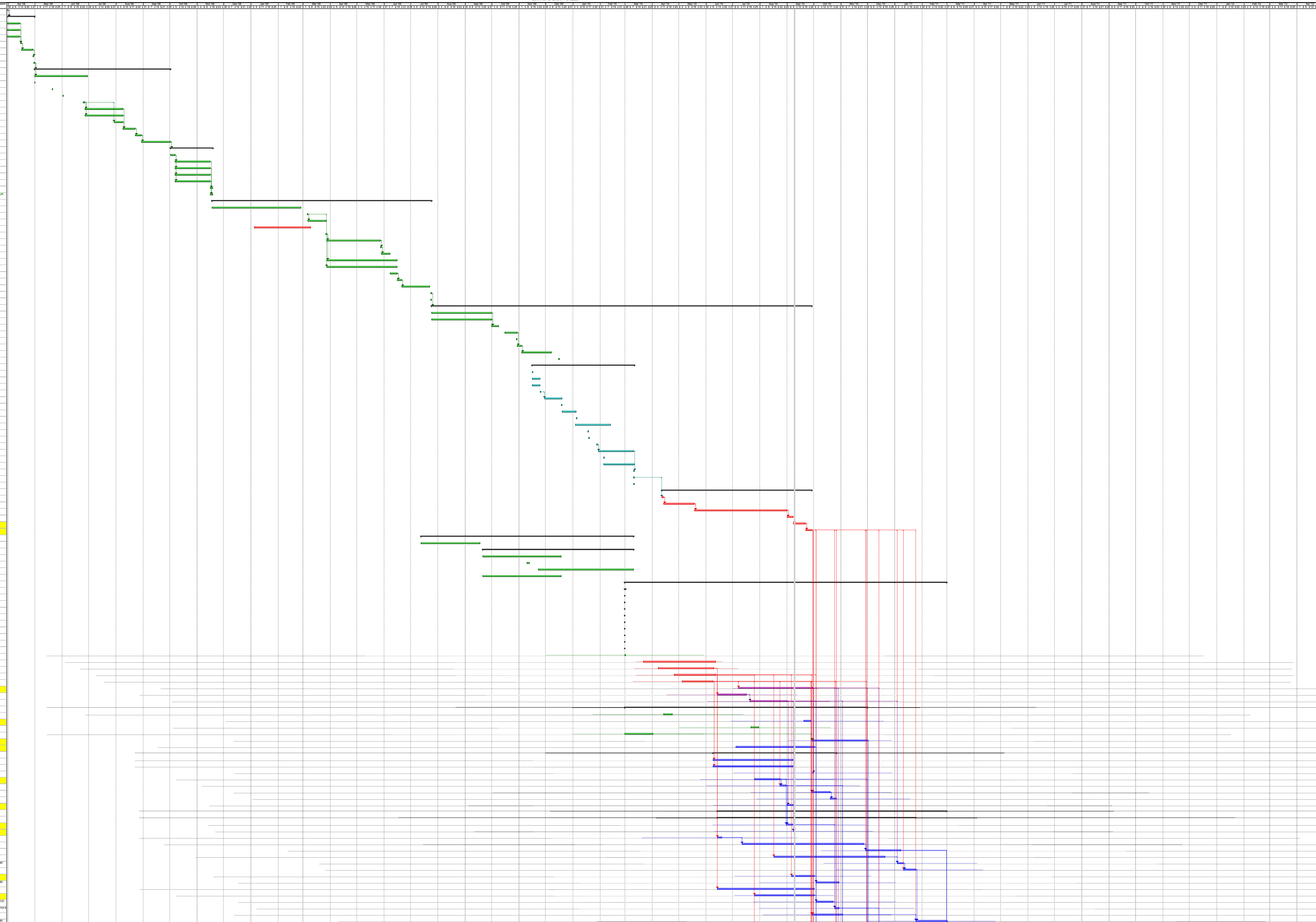
Project# 78-0033

Figure# 5

APPENDIX A

PROJECT SCHEDULE 100% RAMP
ISTT FRONTIER FERTILIZER SUPERFUND SITE
DAVIS, CA
CONTRACT: EP-S9-08-04 PO: 932338

ID	Task Name	Duration	Start	Finish	Predecessors
1	NTP (ACTUAL) PO924961	0 days	3/31/08	3/31/08	
2	1 Design Criteria Report (10% RAMP)	31 days	3/31/08	4/30/08	1
3	1A ISTT System Design	14 days	3/31/08	4/13/08	
4	1B ISTT Plans	14 days	3/31/08	4/13/08	
5	1C ISTT Design & Implment Schedule	14 days	3/31/08	4/13/08	
6	1D Planning Meeting 1	1 day	4/15/08	4/15/08	5,3,4
7	CH2M Hill & EPA Review of 10% Ramp	13 days	4/16/08	4/28/08	6
8	Receive CH2M Hill & EPA Comments on 10% RAMP	1 day	4/29/08	4/29/08	7
9	Conference Call (Review 10% RAMP)	1 day	4/30/08	4/30/08	
10	2 Prelim. RAMP (30%) Monitoring Plans & Specs (100%)	148 days	5/1/08	10/1/08	9
11	Source Area Review / Prelim Monitoring Points	57 days	5/1/08	6/29/08	9
12	2A Conference Call(Discuss Source Zone)	0.5 days	5/1/08	5/1/08	
13	2A Conference Call (Site Geophysical Prop)	0.5 days	5/21/08	5/21/08	
14	2A Conference Call (PMP Borings)	0.5 days	6/2/08	6/2/08	
15	2D Planning Meeting 2 (held early-PMP Borings)	2 days	6/25/08	6/26/08	
16	2A ISTT System Design	40 days	6/27/08	8/8/08	15
17	2B ISTT Plans	40 days	6/27/08	8/8/08	15
18	2C ISTT Design & Implment Schedule	10 days	7/30/08	8/8/08	15
19	2C CH2M HILL Review Drafts, Comment, CES Support SAP	14 days	8/9/08	8/22/08	16,17,18
20	2C CES Reply and Final Prep of 30% Ramp for EPA Review	7 days	8/23/08	8/29/08	19
21	2C EPA Review/Comment/Approve	33 days	8/30/08	10/1/08	20
22	3 Install Prelim. Monitoring Components (Revised-estimated)	48 days	10/2/08	11/18/08	21
23	3A Mobilization	5 days	10/2/08	10/6/08	
24	3B 28 Borings to 95 ft, cores (LB PPE)	40 days	10/7/08	11/15/08	23
25	3C Complete 7 Borings as S2 GW Pumping Wells	40 days	10/7/08	11/15/08	23
26	3D Complete 17 Borings as TMP & S1,S2 MWs	40 days	10/7/08	11/15/08	23
27	3E Complete 4 Boringa as VMPs	40 days	10/7/08	11/15/08	23
28	3G Waste Management (soil, liquid,constr)	3 days	11/16/08	11/18/08	27
29	3A Demobilization	3 days	11/16/08	11/18/08	26,27,24,25
30	4 Intermediate RAMP (60%)	231 days	11/18/08	7/24/09	
31	4A CH2M Hill /EPA Eval of CLIN003 Samples	90 days	11/18/08	2/26/09	
32	4A Conference Call: Treat Vol, Power 60% RAMP	0.5 days	3/6/09	3/6/09	
33	4A CES Requested to Perform Various Power Evaluations	21 days	3/6/09	3/27/09	32
