ENGINEERING DESIGN REPORT

Final – 100% Design

Port of Seattle

Terminal 30 Site

December 20, 2018

Port of Seattle

ENGINEERING DESIGN REPORT
Final – 100% Design

Port of Seattle
Terminal 30 Site

December 20, 2018

PREPARED BY:

CRETE
CONSULTING, INC.

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms and Abbreviations

AS	Air Sparging
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
BTEX	benzene, toluene, ethylbenzene, and xylenes
BMP	best management practice
cPAH	carcinogenic polyaromatic hydrocarbons
CAP	Cleanup Action Plan
CFR	Code of Federal Regulations
CMP	Groundwater Compliance Monitoring Plan
CPOC	conditional point of compliance
CQAP	Construction Quality Assurance Plan
CQCP	Construction Quality Control
Contractor	prime construction contractor
CS	Contractor Superintendent
CRETE	Crete Consulting Incorporated
Ecology	Washington Department of Ecology
EDR	Engineering Design Report
EPA	United States Environmental Protection Agency
HAZWOPER	Hazardous Waste and Emergency Operation
HASP	Health and Safety Plan
HDPE	High density polyethylene
IHS	Indicator hazardous substance
LNAPL	light non-aqueous phase liquid
MTCA	Model Toxics Control Act
PGG	Pacific Groundwater Group
Port	Port of Seattle
PPC	Port Project Coordinator
PPM	Port Project Manager
PSI	pounds per square inch
PE	(Contractor) Project Engineer
PM	Project Manager
PSCAA	Puget Sound Clean Air Authority
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCR	Quality Control Representative
RE	Resident Engineer
RI/FS	Remedial Investigation/Feasibility Study
RCW	Revised Code of Washington

SCFM	Standard cubic feet per minute
SHSS	Site Health and Safety Supervisor
SVE	Soil Vapor Extraction
TEP	Technical Execution Plan
TSA	Transportation Security Administration
TWIC	Transportation Worker Identification Credential
TPH	total petroleum hydrocarbons
T30 Site	Terminal 30 Site
USACE	United States Army Corps of Engineers
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

Professional Certification

Engineer Design Report, Dated December 20, 2018
Terminal 30 - 1901 East Marginal Way South, Seattle, Washington

Based on direct observation made by CRETE Consulting, Inc. (CRETE) personnel, the material and data in this report were prepared under the supervision and direction of the undersigned.

CRETE Consulting, Inc.

Grant Hainsworth
33192

12/20/18

EXPIRES 6-5- 19

Grant Hainsworth, P.E.
Washington State PE Number: 33192
Expiration: 6/5/2019

CRETE Consulting, Inc.

MICHAEL G. BYERS
30698

12-20-18

EXPIRES 12 11 / 20

Micheal Byers, P.E
Washington State PE Number: 30698
Expiration: 12/11/2020

1 Introduction

This Engineering Design Report (EDR) has been prepared for the Port of Seattle (Port) Terminal 30 (T30, Figure 1-1) Site to document the engineering concepts and criteria used for design of the cleanup action. This EDR has been prepared in accordance with the Washington State Department of Ecology (Ecology) Consent Decree dated July 19, 2017 between Ecology and the Port of Seattle for the T30 Site and Washington Administrative Code (WAC) 173-340-400.

This EDR has been prepared by Crete Consulting (CRETE) on behalf of the Port and was developed using information presented in the Cleanup Action Plan and the Remedial Investigation/Feasibility Study for the T30 Site (Ecology 2017 and PGG 2013).

The EDR satisfies the requirements of WAC 173-340-400(4) (a) through (c) and has been prepared under the direct supervision of a registered Professional Engineer. The required plans describing the cleanup action include the EDR, construction drawings (Appendix A) and specifications (Appendix B), and an operation and maintenance plan (Appendix C). Plans attached to this EDR that address specific requirements include:

- Archaeological Monitoring and Discovery Plan (Appendix D)
- Groundwater Compliance Monitoring Plan (CMP; Appendix E).

The Archaeological Monitoring and Discovery Plan was developed to address a comment received from the State Historical Preservation Office (SHPO) during SEPA review for approval of the CAP.

The CMP describes performance and confirmational monitoring that will be performed to assess the long-term effectiveness of the cleanup action and presents decision criteria that will be used to determine when cleanup actions have been successful and operations can cease. See Section 1.2 for the full list of supporting documentation included in this EDR.

1.1 Cleanup Action

This EDR details the design and objectives for the selected cleanup action at the T30 Site. The cleanup action was selected by Ecology in the CAP (Ecology 2017) and is executed through the Consent Decree between the Port and Ecology. The cleanup action will include air sparging/soil vapor extraction (AS/SVE) treatment, LNAPL recovery, long-term compliance monitoring, and institutional controls. The AS/SVE system and the LNAPL recovery wells are shown on Figure 1-2.

These actions are intended to address specific cleanup goals, including:

- Protect human health and the environment
- Maintain cleanup levels at the conditional point of compliance (CPOC) for protection of surface water

- Reduce Light Non-Aqueous Phase Liquid (LNAPL) thickness near MW-59 to sheen
- Reduce contaminant mass in the sheen area

Free product was observed in monitoring wells MW-36, MW-39A, and MW-89 after completion of the CAP. MW-36 and MW-39A have been added to the LNAPL recovery program and the AS/SVE system has been expanded to address the MW-89 area. Since MW-89 was designated as a CPOC monitoring well in the CAP, the groundwater compliance monitoring network has been modified in the EDR and CMP.

Institutional controls will prevent contact with subsurface soil and groundwater contamination by maintaining the asphalt cap as a protective barrier and by establishing procedures that prevent exposure below the asphalt cap without appropriate health and safety procedures and Ecology notification.

1.2 Organization

This EDR includes the following subsections:

- Section 1 – Introduction: Provides the purpose of the EDR report and the organization of the report.
- Section 2 – Background Information: Provides a brief site description and history and a summary of subsurface conditions, nature and extent of contamination, and data collected during the design process.
- Section 3 – Design Criteria: Presents the cleanup and remediation levels (RELs), permitting requirements, and applicable or relevant and appropriate requirements (ARARs).
- Section 4 – Design Basis: Outlines the design assumptions and configuration that were incorporated to achieve the design criteria.
- Section 5 – Scope of Work: Describes the process by which cleanup construction is expected to be implemented.
- Section 6 Construction Quality Assurance: Presents the construction quality assurance testing requirements and organizational structure for the project.
- Section 7 – Operation, Maintenance, and Monitoring: Provides an outline for what will be included in the final Operation, Maintenance, and Monitoring Plan.
- Section 8 – Schedule and Reporting: Provides a schedule for implementing the cleanup action and a description of the reporting requirements.
- Section 9 – References: Lists the sources of information referenced in the document.

The following information is attached to the EDR:

- Appendix A – Drawings: Includes drawings which, in combination with the technical specifications, detail the cleanup action. The drawings include documentation of existing site conditions and construction plans, sections, and details.
- Appendix B – Technical Specifications: Includes technical specifications which, in combination with the drawings, detail the cleanup action. The technical specifications include select Division 1 specifications and all of the Division 2, 20, 26, 31, 32, and 33 specifications required to perform the cleanup action. A complete project manual, including all Division 0 and Division 1 specifications, will be prepared at a later date as part of the bidding package.
- Appendix C– Draft Operation, Maintenance, and Monitoring Plan: Provides procedures for operating (including repair/trouble shooting), maintaining, monitoring, and inspecting specific components of the cleanup action after construction is completed. This document will be finalized after construction is completed and submitted in final format with the Construction Completion Report.
- Appendix D – Archaeological Monitoring and Discovery Plan: The Archaeological Monitoring and Discovery Plan includes an inadvertent discovery protocol and monitoring/treatment plan should cultural resources be identified during construction.
- Appendix E – Groundwater Compliance Monitoring Plan: Provides procedures for monitoring groundwater conditions after construction is completed and data evaluation procedures to assess performance of the cleanup action.
- Appendix F – Permits: Includes copies of permits and applications completed prior to construction.
- Appendix G – Calculations and Design Data: Includes calculations and data that support the design.

2 Site Conditions

The T30 Site is generally located at 1901 East Marginal Way South, Seattle, Washington, approximately one mile southwest of downtown Seattle, in King County, Washington on the shoreline of the East Waterway (Figure 1-1). The T30 Site encompasses about 7 acres of a 34-acre intermodal container terminal where petroleum contamination is present and includes light non-aqueous phase liquid (LNAPL), soil, and groundwater contamination.

Contamination at the T30 Site is due to a Chevron Bulk fuel terminal that operated between 1905 and 1984. The bulk fuel terminal consisted of above-ground fuel storage tanks and associated piping and equipment. The Port purchased the T30 Site from Chevron in 1985. The fuel terminal was demolished between December 1984 and about November 1985. The Port redeveloped the T30 Site and properties to the north and south into the 34-acre Terminal 30 intermodal container terminal. The Port converted Terminal 30 into a cruise ship terminal in 1999 and later converted it back to an intermodal container terminal in 2009.

The intermodal terminal is bordered on the north by an area of public shoreline access to the East Waterway, on the east by East Marginal Way South, on the south by Terminal 25, and on the west by the East Waterway. The East Waterway is an operable unit of the Harbor Island Superfund T30 Site administered by the U.S. Environmental Protection Agency (EPA).

2.1 Owner and Operator Information

Terminal 30 was purchased by the Port of Seattle on January 2, 1985. Terminal 30 and the contiguous Terminal 25 to the south are currently operated as a-70 acre container storage and transfer facility by the Port’s tenant SSA Marine. SSA’s current lease extends through 2023. Containerized freight is transferred between ships, trucks, and temporary terminal storage using a series of rail-mounted overhead cranes and forklifts.

The Port anticipates continued and long-term ownership of Terminal 30 and long-term use as an industrial container facility. The Port has no plans to redevelop this property.

2.2 Previous Cleanup Actions

Work at the T30 Site has included considerable study, interim actions, and redevelopment actions with environmental benefits. A summary of the key environmental milestones is provided below:

- Port and Ecology enter into Agreed Order for RI/FS in 1991 (Ecology 1991)
- Installation of a product recovery system that removed more than 171,000 gallons of product by the early 1990s

- Excavation and offsite disposal of more than 24,000 cubic yards of petroleum impacted soil
- Construction of site-wide 12 to 16-inch thick asphalt cap
- Oxygen Release Compound (ORC®) injection in MW-42 area
- Installation of more than 100 monitoring and recovery wells
- Completion of the initial RI/FS in 1998, and the final RI/FS in 2016
- Installation of a sheetpile wall in 2008 and 2009 as part of the cruise to container terminal conversion
- Continuation of monitoring and product recovery during the 2000s.

The Port and Ecology entered into an Agreed Order for cleanup at T30 Site in 1991 which was amended in 2013 to include preparation of the CAP. In 2017, the Port and Ecology entered into a Consent Decree for site cleanup that includes the preparation of this EDR and the construction, operation, maintenance, and monitoring of the selected cleanup action.

2.3 Nature and Extent

The nature and extent of contamination are described in the Terminal 30 RI/FS (PGG 2013). Contamination at the T30 Site is due to spilling and leaking associated with former terminal operations. The types of products handled at the T30 Site included furnace oil, stove oil, bunker fuel oil, diesel fuel, aviation fuel, Stoddard solvent, thinner, pearl oil, and gasoline (GeoEngineers 1998). The extent of contamination has been significantly reduced since the terminal operations ceased in 1984 due to remedial action and natural degradation processes. The extent of petroleum contamination at the T30 Site is illustrated in Figure 1-2. This figure has been updated since the CAP to reflect the recent LNAPL observations, discussed below, and the measurement of 0.53 mg/L of DRO at CPOC well MW-58A in November 2017 that exceeded the cleanup level of 0.5 mg/L.

The extent of soil contamination is similar to the maximum historical extent of LNAPL with exceedances of cleanup levels for diesel-, oil- and gasoline-range hydrocarbons (TPH-D, TPH-O, and TPH-Gx), and toluene. Groundwater at the T30 Site has exceedances of cleanup levels for benzene, PAHs, and diesel-, oil-, and gasoline-range hydrocarbons. LNAPL free product is present in measureable quantities at MW-59 and MW-36. Measured product thicknesses ranged up to 1.3 feet at MW-59 and 1.66 feet in RW-12. Recent gauging events have identified free product in the sheen area at MW-36 and MW-39A. Up to 0.21 and 0.11 feet were measured at MW-36 and MW-39A, respectively (PGG 2018). Up to 0.18 feet was also measured at MW-36 (PGG 2013, draft groundwater results from 2017). Increased product thicknesses in 2017 likely reflect the unusually high water tables conditions and are not an indication that product is mobile and migrating.

A thin layer of free product (0.03 feet) was observed in MW-89 in November 2017 for the first time since the well was installed in April 2008. Sheen had been previously observed in the well and the borehole log identifies odor and sheen. These observations suggest the potential for intermittent accumulation of free product due to residual petroleum impacts in surrounding soil.

2.4 Design Data Collection

In October 2017, additional data was collected to inform design of the T30 cleanup action. The design field work activities included:

1) Installation of groundwater monitoring wells that will be used as performance groundwater monitoring wells during operation of the AS/SVE system and assessment of existing wells MW-36 and MW-39;
2) Collection of soil vapor samples from groundwater wells to support permitting and emissions treatment design; and
3) Performance of a ground penetrating radar (GPR) survey and a topographical survey of the AS/SVE system alignment.

Results of the data collected, key field reports, and analytical laboratory reports are included in Appendix G. A summary of the design field work associated with each activity is described below.

2.4.1 Monitoring Well Installation and Assessment

The following activities were performed related to monitoring well installation and assessment:

- **Three new Performance Wells –** On October 15, 2017, a hollow stem auger drilling rig was used to install three new wells: MW-36A (to replace MW-36), MW-39A (to replace MW-39), and MW-93. Soil samples were collected at the water table for TPH analyses. Analytical results are summarized and copies of boring logs and analytical reports are included in Appendix G. The results have been incorporated into the T30 Site cleanup action design.
- **Repairs at MW-36 -** On October 15, 2017 repairs at MW-36 included: the flush mount rubber seal and bolts were replaced; and a new deeper J-plug was installed to form a water-tight seal.
- **Decommissioning of MW-39 -** Field work on October 15, 2017 intended to decommission well MW-39, however decommissioning was unsuccessful due to the amount of rebar in the high-strength concrete surrounding the well monument. The top of PVC casing location was marked in the concrete (in the wet concrete) and the well will be decommissioned by over-drilling during the cleanup action.
- **LNAPL Product Removal at MW-36 -** LNAPL gauging and recovery was completed at MW-36 on October 15, 2017. The LNAPL was measured from 9.77 to 10.05 ft. below the top-of-casing (0.28 ft thickness). Approximately 0.5 gallons of LNAPL product was recovered from the well using a peristaltic pump.