34	New Contract and PO Change to PO932338	64 days	1/5/09	3/9/09	
35	4A CES Proceed with 6MW Design	1 day	3/27/09	3/27/09	
36	4A ISTT System Design for 6MW Power	56 days	3/28/09	5/27/09	35
37	4A CH2M Hill Informs CES to re-design for 1MW	1 day	5/28/09	5/28/09	36
38	4A 60% RAMP Design for 1MW	10 days	5/29/09	6/7/09	37
39	4B ISTT Plans (Start 6MW then Revise to 1MW)	75 days	3/28/09	6/15/09	35
40	4C ISTT Design & Implment Schedule	75 days	3/28/09	6/15/09	32
41	4C CH2M HILL R&C, CES Edits	8 days	6/8/09	6/15/09	
42	4C CES Response to Comments	5 days	6/16/09	6/20/09	41
43	4C EPA R&C	30 days	6/21/09	7/22/09	42
44	4D Planning Meeting (Conf Call)	1 day	7/24/09	7/24/09	
45	4D CES given verbal NTP from EPA to add Puppy Electrodes	1 day	7/24/09	7/24/09	
46	5 Pre Final/Final RAMP (for 1MW)	360 days	7/25/09	9/28/10	44
47	5A ISTT System Design (Final RAMP for 1MW)	66 days	7/25/09	9/30/09	
48	5B ISTT Plans	66 days	7/25/09	9/30/09	
49	5C ISTT Schedule (for Electrode Install Only)	8 days	10/1/09	10/8/09	47,48
50	5C CH2M HIL, EPA R&C	14 days	10/16/09	10/29/09	
51	5C Planning Meeting 4 (NTP with E-Install Only CLIN6C1)	1 day	10/29/09	10/29/09	
52	5C CES RTC	5 days	10/30/09	11/3/09	50
53	5C EPA R&C	30 days	11/4/09	12/7/09	52
54	5D Final RAMP Mtg & Community Presentation	1 day	12/16/09	12/16/09	
55	5 Revision For Puppies & 3 MW Design (History)	105 days	11/16/09	3/11/10	
56	Conf Call w/I EPA on Puppy, 2MW,3MW design SOW	1 day	11/16/09	11/16/09	
57	CES Delivers 5 Versions of Design SOW & Variance	9 days	11/16/09	11/24/09	
58	CH2/EPA R&C	9 days	11/16/09	11/24/09	
59	Conf Call w/i EPA : SOW & variance approved by EPA	1 day	11/25/09	11/25/09	
60	CES waiting on Written SOW, PO & NTP from CH2	20 days	11/30/09	12/19/09	59
61	EPA informs team that PG&E can deliver 3MW power	1 day	12/19/09	12/19/09	
62	Holiday Break	11 days	12/20/09	1/4/10	
63	Conference Call to Plan 3MW Power and Revise SOW	1 day	1/5/10	1/5/10	
64	CH2 working on SOW for CES to revise Design Variance	40 days	1/4/10	2/12/10	
65	CES Delivers V6 of Est Design Variance	1 day	1/18/10	1/18/10	
66	Conference Call (power, design SOW, schedule, equipment)	1 day	1/19/10	1/19/10	
67	CH2 Delivers design variance SOW to CES	1 day	1/28/10	1/28/10	
68	CH2,EPA,CES exhange comments on SOW	38 days	1/30/10	3/10/10	67
69	CH2 Informs CES they are responsible for PG&E connections to equip	1 day	2/5/10	2/5/10	
70	CES still can't speak with PG&E	33 days	2/5/10	3/11/10	
71	CES Delivers V7 of CLIN5 Variance to CH2	1 day	3/11/10	3/11/10	68
72	CH2 Delivers another SOW, now for CLIN 5 & 6 to CES	1 day	3/11/10	3/11/10	
73	CH2/EPA Inform CES it's now OK to Speak with PG&E	1 day	3/11/10	3/11/10	
74	5 Critical Path for 3MW Design SOW & PO	122 days	4/12/10	9/28/10	
75	Finalize CLIN5 PO R5 Design Variance (exclude CLIN 6)	2 days	4/12/10	4/13/10	72
76	5 A,B,C CES 3MW Design, Plans, Schedule	5 wks	4/14/10	5/18/10	75
77	CH2 & EPA Review & Comment	15 wks	5/19/10	8/31/10	76
78	CES Response to Comments	5 days	9/1/10	9/7/10	77
79	CH2 & EPA Final Review, CLIN 5D Meetings Scheduled	10 days	9/8/10	9/21/10	78
80	FINAL RAMP Complete for 1MW, 3MW, all Clin 5 Specs Approved, Accepted, Completed	5 days	9/22/10	9/28/10	79
81	6 ISTT SYSTEM INSTALLATION (Items Completed)	228 days	7/13/09	3/10/10	
82	6A Mobilization (partial for well install & some ISTT equip)	65 days	7/13/09	9/17/09	
83	6B Site Preparation (Partial)	160 days	9/21/09	3/10/10	
84	6B1 Abandon Existing Wells	85 days	9/21/09	12/18/09	
85	6B2 Abandon Utilities & Trenches	3 days	11/10/09	11/12/09	
86	6B3 Misc Site Preparation (partial)	97 days	11/23/09	3/10/10	
87	6C1B,6C3B,6C1C All Electrode, TMP's and Puppy's Installed	85 days	9/21/09	12/18/09	
88	6 ISTT SYSTEM INSTALLATION	261 days	3/1/10	2/28/11	
89	6A Mob (Equip onsite for 1MW as of 3/1/10)	1 day	3/1/10	3/1/10	
90	Output Transformers for 1MW	0 days	3/1/10	3/1/10	
91	SCADA	0 days	3/1/10	3/1/10	
92	VEU 1	0 days	3/1/10	3/1/10	
93	Backup VEU	0 days	3/1/10	3/1/10	
94	AWS & Pump Skid	0 days	3/1/10	3/1/10	
95	Condensor skid	0 days	3/1/10	3/1/10	
96	Coalescer	0 days	3/1/10	3/1/10	
97	VPGAC units	0 days	3/1/10	3/1/10	
98	LPGAC Units	0 days	3/1/10	3/1/10	
99	20% order on PSUs 2 & 3 for 3MW	1 day	3/1/10	3/1/10	
100	6B3 Misc Prep: Reprice, Approval, PO, NTP	12 wks	3/22/10	6/11/10	
101	6E2 Soil Gas Collection: Reprice, Approval, PO, NTP	9 wks	4/8/10	6/9/10	
102	6C2 PSU & Controls: Reprice, Approval, PO, NTP	7 wks	4/26/10	6/11/10	
103	All remaining RAMP & CLIN Items: Reprice, Approval, PO, NTP	5 wks	5/5/10	6/8/10	
104	6F1 Electrical Service (From NTP - See Butterfield Schedule)	12 wks	7/8/10	9/29/10	103
105	6E2 Site Cap Portion : Order, procure cap materials	5 wks	6/14/10	7/16/10	101
106	6E2 Install Cap (CH2 est 4 weeks, CES est 6 wks)	6 wks	7/21/10	8/31/10	105
107	6A Mob (Addt'l Equip Needed for 1MW)	197 days	3/1/10	11/30/10	