2.4.2 **Soil Vapor Sampling**

The SVE system will discharge vapors to the atmosphere during operation. To evaluate the need for vapor treatment prior to discharge and to better understand petroleum composition, soil vapor samples from 2 existing and 3 new monitoring wells (MW-42, 39A, 36A, 93 and MW-59) were collected on October 25 and 26, 2017. Samples were analyzed for volatile organic carbons (VOCs, Method TO-15) and Massachusetts Department of Environmental Protection Air-Phase Petroleum Hydrocarbons (MA APH). Analytical results are summarized and analytical reports are included in Appendix G. The results have been incorporated into the T30 Site cleanup action design (see Section 4.2).

2.4.3 **GPR Survey and Topographic Survey**

An initial GPR survey along of the AS/SVE system alignment was conducted on October 25 and 26, 2017 followed by a second GPR survey along the MW-89 leg of the AS/SVE system alignment on August 28, 2018. The survey results have been incorporated in the drawings and design elements have been updated to avoid any documented subsurface conflicts that were identified during the survey.

The second GPR survey identified a fiber optics telecommunication cable in a different location than was indicated on the initial base map. This cable is part of a terminal operations system that was installed by Tideworks Technology, Inc. for SSA. After coordinating with SSA, Tideworks, and Bayshore Communications, it was determined that this cable will be taken out of service during AS/SVE system installation and will be re-installed following AS/SVE construction activities.

In addition to the GPR survey above, an updated topographic survey was conducted throughout October 2017 to provide current information on surface elevations of key features in the AS/SVE system alignment.

3 Design Criteria

The remedial design and associated long-term operation and monitoring approach were developed based on regulatory and other requirements. Regulatory requirements include cleanup standards and RELs presented in the CAP, permitting requirements, substantive requirements of permits exempted due to the work being performed under a Consent Decree, ARARs, and requirements triggered under SEPA review. Other requirements relate to existing site conditions and operations that impact the design. Existing site conditions include that the site is an active cargo terminal with high surface loads from the storage and loading/unloading of shipping containers. These loads were factored into the design as discussed below.

3.1 Cleanup Levels and Remediation Levels

3.1.1 Groundwater Cleanup Standards

For the T30 Site, conditional points of compliances (CPOCs) for groundwater were selected to be located as close as practical to the source of the petroleum sheen area and LNAPL area. Monitoring wells MW-45A, MW-46B, MW-58A, MW-89, and MW-92, located at the edge of tidal flushing and between the sheen/LNAPL areas and surface water receptors were selected as CPOC wells in the CAP. Due to the appearance of free product in MW-89 in 2007, the AS/SVE system was extended to address the MW-89 area and MW-86B was selected to replace MW-89 as a CPOC well (Figure 1-2).

The groundwater cleanup levels in Table 3-1 are surface water criteria for marine water. The marine surface water criteria are applicable for groundwater at the T30 Site because groundwater discharges to the East Waterway. Surface water criteria are not established for diesel-, heavy oil-, and gasoline range organics, and total xylenes. Therefore, MTCA Method A groundwater criteria were selected for those parameters.

3.1.2 Soil Cleanup Standards

For soil at the T30 Site, the point of compliance extends throughout the site to a depth of 15 feet for the direct contact exposure pathway.

T30 Site soil cleanup levels in Table 3-1 are MTCA Method A values for industrial land use or soil leaching to groundwater protective of surface water values.

Table 3-1 Soil and Groundwater Cleanup Levels

Constituent		Soil Cleanup Levels (mg/kg)	GW Cleanup Levels (ug/L)
BTEX Compounds			
	Benzene	**0.03**	**23**
	Toluene	**7**	**15,000**
	Ethylbenzene	**6**	**2,100**
	Xylenes (total)	**9**	**1,000**
Semivoliatile Organic Compounds			
	2-Methylnaphthalene	**NV**	**NV**
PAH Compounds			
	Acenaphthene	**NV**	**643**
	Acenaphthylene	**NV**	**NV**
	Anthracene	**NV**	**25,900**
	Benzo[a]anthracene (TEF=0.1)	**NV**	**See cPAH TEQ**
	Benzo[a]pyrene (TEF=1)	**0.35**	**See cPAH TEQ**
	Benzo[b]fluoranthene (TEF=0.1)	**0.44**	**See cPAH TEQ**
	Benzo[g,h,i]perylene	**NV**	**NV**
	Benzo[k]fluoranthene (TEF=0.1)	**0.44**	**See cPAH TEQ**
	Chrysene (TEF=0.01)	**0.14**	**See cPAH TEQ**
	cPAH TEQ	**NV**	**0.018**
	Dibenzo[a,h]anthracene (TEF=0.1)	**0.64**	**See cPAH TEQ**
	Fluoranthene	**89**	**90**
	Fluorene	**547**	**3,460**
	Indeno[1,2,3-cd]pyrene (TEF=0.1)	**1.25**	**See cPAH TEQ**
	Naphthalene	**5**	**4,940**
	Phenanthrene	**NV**	**NV**
	Pyrene	**3,532**	**2,590**
	Naphthalene	**5**	**4,940**
Petroleum Hydrocarbons			
	Tph: gasoline range organics, no detectable benzene*	**100**	**1,000**
	Tph: gasoline range organics, benzene present*	**30**	**800**
	Tph, diesel range organics + heavy oils	**2,000**	**500**

Notes:
"NV" indicates that no value is available.
mg/kg = milligrams per kilograms
ug/L = micrograms per liter
TEQ: Toxicity Equivalence
TEF: Toxicity Equivalency Factor. Values from WAC 173-340-900 Table 708-2.

3.1.3 **Groundwater Remediation Levels**

Remediation levels (RELs) will be used to track remediation progress in non-CPOC wells. RELs are developed for a subset of indicator hazardous substances (IHSs) that are indicative of TPH abundance, including:

- benzene, toluene, ethylbenzene, xylenes (BTEX);
- diesel range organics;
- gasoline range organics.

RELs are used to demonstrate reduction in petroleum compound contaminant mass in the sheen area. In this context, RELs are a concentration target for operation of the AS/SVE system, and are not a maximum concentration for compliance at performance monitoring wells. RELs in Table 3-2 are the maximum of either:

- 75% of the estimated solubility limit or
- twice the cleanup level.

Table 3-2 T30 Site Remediation Levels

Constituent	Units	Cleanup Level	Remediation Level
Benzene	ug/L	23	47
Toluene	ug/L	15,000	30,000
Ethylbenzene	ug/L	2,100	4,200
Xylenes (total)	ug/L	1,000	2,000
Total BTEX	ug/L	--	--
Gasoline Range Organics	ug/L	1,000	2,085
Diesel Range Organics	ug/L	500	2,085

Notes:
The remediation level for light non-aqueous phase liquid (LNAPL) will be reduction to sheen (no measurable thickness).
See the CAP for further details on how the Site Remediation Levels were developed (Ecology 2017).
ug/L = micrograms per liter

3.1.4 LNAPL Thickness

Measurable thickness of LNAPL in monitoring wells will be considered an exceedance of WAC 173-340-747(10) regardless of groundwater concentrations in samples collected from the well. A measurable thickness is 0.01 feet, the practical measurement limit with an interface probe. The presence of sheen will not be considered an exceedance of the LNAPL criteria.

3.2 Evaluating the Cleanup Action

The CMP (Appendix E) specifies the general field and laboratory methods and data quality objectives that will be used to locate, collect, and chemically analyze groundwater samples at T30 following implementation of the cleanup action. The CMP also details the evaluation of performance and confirmational sampling data and possible contingent actions. A brief description of these evaluation methods is provided below.

Performance monitoring is used to assess remediation system performance. Data from performance wells will be compared to RELs and will be used to determine whether continued operation of the remediation system is warranted. For the T30 Site, performance monitoring will occur for the duration of AS/SVE system operation plus 2 years.

Confirmational monitoring is used to assess the long-term effectiveness of the site cleanup. Data collected during confirmational monitoring will be compared to cleanup levels to determine whether it is necessary to trigger additional monitoring or contingent actions.

3.3 Institutional Controls

A restrictive environmental covenant consistent with the requirements of WAC 173-340-440 will be filed after construction of the AS/SVE and LNAPL recovery systems.

3.4 Permitting

The T30 Site cleanup work is required and is being performed under an Ecology Consent Decree. As a result, the project is exempt from the procedural requirements of State and local permits for on-site actions. However, exempted actions will be conducted in a manner that meets substantive permit requirements. Permits that fall under this umbrella include the Puget Sound Clean Air Agency (PSCAA) Notice of Construction and Application for Approval. Compliance with the substantive requirements of State and Local permits is described in Section 3.6.

Application for an electrical permit shall be submitted by the Electrical subcontractor in accordance with Article 80.51 of the Seattle Electrical Code (November 12, 2014). Due to the limited size of the electrical feeder (less than 400 amperes), drawings and specifications are not required (Article 80.51(B)). The permit submittal and all electrical work will be performed by a Washington state licensed electrical contractor with a City of Seattle business license.

Copies of Permits obtained or submitted to meet substantive requirements prior to construction are included in Appendix F. Others that are obtained after this EDR is approved but are pertinent to the construction will be provided in the Construction Completion Report.

3.5 Other Regulatory Requirements

3.5.1 Archaeological Monitoring

The Native American Graves Protection and Repatriation Act, 1990 Public Law 101-601, provides for the protection of Native American graves and other cultural items. If the items are excavated, they must be returned to the respective peoples. The Archaeological Resources Protection Act is specifically designed to prevent looting and destruction of archeological resources. If archaeological resources are encountered as part of the cleanup, archaeological resources will not be removed without approval from the federal government.

An Archaeological Monitoring and Discovery Plan was prepared based on the SHPO request made during the SEPA review and is included in Appendix D of this report. Based on the findings in the Archaeological Monitoring and Discovery Plan, archaeological monitoring is not recommended due to project conditions and location. Earthwork associated with the construction of the cleanup action will be conducted in the shallow fill unit and not in the deeper native deposits. The Archaeological Monitoring and Discovery Plan includes an inadvertent discovery protocol and monitoring/treatment plan should cultural resources be identified during construction (Appendix D). The Archaeological Monitoring and Discovery Plan was prepared so that construction activities comply with this ARAR.

3.5.2 Health and Safety

Washington Administrative Code (WAC 292-188) specifies Safety Standards for Construction. This code specifies health and safety standards for responding to releases or substantial threats of releases of hazardous substances at hazardous waste sites. The Occupational Safety and Health Administration (OSHA) specifies health and safety requirements for hazardous waste sites (29 CFR 1910.120). Details regarding the use of 40-hour trained contractor personnel and requirements for the contractor’s health and safety plan are provided in Section 6. The Construction Health and Safety Plan will be included in the Contractor pre-submittals (see Section 5.2). The Construction Health and Safety Plan will be prepared so that construction activities comply with this ARAR.

3.5.3 Stormwater Management

Cleanup construction work is exempt from the General Permit to Discharge Stormwater Associated with Construction Activities. Construction work is also exempted from the City of Seattle Stormwater Code because the nature of the work is related to a utility project and includes installation of “underground pipes, conduits, and that includes replacing the ground surface with in-kind material or materials with similar runoff characteristics” (City of Seattle 2016).

Based on the location of the site and contaminated soil removal, a Construction Stormwater and Erosion Control Plan will be required for the project. The plan will be prepared by the Contractor per the specifications required in the drawings and project specifications. The Construction Stormwater and Erosion Control Plan will include Best Management Practices (BMPs) for managing stormwater during remedial activities. Due to the potential presence of contaminated surface soil, any stormwater collected during construction activities from contaminated areas will be captured and stored for off-site commercial disposal.

3.5.4 **Shoreline Master Use Permit**

Portions of the remedial actions and construction activities within shoreline jurisdictional areas must adhere to substantive requirements of the Shoreline Management Act, RCW 90.58, City of Seattle Shoreline Substantial Development Permit, and Shoreline Substantial Development Permit regulations (WAC 173-14) as applied through RMC 4-3-090; however, a permit is not required due to MTCA's procedural preemption.

The substantive requirements applicable to the shoreline master use permit have been incorporated in the planning and design of the cleanup. Erosion and sedimentation controls are addressed in the Contractor's Construction Stormwater and Erosion Control Plan, in accordance with BMPs for managing stormwater during remedial activities.

3.5.5 **Fugitive Dust Emissions**

The Puget Sound Clean Air Agency (PSCAA) provides air emissions criteria for the site. Section 9.15 of Regulation I discusses the requirements regarding visible emissions of fugitive dust. Construction is not expected to generate much fugitive dust due the nature of the site and the cleanup action. The site is completely paved. Installation of the cleanup action will occur through trenching and be conducted in phases, which will limit the amount of soils exposed. Though dust is not expected to be generated, measures will be provided to monitor and suppress any fugitive dust generated during site grading that exceeds Regulation I criteria. The contractor will be required to maintain no visible dust. If visible dust occurs, construction will be halted and corrective measures implemented to prevent further generation of dust.

3.5.6 **Noise Control**

The Washington Noise Control Act (RCW 70.107; WAC 173-60) and the Seattle Municipal Code (SMC; Chapter 25.08) restrict maximum permissible sound levels for sound sources located within the City of Seattle. For the purposes of this project, it will be assumed that construction noise will be generated from an industrial source (excavation on lands zoned as industrial) with the receiving property being industrial. In addition, the noise-producing activity is Construction, as defined by the Seattle Municipal Code. Using these assumptions, and based on the applicable codes, the maximum permissible sound level for the residential area is 70 dB(A) for Industrial noise generation between the hours of 7:00 am and 10:00 pm on weekdays and 9:00 am and 10:00 pm on weekends and legal holidays (New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and the day after, and Christmas Day). The maximum permissible sound levels are measured from the real property of another person or at a distance of 50 feet from the equipment, whichever is greater. Specific permissible sound levels associated with various equipment used on construction sites are described in SMC 25.08.425.

The work area is not residential or otherwise noise-sensitive; therefore, normal OSHA workplace noise guidance will apply during construction. Ear protection will be required in locations where noise levels of 90 decibel A-weighting (dBA) or greater are normally expected to occur. The AS/SVE equipment pad has been designed such that sound levels outside of sound enclosures will be less than 70 dBA during simultaneous operation of all equipment.

3.5.7 Grading and Filling

The Seattle Municipal Code (SMC, Title 22.170) provides requirements for grading and filling activities. Per SMC, site grading includes unsuitable geotechnical material removal and excavation of utility trenches and site filling includes backfilling low areas at the site to specified elevations and preloading existing soil surface for geotechnical purposes. A grading permit is not required because of MTCA's procedural preemption; however, all grading and filling activities will comply with the substantive requirements in the SMC.

3.5.8 Solid Waste Management

Minimum Functional Standards for Solid Waste Handling (WAC 173-304) are applicable to non-hazardous waste management generated during remedial activities. Non-hazardous soil will be handled and disposed in accordance with these requirements.

The cleanup will use existing permitted disposal and recycling facilities that are compliant with the solid waste disposal regulations and are permitted to accept impacted materials to comply with this ARAR.

3.5.9 Trenching and Trench Safety

Trenching will be required for the installation of the distribution system for the AS wells, SVE wells, and required for installing additional electrical lines and ducts to accommodate the AS/SVE system. All trenching will be done in compliance with RCW Chapter 39.04.180 Public Works/Trench Excavations - Safety Systems, RCW Chapter 49.17 WISHA Safety Standards (Current Edition), and WAC 296-155 Safety Standards for Construction Work (Current Edition). Trench safety systems will be required for trenches greater than 4 feet that require personnel to enter; the Contractor will be required to comply with WAC 296-155-657 Requirements for Protective systems.

3.5.10 Well Installation

The cleanup action includes installing wells for the AS, SVE, and product recovery systems. All wells will be installed by a licensed driller and all wells will be completed per the requirements listed in RCW Chapter 18.104 Water Well Construction Act, WAC 173-160 Minimum Standards for Construction and Maintenance of Wells, and WAC 173- Regulation and licensing of well contractors and operators.

3.6 Other Requirements

As stated above, the site is an active terminal used to load/unload and store shipping containers. Access to the site is restricted at all times. All site workers will be certified per

Transportation Security Administration (TSA) Transportation Worker Identification Credentials (TWIC) requirements.

All work will be done in direct coordination with the site tenant, SSA Marine, Inc. Work has been sequenced to permit SSA Marine to have access to defined work areas as soon as work is completed and to ensure that container storage areas and main roadways are available and not blocked for long durations. Construction is expected to occur during normal working hours with no work restrictions.

The T30 Site is subject to heavy loads from the machinery used to unload/load cargo ships and from the storage of loaded shipping containers. The design assumes a maximum loading rate of 100 kips (kips is a standard loading factor for this type of use, one kip equals 1,000 pounds-force). The AS/SVE system has been designed to accommodate this heavy loading. High density polyethylene (HDPE) piping and trench backfill materials (import fill, controlled density fill, crushed surfacing base course, and asphalt concrete pavement) have been selected to meet these loading conditions. All wells will have reinforced concrete aprons surrounding the monument to ensure that the area immediately adjacent to the well is protected from heavy loads. Wells will be outfitted with Sherwood high traffic monuments, or equivalent to be approved by the Port or Engineer prior to installation.

3.6.1 **Vapor Emissions**

Puget Sound Clean Air Agency (PSCAA) regulates the emissions of toxic compounds discharged into the atmosphere. Because AS/SVE system is being implemented under an Ecology Consent Decree, a PSCAA permit is not required. However, the project is required to comply with the substantive requirements of the PSCAA Notice of Construction and Application for Approval.

During the October 2017 field data collection event, soil vapor samples were collected from five site monitoring wells. The details of this sampling are summarized in Appendix G.

Data results suggest that emissions will exceed the following exemptions from emissions treatment for soil and groundwater remediation projects as cited within the Water Treatment heading under Regulation 1, Article 6, and Section 6.03.c (94):

- Less than 15 pounds per year of benzene; and,
- Less than 1,000 pounds per year of toxic air contaminants[1].

Emissions control systems to be used at the T30 Site are discussed in Section 4.2.

---

[1] PSCleanAir Regulation 1, Article 6, revised 11/17/05. http://www.pscleanair.org/library/Documents/1-6.pdf

4 Design Basis

The Design Basis describes how cleanup action components were designed to achieve RELs and satisfy the design criteria presented in Section 3.

4.1 Air Sparging

As stated in the CAP, the purpose of the AS/SVE system is to reduce contaminant mass in groundwater in the sheen area. Air sparging will introduce air into the subsurface below the water table to strip volatile compounds (TPH-G and BTEX) and stimulate biodegradation of other compounds (TPH-D, TPH-O, and PAHs). Air sparging is also useful in the presence of LNAPL to increase the available surface area of LNAPL and promote stripping of volatile components and biodegradation.

Air Sparge Wells

Air sparge wells will be constructed of 2-inch Schedule 40 PVC with a 2-foot 10-slot (0.010-inch) well screen placed from 12 to 14 feet below the water table or 23 to 25 feet bgs. This depth was selected so that the wells remain above the former mudflat to prevent uncontrolled lateral flow of air due to heterogeneities. Well annulus sand pack (10/20 Colorado silica sand) will extend to 6 inches above the top of well screen, followed by a 3-foot bentonite seal, and the remainder of the annulus will be filled with cement-bentonite grout to 3 feet bgs. Wells will be spaced every 30 feet.

Air Sparge Flow Rates and Pressure

Due to the presence of numerous utilities and other subsurface features that could make vapor collection difficult, the air sparge flow rate will be limited to 6 to 7 standard cubic feet per minute (scfm) per air sparge well.

The maximum air injection pressure will be limited to 60% of the overburden soil and groundwater pressure (USACE 2013). The weight of soil is calculated based on 23 feet of soil above the top of well screen, a soil specific gravity of 2.7, a water density of 62.4 pounds per cubic foot (0.036 pounds per cubic inch), and a porosity of 40%. The weight of water is calculated based on 12 feet of water above the top of well screen, a specific gravity of 1, a water density of 62.4 pounds per cubic foot, and a porosity of 40%. The weight of soil is 16.1 psi and the weight of water is 2.1 pounds per square inch (psi), for a total overburden pressure of 18.2 psi. As a result, the maximum air injection pressure will be below 11 psi. At 5 to 10 scfm, 6 to 7 psi will be adequate to overcome the hydraulic head (5.2 psi) plus formation entry pressure, below the maximum injection pressure threshold of 11 psi.

The system will be operated in 5 zones as follows:

- West Zone – 6 wells (AS-1 to -6) at 6 scfm per well (36 scfm total)
- North Zone – 5 wells (AS-7 to -11) at 7 scfm per well (35 scfm total)

- North Central Zone – 5 wells (AS-12 to -16) at 7 scfm per well (35 scfm total)
- South Central Zone – 6 wells (AS-17 to -22) at 6 scfm per well (36 scfm total)
- South Zone – 5 wells (AS-23 to -27) at 7 scfm per well (35 scfm total)

The blower and air distribution manifold will be located at the equipment pad. The 7.5 Hp rotary lobe blower will be capable of producing 120 scfm at 8 psig (Roots URAI33 or similar). 3 zones will operate at a time and will cycle regularly using solenoid or actuated butterfly valves. The cycling time will start at 60 minutes on and 40 minutes off for each zone but may be adjusted during system operation to improve performance. Air will be delivered to each well via a 1-inch SDR11 HDPE pipe. Equipment and trenching details are presented in the drawings (Appendix A).

4.2 Soil Vapor Extraction

Soil vapor extraction will be performed using horizontal wells in the West Zone (SVE-1), North Zone (SVE-2), and North Central Zone (SVE-3). Vertical wells will be used in the South Central and South Zones (SVE-4 through 10, shown on Figure 4-1). The primary design driver for vapor extraction method is the density of potential short-circuiting pathways; the South Central and South Zones contain numerous electrical, sanitary, and storm drain lines.

Soil vapor extraction will be operated continuously and will not be cycled on and off like the air sparging system. Vapor extraction flows will be 2 times the air injection flow for each zone as follows (Figure 4-1):

- West Zone – 1 horizontal well (SVE-1) at 75 scfm total
- North Zone – 1 horizontal well (SVE-2) at 75 scfm total
- North Central Zone – 1 horizontal well (SVE-3) at 75 scfm total
- South Central Zone – 3 vertical wells (SVE-4, -5, and -6) at 25, 20, and 30 scfm each, respectively, due to variable well spacing to avoid utilities and potential short-circuiting (75 scfm total)
- South Zone – 4 vertical wells (SVE-7, -8, -9, and -10) at 18 to 19 scfm each (75 scfm total)

The blower and air distribution manifold will be located at the equipment pad. The 15 Hp explosion-proof regenerative blower will be used that is capable of extracting 375 scfm at 70 inches of water (Rotron EN909, or similar).

Subsurface vapor will be extracted from each SVE well via a 3-inch SDR11 HDPE pipe. Vapor monitoring points will be used to assess vapor extraction effectiveness and flow rates will be adjusted as needed.

Vapor concentrations are expected to be relatively high for the first 6 to 12 months of operation as volatile hydrocarbons are removed from soil, water, and LNAPL. To treat vapors prior to discharge to the atmosphere a thermal/catalytic oxidizer will be installed that will be fueled by two 1,000 gallon propane tanks. The oxidizer will be used to treat discharge vapors until oxidizer inlet concentrations achieve emission discharge limits. The oxidizer will be capable of treating 375 to 500 scfm of vapor and will be built with a dilution air blower so that high initial concentrations will be automatically diluted to within the operating range of the oxidizer (less than 25 or 50 % lower explosive limit depending on which unit is purchased). The oxidizer will be convertible from thermal oxidation to catalytic oxidation with the addition of a catalyst. Once inlet vapor concentrations have dropped to a lower concentration where catalytic operation is possible, the catalyst will be installed and oxidizer operation will be reprogrammed. The use of the catalyst will allow operation of the unit at lower temperatures and will reduce propane consumption.

Equipment and trenching details are presented in the drawings (Appendix A) and specifications (Appendix B).

4.3 LNAPL Recovery

As stated in the CAP, the purpose of LNAPL recovery is to reduce LNAPL thickness to a sheen (less than 0.01 feet of measured LNAPL). Ten 4-inch wells will be installed at the locations indicated on Drawing C-2 (Appendix A) to better define the extent of LNAPL and perform free product recovery. The wells are oriented in 3 rows that are spaced 25 feet with wells staggered along these rows at 35 foot spacing. Free product recovery wells, RW-101 to RW-110, are located to minimize conflicts with intermodal container storage. These wells, plus RW-12 and possibly MW-59, will be accessible within the drive lane even when containers are present. As a result, recovery events at these wells can be scheduled to occur on a recurring schedule. Recovery wells RW-101 to RW-103 are located beneath where containers are stored and will require additional coordination with terminal operations to obtain access. As a result, these recovery wells may not be accessible on a routine schedule.

The 4-inch recovery wells will be constructed of 4-inch Schedule 40 PVC in a 12-inch borehole with a 10 slot screen (0.010-inch) from 5 to 15 feet below grade. Well annulus sand pack (10/20 Colorado silica sand) will extend to 12 inches above the top of well screen, followed by a 3-foot bentonite seal. The well head will be completed using a 12-inch monument designed for increased loads. A 1-inch well stinger and well cap will be placed in each well. The well cap will have a vacuum make-up air valve and a well gauging port. A wellhead connections system will be moved between well heads for connection to a vacuum pump or truck.

LNAPL recovery will also be performed at monitoring wells as free product is identified during performance monitoring. At the beginning of the cleanup action, LNAPL recovery will be performed monthly. The process for initiating and terminating free product recovery at these wells is provided in the CMP. Free product recovery at MW-36, MW-39A, MW-89, and MW-93 has been incorporated into the LNAPL recovery program as part of the cleanup action.

4.4 Electrical Service

The power supply to the equipment pad will be adequate to supply a 100-amp 480 volt service. Drawings E1 through E3 show that the current power lines feeding the capstan motor (the capstan motor was used when the terminal was used for cruise ships, the motor is not part of the SSA facility). The lines from the capstan motor will be intercepted at the existing electrical manhole HH-34. The current circuit breaker in Panel ‘M’ is rated for 40-amp and the current power lines installed to HH-34 can only handle a 40-amp service. This panel and conduit will be upgraded to handle the 60-amp service. A new subsurface conduit will be installed between HH-34 and the equipment pad, including coring into the west side of HH-34, shown on Drawing E1.

4.5 Remote Monitor

The AS/SVE system will include remote monitoring which will include data logging and alarm notifications. A system similar to a Sensaphone Sentinel unit (remote monitoring software and equipment) will be installed which will provide alarm notifications, through cellular connections, via e-mail, text message or voice phone call when alarms are triggered.

5 Scope of Work

This section presents a general scope of work for remedial activities. Construction quality assurance and technical performance criteria in support of this work are provided in Section 6. A schedule detailing design, remediation, and monitoring activities at the property is provided Section 8. And overview of the cleanup is shown in Figure 4-1.

Overall, the cleanup construction process includes the following phases:

1. Procure AS/SVE equipment
2. Install vertical AS wells, SVE wells (vertical and horizontal), and product recovery wells
3. Complete all trenching, piping, electrical, and equipment installation
4. System startup and testing.

The installation of the cleanup system will occur in a phased approach, to limit construction impacts on the tenant. Installation will start at the equipment pad area (Work Area 1) and advance to the product recovery wells (Work Area 4), shown on the drawings (Appendix A).

5.1 Regulatory Approvals and Contract Bids and Awards

In order to proceed with bidding and cleanup construction, the Port will need Ecology approval of this Engineering Design Report. With Commission authorization, the project will be advertised and published for public bid. Once bids are received, a Contractor will be selected, contracting will be completed, and a notice to proceed will be issued.

5.2 Contractor Technical Execution Plan

A Technical Execution Plan (TEP) will be prepared by the Contractor prior to kick off of cleanup construction. The TEP will outline the implementation of the cleanup action. The Port team will review the Contractor’s TEP and request any additional required information so that it is comprehensive and meets all of the specification requirements. The Contractor’s TEP will include specific plans for completing the work. At a minimum, the TEP will include the following elements:

- Description of installation of cleanup action and construction activities included means and methods
- Temporary Erosion and Sedimentation Control measures
- Construction Water Management Approach
- Schedule and sequencing of activities for completion of the cleanup action
- The Construction Quality Control Plan
- Site-specific Construction Health and Safety Plan (HASP)
- Survey Approach

- Electrical Approach

5.3 Mobilization and Site Preparation

The contractor shall mobilize to the T30 Site all the necessary equipment, labor, and materials to perform the work described in the following sections. T30 Site preparation shall include the following activities:

- **Utility Locate.** Prior to commencing any on-site activities, all underground public and private lines will be located and marked with paint. Drawing C1 shows the location of all known utility lines on the property.

- **Temporary Facilities and Access Controls.** The Contractor shall install all required temporary facilities, including worker facilities and staging areas such as stockpiles and storage areas. The Contractor shall establish work zones including perimeter work zone security and barricades and exclusion zones. Details are shown on the Drawing C3.

- **Erosion and Sedimentation Controls.** Temporary erosion and sedimentation controls will include best management practices (BMPs) for construction activities as shown on Drawing C4, details are shown on Drawing C5. Stormwater surface runoff during construction will be controlled by interceptor straw wattles and or sandbags. No construction site stormwater runoff shall drain as untreated surface runoff to the East Waterway. Stormwater resulting from construction activities will be collected, characterized, and disposed of at an offsite disposal facility. Water resulting from construction activities at the T30 Site includes stormwater runoff and equipment/personnel decontamination water. Other stormwater and erosion and sedimentation controls are discussed in the Contractor's Stormwater Pollution Prevention Plan.

- **Health and Safety Plan.** The Contractor shall have a health and safety plan reviewed and approved by the Engineer prior to commencing on-site activities.

5.4 AS/SVE Equipment

From the time of order, the equipment will take 8 to 12 weeks to build. The Contractor will take possession of the equipment at the time of delivery, and will unload and place the equipment on the equipment pad. Under the construction contract, the Contractor will be responsible for energizing the system, connecting any telecommunications, and attaching all the AS/SVE piping to the manifolds on the equipment skid(s).