108	Mob PSU 1	8 days	4/14/10	4/23/10	
109	Mob CT Skids	6 days	9/20/10	9/27/10	
110	Mob 2nd condensor skid	7 days	7/22/10	7/30/10	
111	Procure Vac hoppers (ordered both 1MW & 3MW)	24 days	3/1/10	4/1/10	
112	Modify Vac Hoppers in Shop & Mob to Site	9 wks	9/29/10	11/30/10	111,80
113	Prep & Mob Drip & Brine Skid for 1 MW	13 wks	7/5/10	10/1/10	
114	6B3 Continue Misc Site Preparation	100 days	6/9/10	10/26/10	
115	Continue Rental of Office Trailer and Assoc. Infras…	13 wks	6/9/10	9/7/10	103
116	Continue Rental of Temp Power	13 wks	6/9/10	9/7/10	103
117	Install Electric Power to Office Trailer (From PG&E Drop)	1 day	9/30/10	9/30/10	104
118	Install PG&E Tranny & CES Equip Pads (PG&E approval + 3 wks)	21 days	7/26/10	8/23/10	
119	Construct Containment Berm (GW Process Components)	5 days	8/24/10	8/30/10	118,103
120	Install security fence	15 days	9/29/10	10/19/10	106,80
121	Install "bunny" ground mats around fence	5 days	10/20/10	10/26/10	120
122	Install 1MW Tranny Ground Mats	5 days	9/1/10	9/7/10	106
123	6C2 Install PSU and Control Components	186 days	6/14/10	2/28/11	
124	PSU & Components procure, delivery, install	161 days	6/14/10	1/24/11	
125	Set PSU 1 for 1MW (Not Wire yet b/c no elec serv)	5 days	8/31/10	9/6/10	118,119
126	Set 1MW Tranny's on ground mats	1 day	9/8/10	9/8/10	106,122
127	Complete (90%) Orders for 3MW PSUs	1 wk	6/14/10	6/18/10	102
128	Build, deliver 3MW PSUs	20 wks	7/12/10	11/26/10	127
129	Install/Program PSUs 2 & 3	30 days	11/29/10	1/7/11	128,80
130	Procure Trannys for 3MW	18 wks	8/17/10	12/20/10	102
131	Install Tranny Ground Mats for 3MW	1 wk	1/4/11	1/10/11	106,130,80
132	Install Tranny's for 3MW	2 wks	1/11/11	1/24/11	131,80
133	Procure cable for 1MW (electrodes, & psu to trannys)	4 wks	9/6/10	10/1/10	102
134	Procure/Install Drip Tubes to All Electrodes (1 and 3MW)	4 wks	10/4/10	10/29/10	113,106,80
135	Procure & build drip stands for 3 MW	16 wks	6/14/10	10/1/10	102
136	Procure & build j boxes, tmp boxes, comm cables	10 wks	7/26/10	10/1/10	102
137	Install PSU & Electrode cable, CT skids for 1MW	3 wks	10/4/10	10/22/10	106,102,133
138	Wire & Program PSU 1 (requires completed PG&E drop)	5 days	10/25/10	10/29/10	125,137,104,8
139	Procure cable for 3MW (electrodes, & psu to trannys)	5 wks	9/29/10	11/2/10	102,80
140	Install cable, CT skids for 3MW	5 wks	1/25/11	2/28/11	132,139,80
141	3D TC install	60 days	7/26/10	10/15/10	