5.5 Well Installation

Air injection, vapor extraction, vapor monitoring, and LNAPL recovery wells will be installed by a Washington State licensed driller and all wells will be completed per the requirements listed in RCW Chapter 18.104 Water Well Construction Act, WAC 173-160 Minimum Standards for Construction and Maintenance of Wells, and WAC 173-162 Regulation and Licensing of Well Contractors and Operators. Well installation will occur prior to trenching and work sequencing through the work areas.

5.6 Trenching, Piping, Electrical and Backfill

The AS/SVE system will be installed in segments to limit the impact to the terminal operator. The system will be installed in 4 Work Areas, show on Drawing C3. Work will start at Work Area 1 which includes the equipment pad area. The initial trenching will start at work Area 1 and move towards Work Area 4. The Contractor will complete all work in a work area – trenching, piping, electrical, well installation, backfill and final asphalt surfacing, before moving to the next Work Area. Electrical improvements will be installed during work in Work Area 1.

Because the AS/SVE system is being installed in the main part of the active container storage terminal, each AS or SVE well will be installed as a separate unit and all AS components will be below the ground surface. This means that one pipe will be buried and run from the equipment shed all the way to the AS or SVE well. And each AS or SVE well will be controlled at the manifold mounted at the equipment pad. This will allow full access to the system by a technician even if the AS or SVE wells are located under stacked shipping containers. This also means that at the start of the AS/SVE trench (at the equipment pad), the trench will be its widest because it has the most AS/SVE pipes. As the trench moves towards the end of the system (Work Area 4) the trench will become narrower. The initial width of the trench will be 7 feet and the final width will be 3.5 feet.

Piping to/from AS/SVE locations will be fusion-welded high density polyethylene (HDPE). The piping placement within the trench was design to avoid dips in the SVE piping that could accumulate water and create a vapor lock. The piping and trench backfill material were selected to satisfy the 100 kip design load. Trench details are provided in the Drawings.

Due to the presence of debris within the surficial fill that will be excavated for trenching, all excavated soil will be disposed at an off-site permitted landfill and may be direct loaded into trucks by the Contractor, after the soil has been characterized. Backfill around the horizontal SVE collection pipes will be backfill for sand drains. Backfill around the AS and SVE distribution pipes will be controlled density fill. The surface of all trench areas will be completed with 8 inches of crushed surfacing base course and 8 inches of asphalt as shown on the drawings. Representative sample(s) will be collected and tested for site IHSs to ensure the quality of the import backfill. Fill from a single virgin source will require only one sample and analysis. Backfill and compaction will be performed in accordance with WSDOT standards (M41-10 Part 2-06.3(2)) using 6-inch lifts, each compacted to 95% Proctor testing, as detailed in the specifications.

5.7 AS/SVE Equipment Installation

Above-ground piping on the suction side of the SVE blower within the equipment pad may be fusion-welded HDPE or carbon steel. Piping on the discharge side of the AS and SVE blowers within the equipment pad will be carbon steel due to the high blower discharge temperatures.

The AS/SVE system will be delivered on skids and each piece of equipment will be fitted with sound damping insulation. The entire AS/SVE system and all supporting equipment (including the propane tank) will be fenced off from the terminal and have a locked gate to ensure that access is restricted to authorized personnel. Signs will be posted stating that access is restricted and provided instructions on what to do if something unusual is observed.

5.8 Disposal of Wastes

Excavated soil from trenching will be direct loaded to trucks or stockpiled prior to off-site disposal at a permitted landfill. Soil will be properly profiled for disposal prior to the start of excavation activities. Truck traffic will be controlled for both volume and individual load size to ensure suitability for local roads. Loads will be kept within the frame of each truck bed and covered in conformance with Washington State Department of Transportation (WSDOT) standards to mitigate dust emissions. Soil generated from the installation of the wells (drill cuttings) will be temporarily stockpiled within the work area and disposed with soils excavated from the soil trenching. The Contractor will be responsible for properly covering and managing all stockpiled materials, including drill cuttings.

Decontamination of trucks and equipment will generate approximately 100 gallons of water each day during excavation activities. This water will be drummed or tanked and hauled off-site for disposal.

6 Construction Quality Assurance

This draft Construction Quality Assurance Plan (CQAP) describes the means to assure construction of the remediation system to meet the requirements of the specifications. The CQAP will be finalized using the Contractor's specific plan for installation that will be provided in the Technical Execution Plan.

6.1 Organization and Responsibilities

6.1.1 Washington Department of Ecology

Ecology is the regulatory authority and responsible agency for overseeing and authorizing the cleanup action. In this capacity, Ecology will review and approve the design documents. Ecology and the Port will jointly resolve unforeseen problems, potentially changing construction activities.

The Ecology Project Manager (Ms. Sunny Becker) will be responsible for overseeing the cleanup action to ensure that the cleanup action meets cleanup action objectives and is implemented in accordance with the Consent Decree.

6.1.2 Port of Seattle

The Port Project Coordinator (PPC; Roy Kuroiwa) will act as the primary point of contact with Ecology for this work.

The Port Project Manager (PPM; Catherine Chu) will be responsible for internal Port coordination of contracting and construction management. The PPM will manage all scheduling and coordination of Port resources as needed to ensure Contractor procurement and execution of the contract. Coordination activities include but are not limited to:

- Management of design consulting team
- Bid/design strategy development with design team
- Project schedule and budget tracking
- Coordination of design team activities with internal Port activities, including engineering, construction, surveying, and procurement.

The Port Resident Engineer (Matthew Weiss , P.E.) will be responsible for the following:

- Management of bid documents and execution of the Project
- Management of construction QA activities and associated deliverables
- Interaction with and direction to the Contractor, including claims.

The RE will be the primary means of contact with the Contractor and will be the only individual to direct the Contractor or modify Contractor activities on the Port's behalf. All communications regarding QA elements that may modify Contractor activities will go through the RE.

6.1.3 **Contractor**

The Contractor will perform the installation of the cleanup action. The Contractor will comply with any BMPs and will adjust practices in response to air, noise, and light monitoring data collected by the Port. Any adjustments to work will occur at the direction of the Port RE.

These activities will be conducted in accordance with the approved contract drawings and specifications, which include several Contractor-written plans. Specific Contractor personnel and functions, as well as any subcontractors under the direction of the Contractor, will be described in the Contractor's Technical Execution Plan submittal. The Technical Execution Plan describes the Contractor's plan for completing the cleanup action. Elements in this CQAP will be adjusted such that they are appropriate given the Contractor's specific methods for completing the work.

Contractor Licensing and Training

All site Contractor and subcontractor personnel will be required to have current health and safety training required by the Washington State Department of Labor and Industries (Chapter 296-2 Washington Administrative Code [WAC], Subpart P, Hazardous Waste Operations and Emergency Response [HAZWOPER]), including specific onsite training. The exception to this may include truck drivers and third-party surveyors if their roles do not place them in potential contact with contaminated materials/soil.

The Contractor is responsible for following all local, state, and federal laws related to licensing and training. At a minimum, the Contractor will conduct the following activities:

- Obtain a business license from the appropriate jurisdiction in which the work is being performed.
- Comply with the Port Construction Safety & Health Manual, all OSHA and WISHA requirements and amendments, and the following chapters of WAC:
  - Chapter 296-24 General Safety and Health Standards.
  - Chapter 296-62 General Occupational Health Standards.
  - Chapter 296-155 Safety Standards for Construction Work.
  - Chapter 296-800 Safety & Health Core Rules
- Comply with the following requirements when they are applicable:
  - American National Standards Institute and American Society of Safety Engineers standards
  - Local building and construction codes
  - Seattle Fire Department codes
  - National Fire Protection Act 70E
  - National Electrical Code.

Contractor Personnel

Contractor roles are defined in specification Section 01308 – Contractor Project Organization. The Contractor's Project Manager (PM) will report directly to the Port RE. The Contractor's PM provides management of and direction to all Contractor and subcontractor personnel, and has overall responsibility for executing the work in compliance with the contract.

Depending on the number of staff, some of the following roles may be filled by the same person. The Contractor Superintendent (CS) will provide onsite management of and direction to the Contractor's and subcontractor's personnel. The CS may not be the same person as the PM, and the CS will be responsible for executing the work in full compliance with the contract drawings and specifications. In addition, the CS will verify proper operation and maintenance of equipment, manage subcontractors, and provide daily reports to the RE.

The Contractor Quality Control Representative (QCR) will be responsible for implementation and maintenance of the Construction Quality Control Plan (CQCP).

The Contractor Project Engineer (PE) is responsible for the daily performance of field QC activities in support of the Project. The Contractor PE will work with onsite office staff. The Contractor PE will be a licensed Professional Engineer in the state of Washington.

The Contractor Site Health and Safety Supervisor (SHSS) will fulfill the duties and responsibilities of the environmental and safety supervisor. The SHSS will ensure that operations are performed in compliance with applicable client and site-specific requirements and government regulations.

Other site personnel (craft labor) may be added as deemed necessary by the Contractor. Additional responsibilities of the Contractor personnel will be determined by the Contractor.

The Contractor will use an Ecology approved analytical laboratory for chemical testing requirements. The Contractor's laboratory must adhere to the requirements of Specification Section 01451- Quality Control; Testing Laboratory Services.

6.1.4 Port Consultants

As the prime design consultant to the Port, CRETE Consulting, Inc. (CRETE) is responsible for designing all site activities, managing the preparation of relevant documents, and managing/coordinating design subconsultants. CRETE will also perform construction oversight, including technical review and documentation support throughout construction.

Moffat & Nichol is responsible for the electrical design, trenching design, and completion elements at the terminal. Moffat & Nichol will provide coordination as needed to ensure that construction activities are integrated with the active terminal operations.

Pacific Groundwater Group is responsible for coordination with existing T30 Site data and support related to the groundwater monitoring program.

Cultural Resources Consultants, Inc. has developed a plan for identifying cultural resources that may be discovered during excavation activities. The plan describes areas and lithological or fill units of the T30 Site that have the potential to contain cultural resources and actions to be taken if such materials are identified.

6.2 Pre-Construction Documentation

A Technical Execution Plan (TEP) will be prepared by the Contractor and prior to staring the cleanup action described in Section 5.4

6.3 Construction Documentation

During construction activities, the Contractor will be required to submit daily reports to the Port RE. These submittals are for informational purposes only and are intended to summarize daily work conditions, deviations, and corrective measures. The specifications also describe Contractor submittal requirements in detail. Ecology will be notified immediately (per HASP) of any emergencies (including injury, accidents).

6.4 Post-Construction Documentation

After the completion of the construction activities the Contractor will be required to submit record drawings for various elements of the construction, including the as-builts showing AS/SVE system completion, electrical modifications, backfilling and compaction results, and soil disposal documentation. The Contractor will also submit certificates of conformance for import materials. The Contractor will submit these materials to the Port, and they will be included in the Completion Construction Report submitted to Ecology.

7 Operation, Maintenance, and Monitoring

An Operation, Maintenance, and Monitoring Plan (OM&M Plan) will be prepared once the Contractor has installed all AS/SVE equipment. A draft OM&M Plan is included in Appendix C. The OM&M Plan will include the following details:

- AS/SVE System
    - Operation Monitoring Parameters and Procedures
    - Evaluation of Operation Monitoring Parameters
    - Adjustments to Operations Based on Operation Monitoring
    - Vapor Emission Testing and Reporting
    - Temporary Shutdown Procedures Prior to LNAPL Recovery and Groundwater Sampling at Locations Within the AS/SVE Area of Influence
    - AS/SVE Reporting
    - AS/SVE Termination
    - Equipment Maintenance
- LNAPL Recovery
    - LNAPL Recovery and Measurement Procedures and Frequency
    - Monitoring Parameters and Procedures
    - Evaluation of Monitoring Parameters
    - LNAPL Recovery Reporting
    - LNAPL Recovery Termination
    - Well Maintenance
- Revision Procedures for updating the OM&M Plan

Details regarding the long term groundwater compliance monitoring are provided in the CMP (Appendix E).

7.1 Cleanup Action Completion Criteria

The AS/SVE system will operate until groundwater monitoring meets the shutdown criteria. The groundwater monitoring network is shown on Figure 7-1. The CMP (Appendix E) includes the sampling plan to evaluate the performance of the system, steps to take if remediation objectives are not achieved, and shutdown criteria.

LNAPL recovery will continue until measurable LNAPL thickness is less than 0.01 feet at MW-59, RW-12, and additional recovery wells installed during system setup. The CMP (Appendix E) includes details on monitoring and termination of LNAPL recovery.

8 Schedule and Reporting

8.1 Implementation Schedule

Below is an anticipated timeline from bidding through construction completion.

- **March 2019 – Contract Award and Contract Execution**. Port approval of Contractor. Upon full execution of the construction contract, the Contractor will develop critical contract submittals, but will not mobilize to the T30 Site until critical submittals have been approved by the Port (and regulatory agencies, as required).
- **April 2019 – Notice-to-Proceed**. Upon approval of the critical submittals, the Contractor may proceed with long lead items such as ordering equipment.
- **April to July 2019 – Construction Activities.** The Contractor will complete the installation of the cleanup action. This will include all trenching, electrical, drilling, and shakedown testing associated with the installation of the AS/SVE system and the LNAPL recovery system.
- **July to September 2019 – AS/SVE Start-Up Monitoring.** Following the installation of the AS/SVE system, there will be 3 months of start-up monitoring to ensure the system has been installed per the design and that no modifications are required.
- **December 2019 – Construction Completion Report and the Final Operation, Maintenance, and Monitoring Plan**. Contractor's work is complete once the Port and Ecology approve the construction report. Once the Contractor has completed all installation associated with the AS/SVE system, the Operation, Maintenance, and Monitoring Plan will be finalized.

8.2 Reporting

Reports will be prepared and issued to Ecology to document work performed for compliance with the Consent Decree and to meet MTCA regulatory requirements for the cleanup action.

8.2.1 Completion Report

After installation of the AS/SVE systems, LNAPL recovery wells, and groundwater monitoring wells has been completed, a Construction Completion Report will be prepared to meet the requirements of WAC 173-340-400(6)(b). This report will document construction of the remedy components described in this EDR. Record drawings will be included showing actual locations and installation notes for underground lines and providing specifications for equipment and piping. Well logs will be included for all wells installed for the T30 Site remedy. Survey reports will be appended to the Completion Report.

Deviations from design drawings and/or specifications will be described in the Completion Report; the rationale for deviations will also be documented. The report will describe construction techniques as appropriate and will include results of relevant tests and measurements made during remedy construction, including quality assurance testing.

The Completion Report will be prepared under oversight of a Professional Engineer licensed in Washington State. The report will include an opinion by the Professional Engineer as to whether the cleanup action has been constructed in substantial compliance with the drawings (Appendix A) and technical specifications (Appendix B) and related documents included in this EDR. The Professional Engineer's opinion will be based upon observations, testing, and inspections.