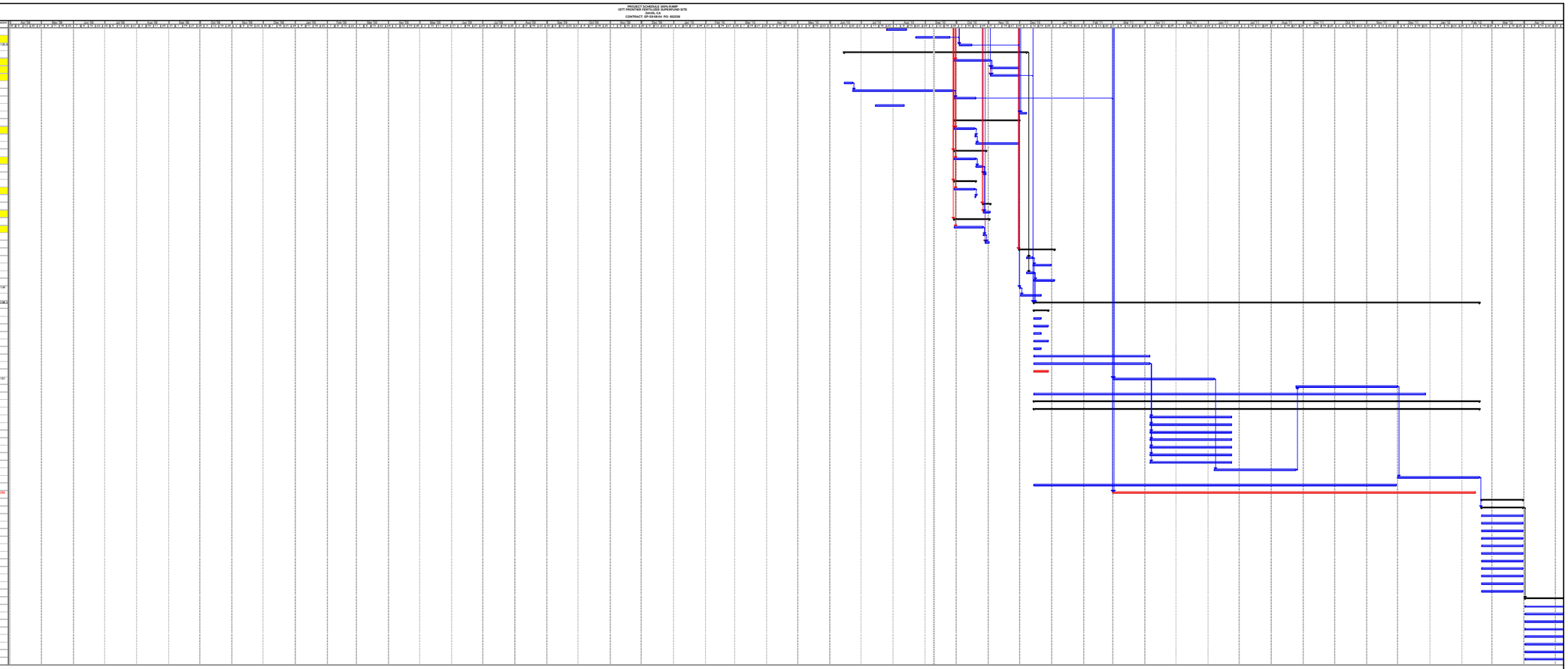
CES Project: 78-0033
Revision Date: 9/9/10
Revision V6

78-0033_SCHEDULE_DF_V16_090810JP_MPP03
Green = Complete Red/Purple = Critical Black/Blue = To Do Teal = Delay
Yellow shading= major planned activities for upcoming month

CES PROJ. NO: 78-0033
CH2M Hill Project No:38421.FD.01 & 385112.PP.04

PROJECT SCHEDULE SWN BAMP
IGTT FRONTIER SITE SUPERFUND SITE
CERCLA
CONTRACT: EP-S8-06-04 PO: 1022328

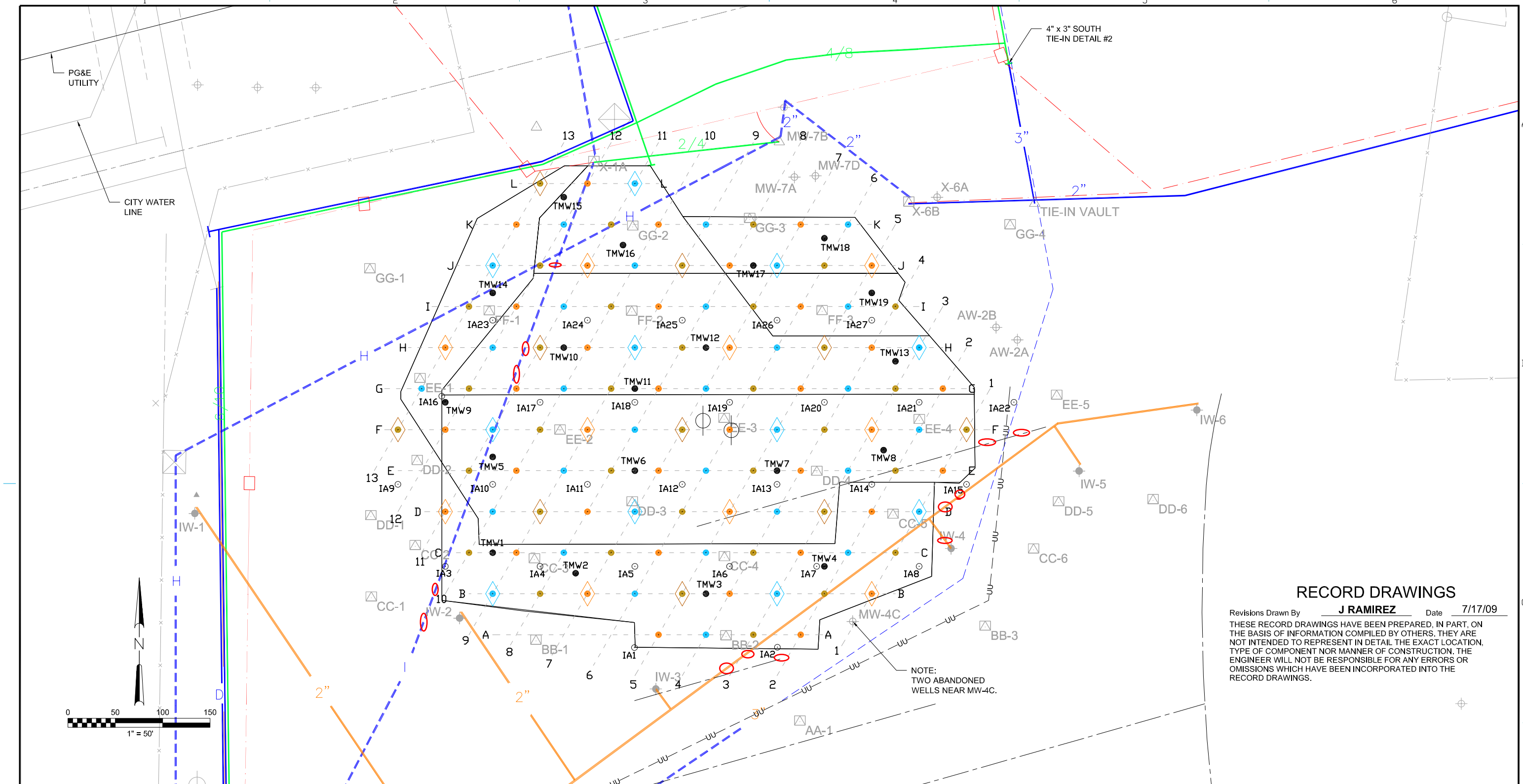
ID	Task Name	Duration	Start	Finish	Predecessors
1100	Relocate TC, Water & Compressed	2 days	11/8/06	11/9/06	107
1101	Build TCs	5 wks	10/23/06	10/26/06	
1102	Install TCs	10 days	12/4/06	12/15/06	135,140,136,8
1103	**SE2 Soil Gas Containment & Treatment Install**	**125 days**	**6/15/06**	**12/7/06**	
1104	Procure piping, 1MW system (requires material & WMP approval)	5 wks	6/26/06	7/28/06	80
1105	Install 1MW SVE Process Components (if powered off PSU)	4 wks	11/3/06	11/30/06	146,119
1106	Install 1 later SVE trailer mpng	4 wks	11/3/06	11/30/06	146,106
1107	Procure condenser skid,4000 for 3MW	4 days	6/15/06	6/22/06	
1108	Build, deliver 3MW condenser,AWS skids	14 wks	6/22/06	9/28/06	149
1109	Install SVE Process Components for 3MW	15 days	9/29/06	10/19/06	150,80
1110	Build Coalescers, 3MW	4 wks	7/10/06	8/11/06	
1111	Install Vac Hoppers, Coalescers 3MW	1 wk	12/1/06	12/7/06	112,116
1112	**SE4 VPGAC**	**45 days**	**9/29/06**	**11/30/06**	
1113	Procure 8000 lbs VPGAC, 1MW system	14 days	9/29/06	10/18/06	153,80
1114	Charge VPuAC, release self cleaner	1 day	10/19/06	10/19/06	155
1115	Procure/Charge addl VPGAC for 3MW system	6 wks	10/20/06	11/30/06	156
1116	**SE5 GW Containment & Treatment Install**	**45 days**	**9/29/06**	**11/30/06**	**153**
1117	Procure holding tank & pumps	3 wks	9/29/06	10/19/06	80
1118	Install Tanks and pumps	1 wk	10/20/06	10/26/06	159
1119	Test, commission water treatment system	2 days	11/27/06	11/30/06	165,164
1120	**SE6 LPGAC**	**45 days**	**9/29/06**	**11/30/06**	**153**
1121	Procure 2000 lbs LPGAC (carbon, 1MW system	14 days	9/29/06	10/18/06	80
1122	Charge LPGAC, assess with carbon	1 day	10/19/06	10/19/06	153
1123	**SF3 Sanitary Sewer Service (New to GWTP)**	**5 days**	**10/27/06**	**11/3/06**	**153**
1124	Pipe to GW plant & sewer discharge point (needs CH2 help)	5 days	10/27/06	11/3/06	153,80
1125	**SF5 Backup Generator**	**24 days**	**9/29/06**	**10/30/06**	**153**
1126	Procure, deliver to site	4 wks	9/29/06	10/26/06	80
1127	Install	2 days	10/27/06	10/30/06	158
1128	Test, commission backup power system	2 days	10/26/06	11/1/06	165,164
1129	**0500 Baseline Sampling & Analysis**	**64 days**	**10/5/06**	**3/30/07**	**153,181**
1130	0500G1a Sample Gas	4 days	12/8/06	12/13/06	145
1131	0500G1b Analyze Gas Samples (24 hr TAT)	14 days	12/14/06	12/31/06	172
1132	0500G2a Liquid Sampling	5 days	12/8/06	12/14/06	145
1133	0500G2b Analyze Liquid Samples (24 hr TAT)	14 days	12/15/06	1/3/07	174
1134	0500U1 Temperature	1 day	1/2/07	1/2/07	164,104,138
1135	0500 Phase VI Reports	14 days	1/2/07	1/21/07	178
1136	**0501A IGTT Testing/Start-up/Heat-up, Clin 5 & 1MW CLIN 6 Epoxy Approved, Accepted, Completed**	**208 days**	**12/5/06**	**9/13/07**	**143,146,138,1**
1137	**0501A Sampling & Analysis**	**55 days**	**12/5/06**	**1/25/07**	
1138	0501A1a Gas Sampling(soil & heat proc influent/eff	1 wk	12/15/06	12/21/06	