8.2.2 **Progress Reports**

Progress reports will be prepared on a quarterly basis, in accordance with the requirements of the Consent Decree, and submitted to Ecology via email no later than the 30th day following each quarterly reporting period. The progress reports will document work completed and planned for implementing the cleanup action, and will also include all other information specified in Section XI of the Consent Decree.

9 References

City of Seattle 2016. City of Seattle Stormwater Manual, dated January 2016.

Ecology 1991. In the Matter of Remedial Action by: Port of Seattle Agreed Order: Terminal 30. Effective Date: August 30, 1991.

Ecology 2017. Consent Decree and Cleanup Action Plan. July 19, 2017.

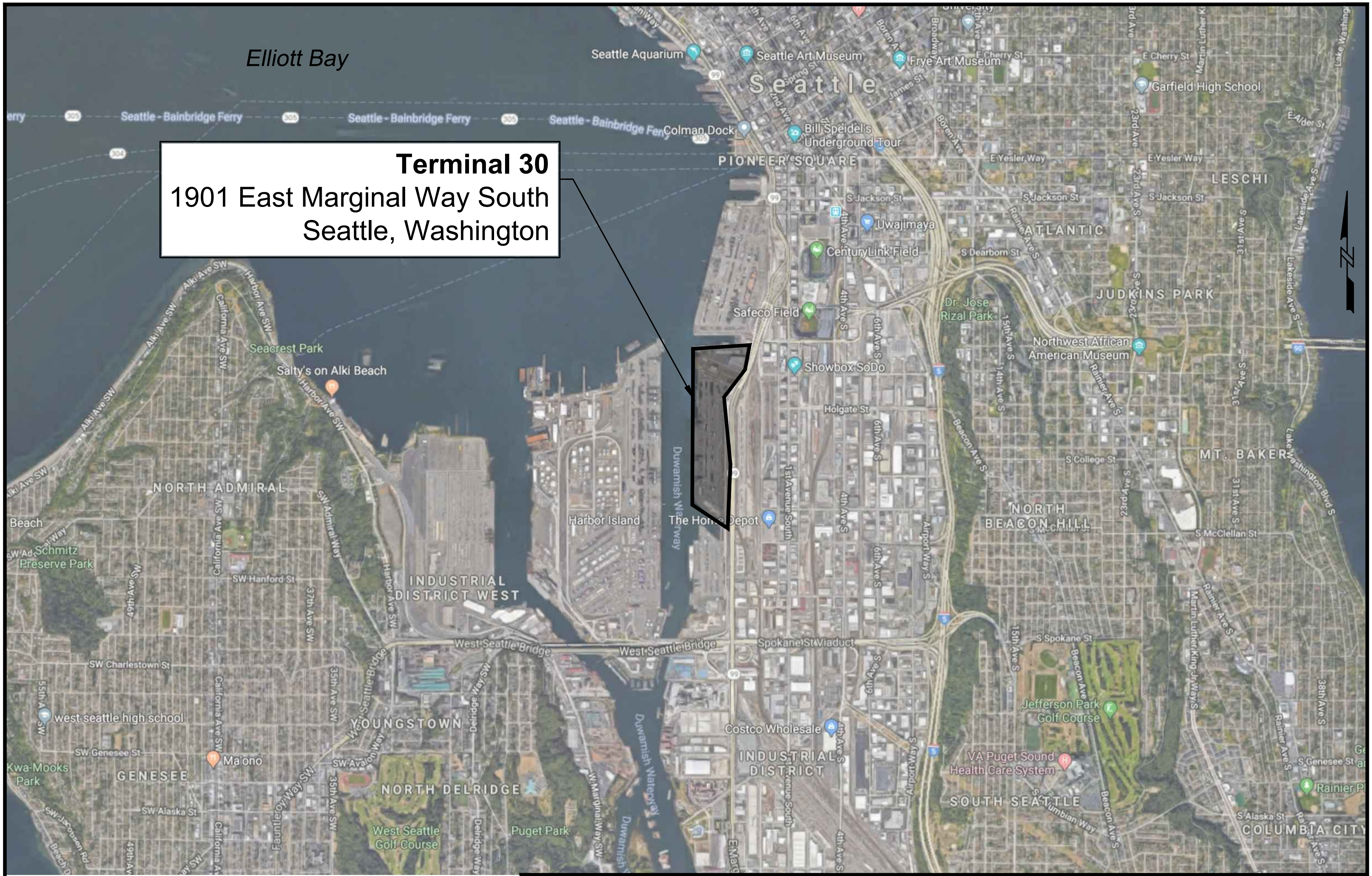
GeoEngineers, Inc. 1998. Terminal 30 Final Report Remedial Investigation/ Feasibility Study. Prepared for the Port of Seattle. December 21, 1998.

Pacific Groundwater Group 2013. Terminal 30 Remedial Investigation /Feasibility Study. November 2013.

USACE 2013. In-Situ Air Sparging. Engineer Manual (EM) 200-1-19. United States Army Corps of Engineers Environmental Quality. December 31, 2013.

Figures

File: E:\Project\clients\Crete\T30\T30_001.dwg Layout: FIG 1.1 User: sangw Plotted: Nov 18, 2017 - 7:08am Xref's:



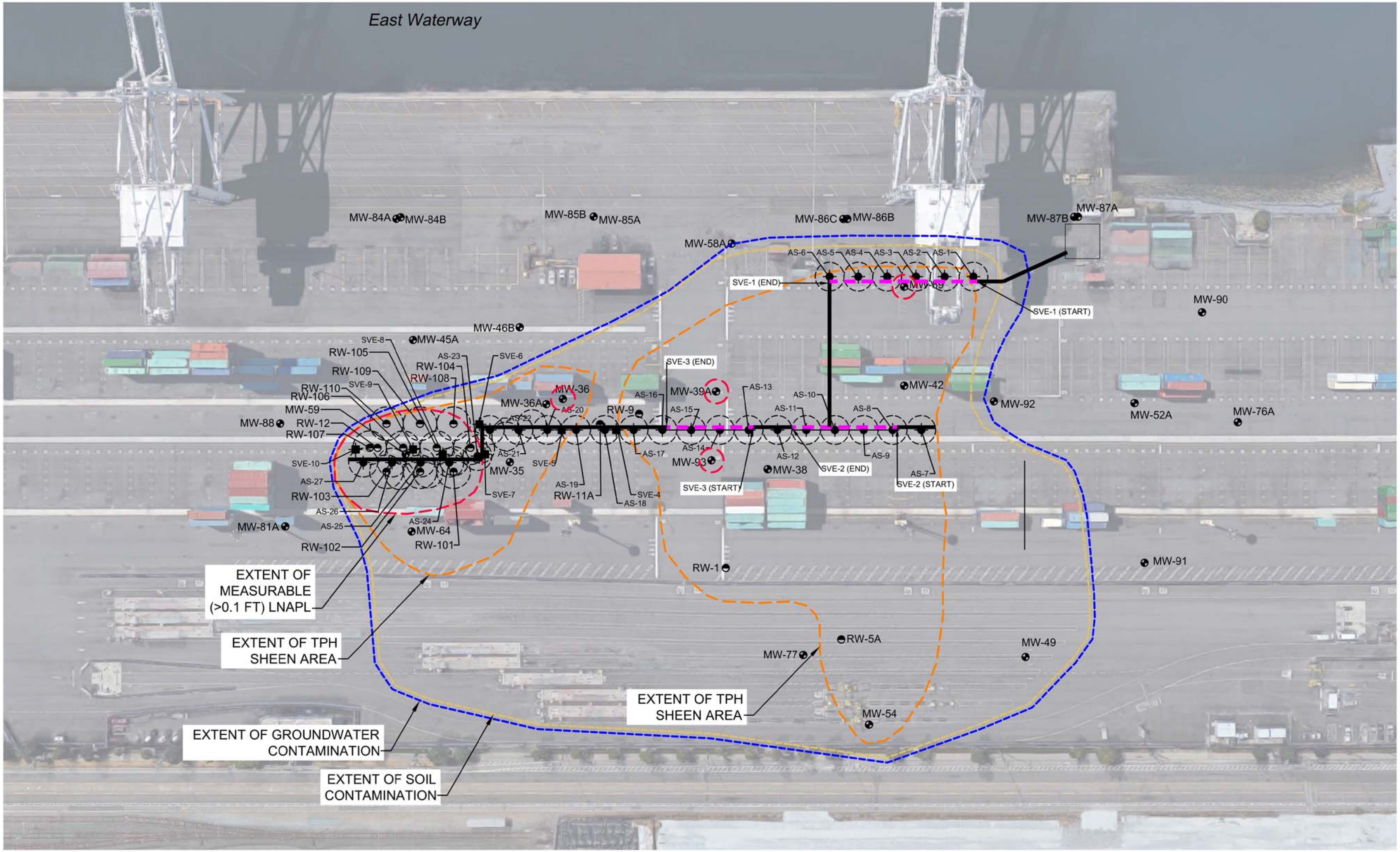
CRETE
CONSULTING, INC.

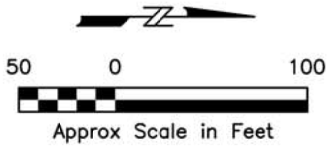
Engineering Design Report
Terminal 30 Cleanup Action

Location Overview

DATE: 11/18/2017
DRWN: bts

Figure 1-1





CRETE
CONSULTING, INC.

LEGEND

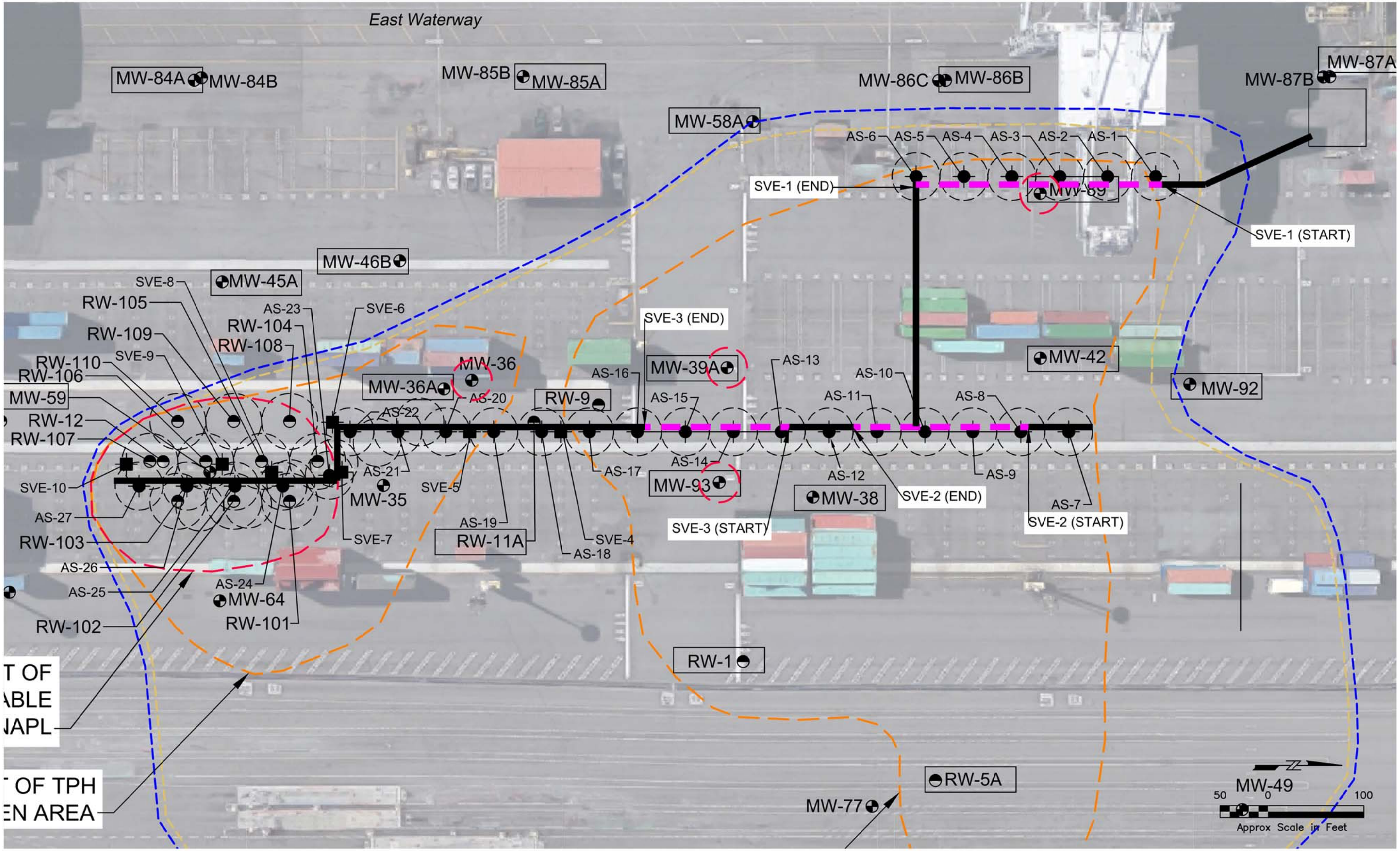
- ● AS WELL
- ■ SVE WELL (VERTICAL)
- ◉ MONITORING WELL
- ◒ PRODUCT RECOVERY WELL
- DECOMMISSIONED MONITORING WELL