1139	0501A1b Gas Analysis of 0501A1a	2 wks	12/15/06	12/28/06	
1140	0501A2a Liquid sampling	1 wk	12/15/06	12/21/06	
1141	0501A2b Liquid Analysis of 0501A2a	2 wks	12/15/06	12/28/06	
1142	0501A3 Temperature	1 wk	12/15/06	12/21/06	
1143	0501A4 Performance Monitoring & recording	16 wks	12/15/06	4/3/07	
1144	0501C1 Stage 1 Start-up,Testing, O&M to Reach Temp)	16 wks	12/15/06	4/3/07	
1145	**Temp Shutdown for 3MW Field Wiring**	**2 wks**	**12/15/06**	**12/28/06**	
1146	0501C2 O&M Stage 2 SU,Testing,O&M to reach Temp, Clin 6 Specifications Approved, Accepted, Completed	14 wks	3/1/07	6/6/07	128,140,120
1147	0501C3 O&M Stage 3 SU,Testing,O&M to reach Temp, Clin 6 Specification Approved, Accepted, Completed	14 wks	8/20/07	11/20/07	200
1148	0501U1 PSMM VI reports	54 days	12/15/06	2/27/07	
1149	**0502 IGTT Steady State Temp. Condition (demobilizing returns)**	**205 days**	**12/15/06**	**9/13/07**	
1150	**0502A Sampling & Analysis**	**205 days**	**12/15/06**	**9/13/07**	
1151	0502A1a Gas Sampling(soil & heat proc influent/eff	11.4 wks	4/9/07	6/22/07	186
1152	0502A1b Gas Analysis of 0502A1a	11.4 wks	4/9/07	6/22/07	186
1153	0502A2a Liquid Sampling	11.4 wks	4/9/07	6/22/07	186
1154	0502A2b Liquid Analysis of 0502A2a	11.4 wks	4/9/07	6/22/07	186
1155	0502A3 Temperature	11.4 wks	4/9/07	6/22/07	186
1156	0502B Performance Monitoring & Recording	11.4 wks	4/9/07	6/22/07	186
1157	0502C1 Stage 1 O&M (To achieve diminishing returns)	11.4 wks	4/9/07	6/22/07	186
1158	0502C2 Stage 2 O&M (To achieve diminishing returns)	11.4 wks	8/7/07	8/24/07	188
1159	0502C3 Stage 3 O&M (To achieve diminishing returns)	11.4 wks	12/11/07	2/17/08	189
1160	0502D Phase VIII Reports	10 wks	12/15/06	11/29/07	
1161	Remob to Site for Campaign Switches (move wells,wellheads & manifolds)	30 wks	3/3/08	9/15/08	243,148,232
1162	**0503A IGTT System Shut-down**	**30 days**	**2/20/08**	**3/28/08**	
1163	**0503A Sampling & Analysis**	**30 days**	**2/20/08**	**3/28/08**	**255**
1164	0503A1a Gas Sampling(soil & heat proc influent/eff	30 days	2/20/08	3/28/08	
1165	0503A1b Gas Analysis of 0503A1a	30 days	2/20/08	3/28/08	
1166	0503A2a Liquid Sampling (4 wd, 10 MW, Proc infl/eff)	30 days	2/20/08	3/28/08	
1167	0503A2b Liquid Analysis of 0503A2a	30 days	2/20/08	3/28/08	
1168	0503A3 Temperature	30 days	2/20/08	3/28/08	
1169	0503A4 Soil Sampling Support	30 days	2/20/08	3/28/08	
1170	0503A4a Advance & Grout 45 borings to 20ft bg (LO PPE)	30 days	2/20/08	3/28/08	
1171	0503A4b Collect Cores (2,6,10,15,20,25)	30 days	2/20/08	3/28/08	
1172	0503A4c Analyze Samples from 0503A4b	30 days	2/20/08	3/28/08	
1173	0503B Performance Monitoring & Recording	30 days	2/20/08	3/28/08	
1174	0503D Phase VIII Reports	30 days	2/20/08	3/28/08	
1175	**0504 IGTT System Demobilization**	**60 days**	**4/2/08**	**6/23/08**	**255**
1176	0504A Performance Monitoring & recording	30 days	4/2/08	5/11/08	
1177	0504B Remove IGTT System Components	60 days	4/2/08	6/23/08	
1178	0504C Close Heating Electrodes	30 days	4/2/08	5/11/08	
1179	0504D Close Drill Ext & Mills	30 days	4/2/08	5/11/08	
1180	0504E Close Gas Ext Wells	30 days	4/2/08	5/11/08	
1181	0504F Close TMPs	30 days	4/2/08	5/11/08	
1182	0504G Close Combo Temp/Gas/GW Mills	30 days	4/2/08	5/11/08	
1183	0504H Phase X Reports	30 days	4/2/08	5/11/08	