Engineering Design Report
Terminal 30 Cleanup Action

Location of Cleanup Action
and Groundwater Monitoring Wells

DATE: 12/2/2017 | DRWN: BTS

Figure 1-2



LEGEND

●	AS WELL
■	SVE WELL (VERTICAL)
●	MONITORING WELL
●	PRODUCT RECOVERY WELL
	DECOMMISSIONED MONITORING WELL

CPOC GROUNDWATER WELL

INTERIOR GROUNDWATER WELL

PERFORMANCE GROUNDWATER WELL

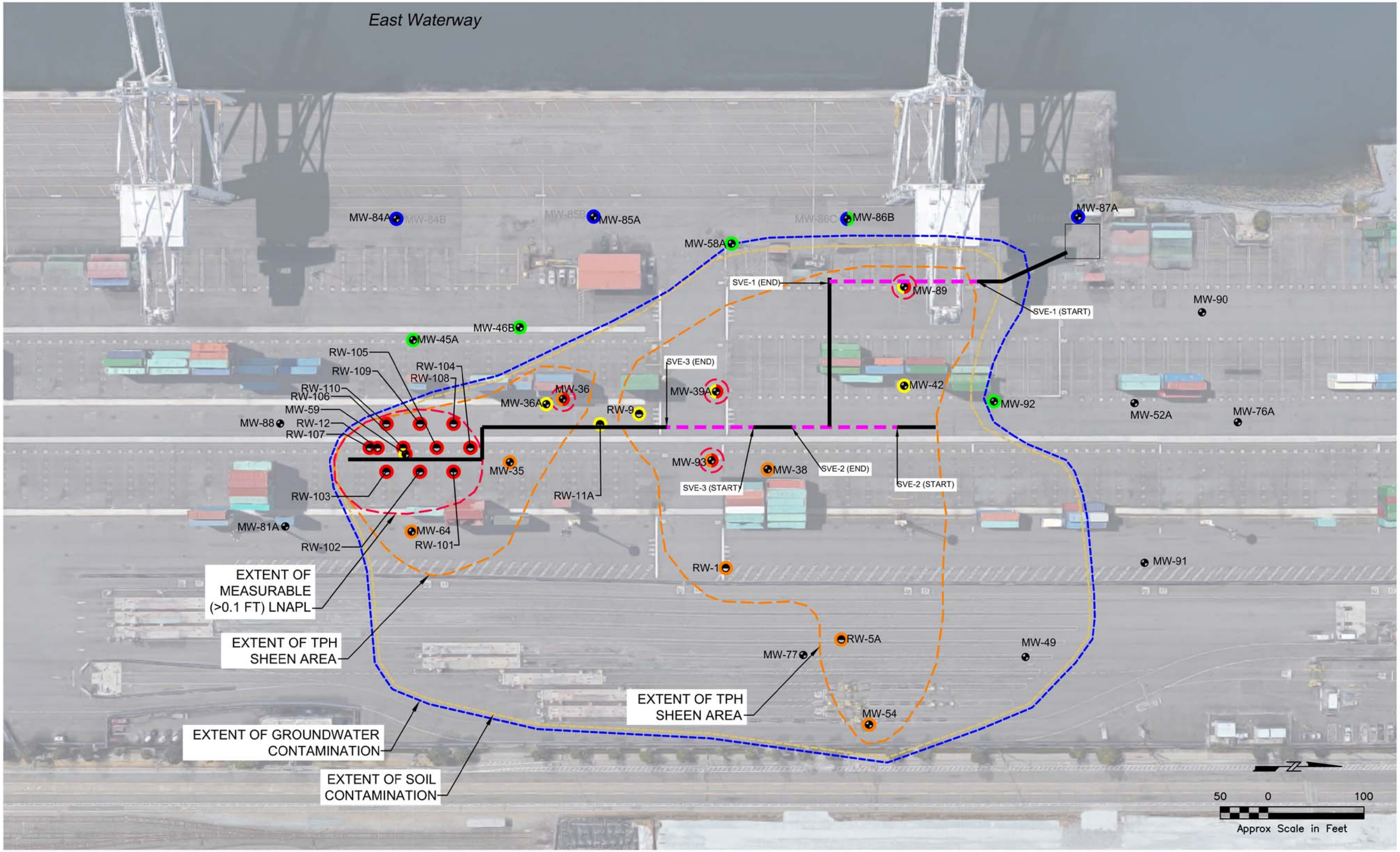
CRETE
CONSULTING, INC.

Engineering Design Report
Terminal 30 Cleanup Action

AS/SVE System Layout

DATE: 11/18/2017 DRWN: BTS

Figure 4-1



LEGEND

◐ MONITORING WELL
◓ PRODUCT RECOVERY WELL
DECOMMISSIONED MONITORING WELL

CRETE
CONSULTING, INC.

Engineering Design Report
Terminal 30 Cleanup Action

Extent of Groundwater Plume and Compliance Monitoring Network

DATE: 12/2/2017	DRWN: BTS		**Figure 7-1**

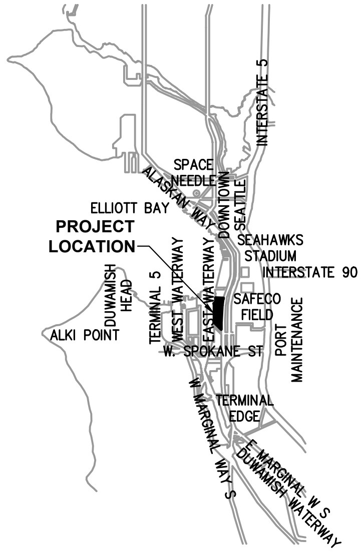
Appendix A

T-30 Cleanup Design Drawings

Port of Seattle

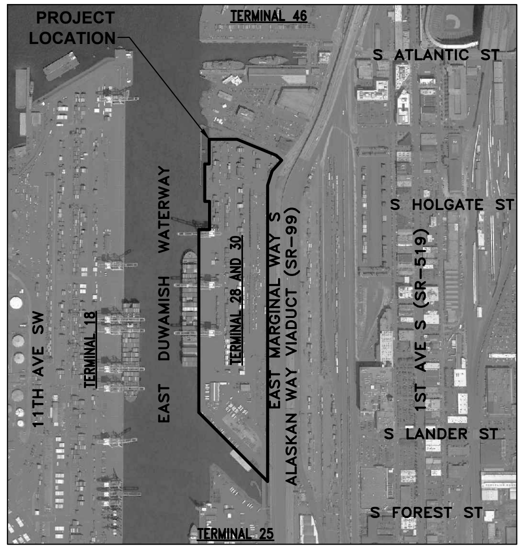
SEAPORT FACILITIES

TERMINAL 30 CLEANUP



VICINITY MAP
NOT TO SCALE

N



LOCATION MAP
NOT TO SCALE

N

CRETE
CONSULTING, INC.

moffatt & nichol

SHEET NO.	SHEET TITLE	SHEET NO.	SHEET TITLE	SHEET NO.	SHEET TITLE
	GENERAL PROJECT PLANS		CIVIL PROJECT PLANS		ELECTRICAL PROJECT PLANS
G0	COVER SHEET & SHEET INDEX	C1.1	EXISTING CONDITIONS & DEMOLITION PLAN - 1 OF 2	E1	ELECTRICAL NOTES & ABBREVIATIONS
G1	NOTES & ABBREVIATIONS	C1.2	EXISTING CONDITIONS & DEMOLITION PLAN - 2 OF 2	E2	ELECTRICAL SITE PLAN
G2	LEGEND AND SYMBOLS	C2.1	TESC PLAN - 1 OF 2	E3	ELECTRICAL ONE-LINE DIAGRAM
G3	ALIGNMENT DATA	C2.2	TESC PLAN - 2 OF 2	E4	ELECTRICAL DETAILS
G4	SITE CONTROLS & CONTRACTOR WORK AREAS	C3	TESC NOTES AND DETAILS		
		C4.1	AS/SVE SYSTEM & RECOVERY WELL LAYOUT - 1 OF 2		
		C4.2	AS/SVE SYSTEM & RECOVERY WELL LAYOUT - 2 OF 2		
		C5.1	AS/SVE SYSTEM PROFILE - 1 OF 3		
		C5.2	AS/SVE SYSTEM PROFILE - 2 OF 3		
		C5.3	AS/SVE SYSTEM PROFILE - 3 OF 3		
		C6.1	AS/SVE P & ID - 1 OF 2		
		C6.2	AS/SVE P & ID - 2 OF 2		
		C7.1	AS/SVE TRENCH DETAILS - 1 OF 6		
		C7.2	AS/SVE TRENCH DETAILS - 2 OF 6		
		C7.3	AS/SVE TRENCH DETAILS - 3 OF 6		
		C7.4	AS/SVE TRENCH DETAILS - 4 OF 6		
		C7.5	AS/SVE TRENCH DETAILS - 5 OF 6		
		C7.6	AS/SVE TRENCH DETAILS - 6 OF 6		
		C8.1	AS/SVE SYSTEM & RECOVERY WELL DETAILS - 1 OF 4		
		C8.2	AS/SVE SYSTEM & RECOVERY WELL DETAILS - 2 OF 4		
		C8.3	AS/SVE SYSTEM & RECOVERY WELL DETAILS - 3 OF 4		
		C8.4	AS/SVE SYSTEM & RECOVERY WELL DETAILS - 4 OF 4		

MAJOR CONTRACT

RECOMMENDED FOR APPROVAL

DATE

DATE

DATE

APPROVED BY

DATE

WORK PROJECT NO.
WP-U00212

PORT OF SEATTLE NO. + SHEET NUMBER
30-1801 G0

File: Q:\SEA\9834\CADD_Active_SheetSet\301801G000; Plotted: 11/21/2018 11:29 AM by WILLIAMS, MARISOL; Saved: 11/19/2018 8:06 AM by MWILLIAMS

ABBREVIATIONS

APPROX	APPROXIMATELY
AS	AIR SPARGE
CB	CATCH BASIN
CL	CENTERLINE
CND	CONDUIT
CNDO	CONDUIT ONLY
CONC	CONCRETE
DI	DUCTILE IRON
DIA	DIAMETER
DWG	DRAWING
EL	ELEVATION
EQULV	EQUIVALENT
ETC	ET CETERA
EXST	EXISTING
FT	FEET
GA	GAUGE
GAL	GALLON
HDPE	HIGH DENSITY POLYETHYLENE
IN	INCH
IN3	CUBIC INCHES
LB	POUND
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
NTS	NOT TO SCALE
NUMB	NUMBER
OC	ON CENTER
OD	OUTSIDE DIAMETER
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
REINF	REINFORCEMENT
RW	RECOVERY WELL
SCHED	SCHEDULE
SPEC	SPECIFICATION
SS	SANITARY SEWER
STA	STATION
STL	STEEL
STRMD	STORM DRAIN
SVE	SOIL VAPOR EXTRACTION
T&B	TOP AND BOTTOM
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
VM	VAPOR MONITORING
w/	WITH
WTR	WATER
±	PLUS OR MINUS
&	AND
°	DEGREES
@	AT
'	FEET
"	INCHES
%	PERCENT

GENERAL NOTES

1. THESE GENERAL NOTES SHALL APPLY TO ALL SITE ACTIVITIES. ANY CONFLICTS BETWEEN THE GENERAL NOTES, SPECIFIC NOTES IN THE DRAWINGS, AND/OR CONSTRUCTION OR MATERIAL SPECIFICATIONS SHALL BE RESOLVED AFTER SUBMITTAL BY THE CONTRACTOR TO THE ENGINEER BY A REQUEST FOR INFORMATION.

2. THIS WORK IS CONDUCTED UNDER A CONSENT DECREE WITH THE WASHINGTON DEPARTMENT OF ECOLOGY AND THE PORT OF SEATTLE.

3. CONTRACTOR IS RESPONSIBLE FOR VERIFYING UTILITY LOCATIONS SHOWN ON THE PLANS AND PRESENT IN THE AREA AFFECTED BY THE WORK.

4. CONTRACTOR SHALL PROTECT ALL UTILITIES OUTSIDE OF THE WORK AREA AND SHALL REPAIR ANY DAMAGE BY THEIR ACTIVITIES AT CONTRACTOR'S EXPENSE.

5. CONTRACTOR SHALL INSTALL AND MAINTAIN A SECURE SITE PERIMETER FENCE AROUND EACH WORK AREA AND CONTRACTOR AREAS AT ALL TIMES DURING CONSTRUCTION. FENCING SHALL INCLUDE SIGNAGE NOTIFYING TERMINAL WORKERS OF SITE HAZARDS. LOCKABLE GATES SHALL BE INSTALLED TO PROVIDE VEHICLE AND PERSONNEL ACCESS.

6. CONTRACTOR SHALL BE ADVISED THAT THE WORK AREAS ARE INSIDE AN ACTIVE CONTAINER TERMINAL. THE CONTRACTOR SHALL MINIMIZE THE IMPACT TO THE ACTIVE CONTAINER TERMINAL AND MINIMIZE THE FOOTPRINT OF WORK ACTIVITIES FOR THE DURATION OF THE PROJECT. THE CONTRACTOR SHALL FOLLOW ALL SAFETY REQUIREMENTS AND SITE RESTRICTIONS REQUESTED BY THE CONTAINER TERMINAL OPERATOR.

7. CONTRACTOR SHALL ENSURE THAT THE CONTAINER TERMINAL TRUCKS AND TRAFFIC HAVE ACCESS TO ALL CROSSINGS OUTSIDE OF THE WORK AREAS AT ALL TIMES.

8. THE CONTRACTOR SHALL POST TEMPORARY SIGNAGE FOR DIRECTING VEHICULAR TRAFFIC AROUND THE WORK AREAS.

9. IT IS POSSIBLE THAT DISTURBANCE OF HISTORICAL NATIVE AMERICAN MATERIALS MAY OCCUR AS A RESULT OF THE EXCAVATION OPERATIONS. IN THE CASE OF AN INADVERTENT DISCOVERY, THE CONTRACTOR SHALL CEASE EXCAVATION AND NOTIFY THE ENGINEER. CONTRACTOR SHALL ALLOW ACCESS TO WORK AREAS AS REQUESTED BY THE ENGINEER.

HEALTH AND SAFETY NOTES

1. THE CONTRACTOR SHALL COMPLY WITH THE FEDERAL OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970 (OSHA).

2. FORTY-HOUR OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE (HAZWOPER) TRAINING, WITH CURRENT ANNUAL 8-HOUR REFRESHER, SHALL BE REQUIRED FOR ALL ONSITE WORKERS AND OTHER WORKERS WITH POTENTIAL FOR HANDLING OR EXPOSURE TO SITE SOIL OR GROUNDWATER, WITH THE EXCEPTION OF TRUCK DRIVERS AND SURVEYORS (UNLESS THEIR ACTIVITIES REQUIRE POTENTIAL EXPOSURE TO CONTAMINATED MATERIALS). TRUCK DRIVERS WILL RECEIVE ORIENTATION ON THE SITE SPECIFIC CONSTRUCTION HEALTH AND SAFETY PLAN; NO OTHER HEALTH AND SAFETY TRAINING WILL BE REQUIRED, PROVIDED THAT ALL OUT-OF-CAB ACTIVITIES ARE RESTRICTED TO COVERING OF LOADS, NECESSARY VEHICLE INSPECTIONS, AND SIGNING OF MANIFESTS.

3. THE CONTRACTOR SHALL SUBMIT, FOR THE ENGINEER'S REVIEW AND COMMENT, A SITE-SPECIFIC CONSTRUCTION HEALTH AND SAFETY PLAN. THE ENGINEER'S REVIEW OF, OR COMMENT ON, THE SITE-SPECIFIC CONSTRUCTION HEALTH AND SAFETY PLAN SHALL NOT, IN ANY WAY, RELIEVE THE CONTRACTOR OF ANY RESPONSIBILITY OR LIABILITY FOR THE PLAN. DELAY IN SUBMITTING A WRITTEN SITE- SPECIFIC CONSTRUCTION HEALTH AND SAFETY PLAN WILL NOT CONSTITUTE GROUNDS FOR A CONTRACT SCHEDULE EXTENSION OR DELAY CLAIM.

4. THE SITE SPECIFIC CONSTRUCTION HEALTH AND SAFETY PLAN SHALL BE PROVIDED TO, AND THE CONTRACTOR SHALL OBTAIN WRITTEN ACKNOWLEDGMENT BY, ALL SUBCONTRACTORS USED IN THE COMPLETION OF THE WORK.

5. ALL CONTRACTOR PERSONNEL WORKING ON THE SITE ARE REQUIRED TO HAVE A VALID TRANSPORTATION SECURITY ADMINISTRATION TRANSPORTATION WORKER IDENTIFICATION CREDENTIAL ON THEIR PERSON AT ALL TIMES WHILE WITHIN THE SECURE TERMINAL BOUNDARY.

SOIL STAGING AREA NOTES

1. SOILS EXCAVATED DURING TRENCHING SHALL BE LOADED INTO WAITING TRUCKS. NO TRUCK QUEUING PERMITTED ON THE SITE.

WORK SEQUENCING NOTES

1. WORK SHALL BE IMPLEMENTED IN A PHASED APPROACH. WORK IS RESTRICTED TO THE WORK AREAS DEFINED IN THE DRAWINGS. WORK SHALL BE COMPLETED IN A SEQUENCED MANNER STARTING AT WORK AREA 1 AND ENDING AT WORK AREA 4. ONCE WORK IS COMPLETED IN A WORK AREA, THE WORK AREA SHALL BE RESTORED AND MADE AVAILABLE FOR USE BY THE CONTAINER TERMINAL OPERATOR.

2. THE AREA AROUND THE EQUIPMENT LAYOUT AREA AND THE STAGING AREA IN WORK AREA 4 WILL BE AVAILABLE FOR THE DURATION OF THE WORK.

3. THE CONTRACTOR SHALL PERFORM ALL UTILITY INTEGRITY TESTING, BACKFILL AND FINISH THE PAVEMENT SURFACE BEFORE MOVING ON TO THE NEXT WORK AREA. THE ENGINEER SHALL APPROVE THE COMPLETION OF EACH WORK AREA BEFORE THE CONTRACTOR CAN MOVE TO THE NEXT WORK AREA.

CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES

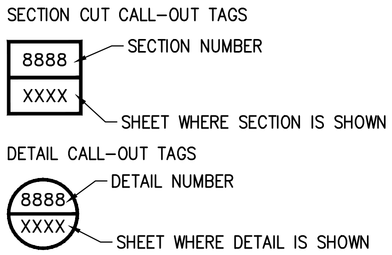
PROJECT NAME: **TERMINAL 30**
CLEANUP

SHEET TITLE: **NOTES & ABBREVIATIONS**

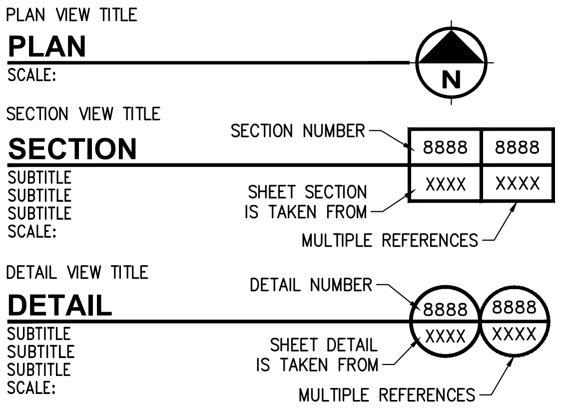
POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 G1

File: Q:\SEA\9834\CADD_Active_SheetSet\301801G001; Plotted: 11/21/2018 11:29 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:23 AM by MWILLIAMS

REFERENCE SYMBOLS



DRAWING VIEW TITLES



SURVEYORS LEGEND

TBD

CALL 2 DAYS
BEFORE YOU DIG
1–800–424–5555

CRETE
CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11–21–18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8–24–17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12–6–17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5–12–18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11–21–18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: **LEGEND AND SYMBOLS**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 G2

AS/SVE TRENCH ALIGNMENT DATA

TRENCH SECTION	STATION RANGE		STATION OFFSET				
	STA BEGIN	STA END	EDGE OF TRENCH		SHOULDER WIDTH (IN)	SAWCUT LIMITS	
			L (IN)	R (IN)		L (IN)	R (IN)
1	0+00	0+73	48	48	24	72	72
2	0+73	1+00	48	54	24	72	78
3	1+00	2+54	48	48	24	72	72
4	2+54	4+06	42	42	24	66	66
5	4+06	5+13N	0	36	12L & 24R	12	60
6	4+06	4+45	36	41	24	60	65
7	4+45	4+85	36	41	24	60	65
8	4+85	5+75	29	41	24	53	65
9	5+75	6+28	29	41	24	53	65
10	6+28	7+68	22	41	24	46	65
11	7+68	7+76	24	24	12	36	36
11	7+76	7+82	N/A	N/A	N/A	N/A	N/A
11	7+82	8+02	24	24	12	36	36
12	8+02	9+34	21	21	9	30	30

WELL ALIGNMENT DATA

WELL ID	STATION	STATION OFFSET	
		L (FT)	R (FT)
VMP–1	4+71.29N	N/A	24.50
VMP–2	5+20.07	24.50	N/A
VMP–3	7+00.07	24.50	N/A
VMP–4	8+65.70	N/A	17.25
RW–100	8+31.41	12.90	N/A
RW–101	8+66.41	12.90	N/A
RW–102	9+01.41	12.90	N/A
RW–104	8+13.91	N/A	12.25
RW–105	8+48.91	N/A	12.10
RW–106	8+83.91	N/A	12.10
RW–107	9+18.91	N/A	12.10
RW–108	8+31.41	N/A	37.10
RW–109	8+66.41	N/A	37.10
RW–110	9+01.41	N/A	37.10

WELL ALIGNMENT DATA

WELL ID	STATION	STATION OFFSET	
		L (FT)	R (FT)
AS–1	1+04.40	N/A	5.00
AS–2	1+34.40	N/A	5.00
AS–3	1+64.40	N/A	5.00
AS–4	1+94.40	N/A	5.00
AS–5	2+24.40	N/A	5.00
AS–6	2+54.40	N/A	5.00
AS–7	4+11.30N	N/A	3.50
AS–8	4+41.30N	N/A	3.50
AS–9	4+71.30N	N/A	3.50
AS–10	5+01.30N	N/A	3.50
AS–11	4+30.07	3.50	N/A
AS–12	4+60.07	3.50	N/A
AS–13	4+90.07	3.50	N/A
AS–14	5+20.07	3.50	N/A
AS–15	5+50.07	3.50	N/A
AS–16	5+80.07	3.50	N/A
AS–17	6+10.07	3.50	N/A
AS–18	6+40.07	3.50	N/A
AS–19	6+70.07	3.50	N/A
AS–20	7+00.07	3.50	N/A
AS–21	7+30.07	3.50	N/A
AS–22	7+60.07	3.50	N/A
AS–23	8+05.07	2.13	N/A
AS–24	8+35.70	2.13	N/A
AS–25	8+65.70	2.13	N/A
AS–26	8+95.70	2.13	N/A
AS–27	9+25.70	2.13	N/A
SVE–1 START	0+99.67	N/A	3.00
SVE–1 END	2+54.40	N/A	3.00
SVE–2 START	4+05.68	N/A	N/A
SVE–2 END (N)	4+76.09N	N/A	2.00
SVE–2 END (S)	4+45.28	2.00	N/A
SVE–3 START	4+48.28	1.42	N/A
SVE–3 END	5+75.28	1.42	N/A
SVE–4	6+28.07	4.50	N/A
SVE–5	6+85.07	4.50	N/A
SVE–6	*	N/A	N/A
SVE–7	7+96.32	3.00	N/A
SVE–8	8+42.85	N/A	2.75
SVE–9	8+73.65	N/A	2.75
SVE–10	9+33.65	N/A	2.75

* STATION AND OFFSET DON'T APPLY AT BEND IN TRENCH. N:16446.12 E:30678.30

NOTES

1. AS/SVE TRENCH ALIGNMENT STATION LINE IS NOT CENTERED IN THE TRENCH AT ALL LOCATIONS. REFER TO AS/SVE TRENCH ALIGNMENT DATA TABLE ON THIS SHEET FOR STATION OFFSETS.
2. CONTRACTOR TO INSTALL AS/SVE PIPING BELOW RUBBER TIRED GANTRY PAD (STA 8+04 TO STA 8+12) USING TRENCHLESS METHODS (NO OPEN CUT ALLOWED AT THIS LOCATION).
3. AS/SVE TRENCH SAWCUT LIMITS ARE SHOWN ON SHEETS C1.1 AND C1.2.
4. AS/SVE TRENCH LIMITS AND SECTION CUTS ARE SHOWN ON SHEETS C4.1 AND C.42.
5. AIR SPARGE, SOIL VAPOR EXTRACTION, VAPOR MONITORING, AND PRODUCT RECOVERY WELLS ARE SHOWN ON SHEETS C4.1 AND C4.2.

SURVEY CONTROL NOTES

UNIT OF MEASUREMENT: U.S. SURVEY FEET

DATUM HORIZONTAL: SEATTLE TIDELAND 2014

DATUM VERTICAL: MEAN LOWER LOW WATER

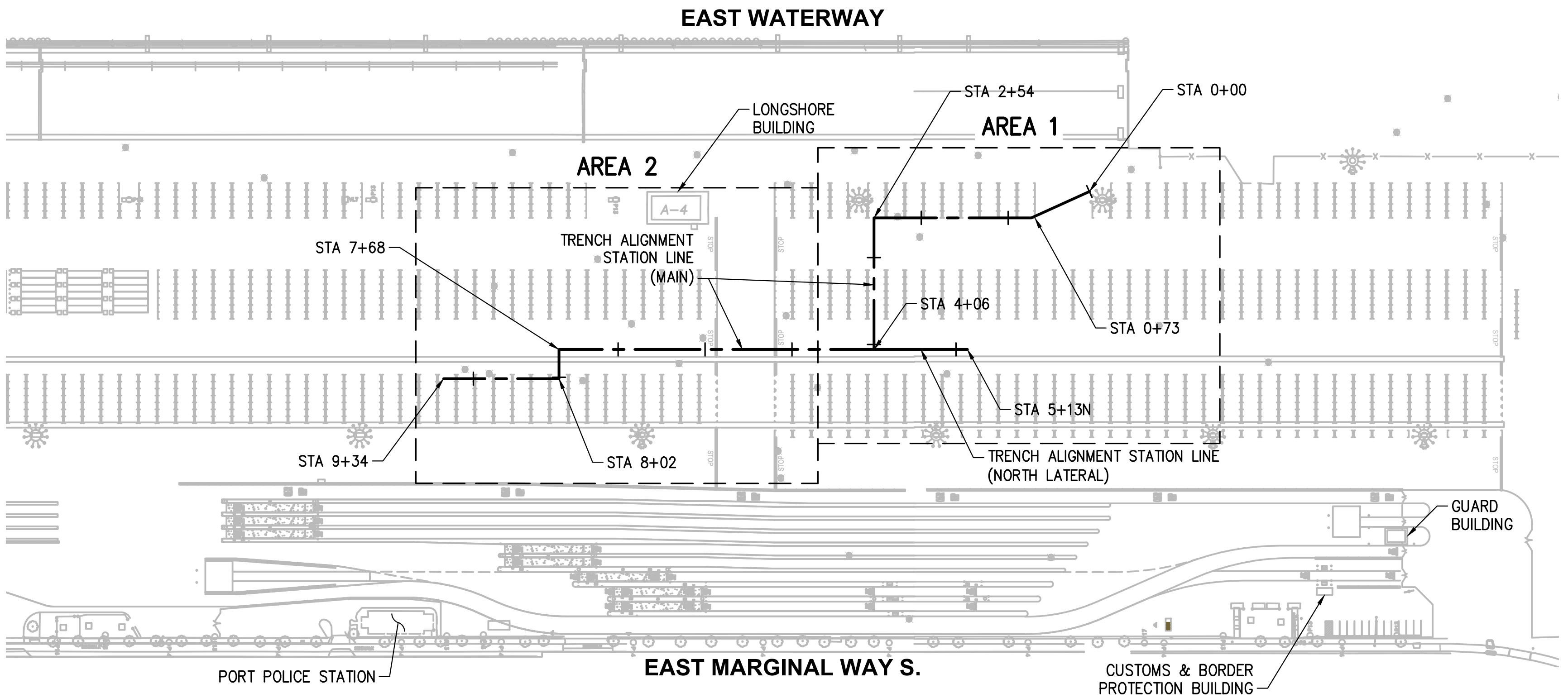
SITE HORIZONTAL AND VERTICAL CONTROL:

POS CONTROL D235(PK)
NORTHING:17149.4090
EASTING:30689.7500
EL: 18.50

POS CONTROL D236(PK)
NORTHING:16233.9730
EASTING:30689.1980
EL: 18.62

BASIS OF BEARING:

SEAPORT AND ITS VICINITY AREAS



ALIGNMENT PLAN

AS/SVE TRENCH
SCALE: 1" = 100'

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: **ALIGNMENT DATA**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 G3

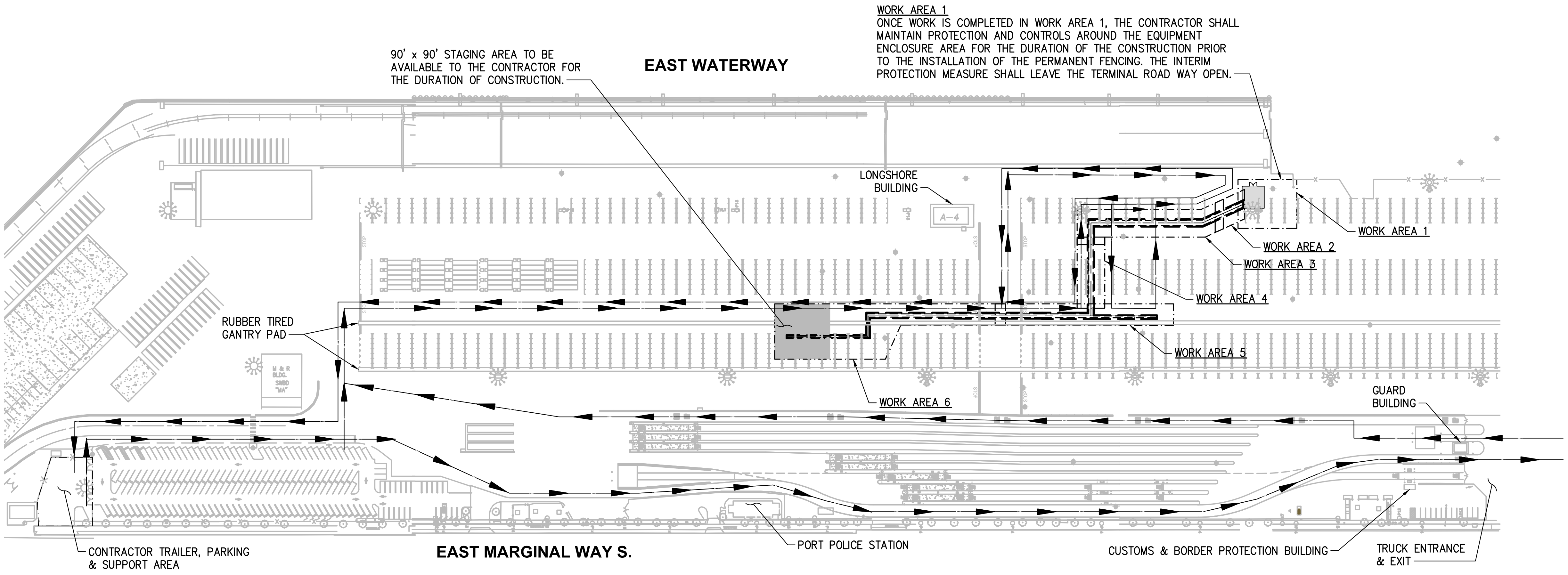
File: Q:\SEA\9834\CADD_Active_SheetSet\301801G003; Plotted: 11/21/2018 11:29 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:26 AM by MWILLIAMS

NOTES

1. THE STAGING AREA IN WORK AREA 4 AND EQUIPMENT ENCLOSURE AREA IN WORK AREA 1 SHALL BE AVAILABLE TO THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
2. EXCEPT AS STATED IN NOTE 1, CONTRACTOR SHALL OCCUPY ONLY A SINGLE WORK AREA AT ANY ONE TIME TO MINIMIZE DISRUPTION TO TERMINAL OPERATIONS.
3. EXCEPT AS STATED IN NOTE 1, CONTRACTOR SHALL FINISH WORK IN A WORK AREA PRIOR TO MOVING TO AN ADJACENT WORK AREA.
4. CONTRACTOR'S SCHEDULE SHALL CLEARLY IDENTIFY WHEN THEY WILL OCCUPY EACH WORK AREA. THIS SCHEDULE SHALL BE APPROVED BY THE ENGINEER AND TENANT PRIOR TO ANY SITE WORK.
5. CONTRACTOR SHALL NOT HAVE ANY TRUCKS QUEUED FOR LOADING OR UNLOADING IN ANY AREAS OF THE SITE OUTSIDE OF THE ACTIVE WORK AREA.