Task Progress Rollup
Revision Date: 9/26/06
Revision: 05

Green = Complete Red/Purple = Critical Black/Blue = To Do Teal = Delay
Yellow shading= Major planned activities for upcoming month

APPENDIX B



RECORD DRAWINGS

Revisions Drawn By **J RAMIREZ** Date 7/17/09

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

LEGEND

- EXTRACTION WELL
- MONITORING WELL
- PMP WELLS
- ELECTRODES
- FENCE
- SIGN POST
- UNDIFFERENTIATED UTILITY (GEOPHYSICAL)
- SUSPECTED UTILITY LINE (GEOPHYSICAL)

PVC

- 2" — 2" ø PVC WITH SECONDARY CONTAINMENT
- D — 6" ø PVC TREATED WATER DISCHARGE LINE
- I — 2" ø PVC SINGLE WALL PIPE (DASHED WHERE INACTIVE)
- 3" — 3" ø PVC WITH 6" SECONDARY CONTAINMENT (DASHED WHERE INACTIVE)
- 1.5" — 1.5" ø PVC WITH SECONDARY CONTAINMENT
- H — 1.5" ø HOSE CONTAINED IN PVC SECONDARY CONTAINMENT (DASHED WHERE INACTIVE)

ABS

- 2" ABS
- 4" ABS

HDPE

- 2/4 — 2" CARRIER W/ 4" CONTAINMENT
- 4/8 — 4" CARRIER W/ 8" CONTAINMENT
- 6/10 — 6" CARRIER W/ 10" CONTAINMENT

ELEC

- UNDERGROUND CONDUIT, RIGID PVC, SCHEDULE 40 (ACTIVE UNLESS NOTED)

NOTE:

1. PIPE TERMINATION LOCATIONS MARKED WITH POST AND SIGN AT SURFACE.

DSGN						
DRAWN J KLAPP						
CHKD						
APVD	NO.	DATE	REVISION	BY	APVD	

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

CH2MHILL

FRONTIER FERTILIZER – NPL

UNDERGROUND UTILITIES & KNOWN OBSTRUCTIONS

SHEET
DWG
DATE Jul 2009
PROJ

FILENAME: 384210_C01.DWG PLOT DATE:17-Jul-09 PLOT TIME: 12:54:41 PM

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