LEGEND

◄──	APPROXIMATE LOCATION & DIRECTION OF ALLOWABLE CONSTRUCTION TRAFFIC.
—·—·—	CONTRACTOR WORK AREAS.



PLAN
SCALE: 1" = 100'

N

1"=100'-0" 100 0 100 200
Scale Feet

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

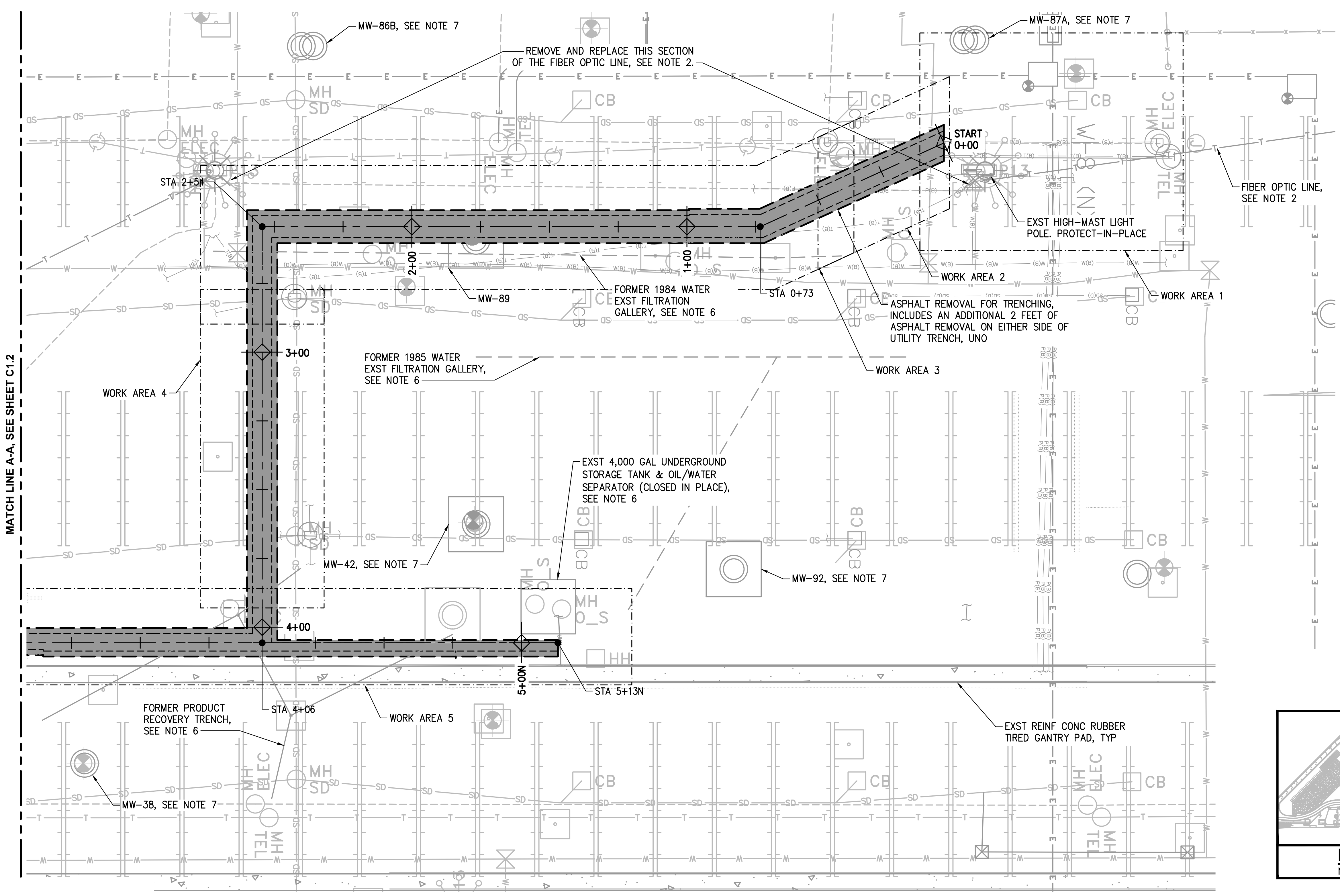
REVISIONS									
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **SITE CONTROLS & CONTRACTOR WORK AREAS**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 G4

File: Q:\SEA\9834\CADD_Active_SheetSet\301801G004; Plotted: 11/21/2018 11:29 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:28 AM by MWILLIAMS



AREA 1 - PLAN

SCALE: 1" = 20'

1"=20'-0" 20 0 20 40

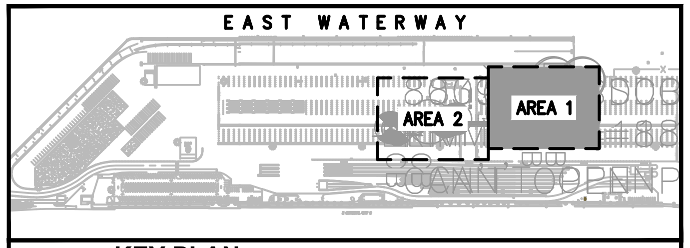
Scale Feet

NOTES

1. SEE SHEET C5.1 FOR UTILITY CONFLICTS.
2. CONTRACTOR SHALL VERIFY THE LOCATION AND DEPTHS OF ALL EXISTING UTILITIES, INCLUDING THE FIBER OPTIC LINE INSTALLED BY KERF CUT METHOD. THE CONTRACTOR SHALL DISCONNECT THE FIBER OPTICS LINE FROM THE JUNCTION BOXES ON THE HIGH MAST LIGHT POLE BASES. THE FIBER OPTICS LINE SHALL BE REMOVED FROM WHERE IT CONFLICTS WITH THE AS/SVE TRENCH BETWEEN STATION 0+00 TO STATION 2+75. THE FIBER OPTICS LINE SHALL BE REPLACED BASED ON A SCHEDULE APPROVED BY SSA AND THE ENGINEER, BUT NOT OCCURRING BEFORE CONSTRUCTION IS COMPLETED IN WORK AREA 3. ALL OTHER SECTIONS OF THE FIBER OPTIC LINE SHALL BE PROTECTED. ALL UTILITIES SHALL BE PROTECTED. ASPHALT CUTS AND TRENCHING MAY BE FIELD ADJUSTED AS APPROVED BY THE ENGINEER TO PROTECT UTILITIES.
3. SEE SHEET G3 FOR TRENCH AND SAWCUT ALIGNMENT DATA.
4. SAWCUTTING & ASPHALT REMOVAL FOR SVE AND AS WELLS NOT SHOWN. REFER TO TRENCH DETAILS 9/C7.4 AND 10/C7.4.
5. PAVEMENT MARKINGS REMOVED AS PART OF ASPHALT REMOVAL SHALL BE RESTORED PRIOR TO PROJECT COMPLETION.
6. ABANDONED FEATURES FROM THE HISTORICAL PRODUCT RECOVERY NETWORK MAY BE ENCOUNTERED DURING SUBSURFACE EXCAVATION WORK. IF THESE ABANDONED FEATURES ARE ENCOUNTERED, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY AND PROVIDE ACCESS FOR THE ENGINEER TO EXAMINE THE ABANDONED FEATURES. THE ENGINEER WILL DETERMINE IF MODIFICATIONS TO THIS SCOPE OF WORK ARE REQUIRED.
7. THE EXISTING WELL APRON SHALL BE REPLACED WITH A REINFORCED WELL APRON. FOR EXISTING AREAS OUTSIDE OF WORK AREAS 1 THROUGH 6, THE CONTRACTOR SHALL MINIMIZE THE FOOT PRINT REQUIRED TO COMPLETE THESE MODIFICATIONS AND ARE LIMITED TO AN AREA OF 20 x 20 FT. A HIGH STRENGTH, QUICK SETTING CONCRETE SHALL BE USED TO MINIMIZE CURING TIME. SEE WELL APRON DETAIL ON SHEET C8.1.

LEGEND

▨	ASPHALT REMOVAL FOR TRENCHING
— —	SAWCUT LIMITS FOR ASPHALT REMOVAL
— — —	TRENCH ALIGNMENT



KEY PLAN

NTS

CALL 2 DAYS BEFORE YOU DIG
1-800-424-5555

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C001_1; Plotted: 11/21/2018 11:31 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:41 AM by MWILLIAMS

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

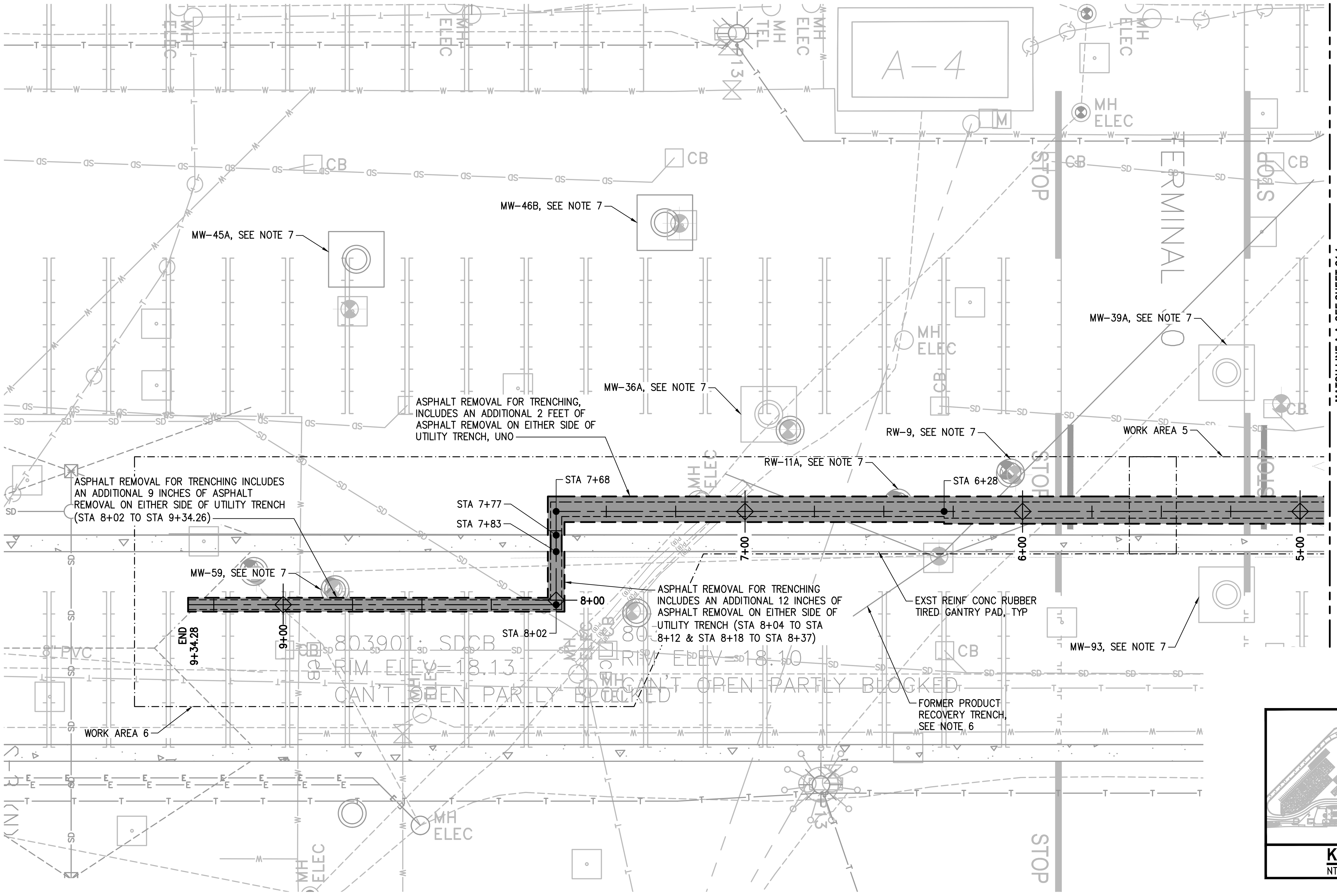
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: EXISTING CONDITIONS & DEMOLITION PLAN - 1 OF 2

POS WORK PROJECT NUMBER WP-U00212
CONSULTANT'S PROJECT NUMBER 9834
POS PROJECT TRACKING NUMBER 30-1801 C1.1



AREA 2 - PLAN

SCALE: 1" = 20'

1"=20'-0"

20 0 20 40

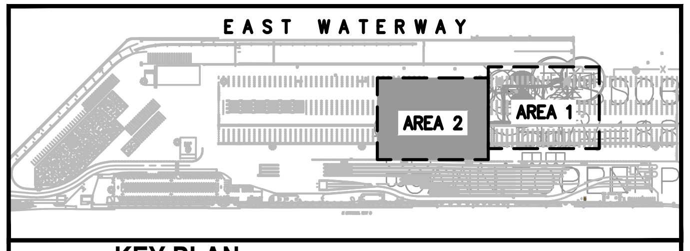
Scale Feet

NOTES

1. SEE SHEET C5.1 FOR UTILITY CONFLICTS.
2. CONTRACTOR SHALL VERIFY THE LOCATION AND DEPTHS OF ALL EXISTING UTILITIES, INCLUDING THE FIBER OPTIC LINE INSTALLED BY KERF CUT METHOD. THE CONTRACTOR SHALL DISCONNECT THE FIBER OPTICS LINE FROM THE JUNCTION BOXES ON THE HIGH MAST LIGHT POLE BASES. THE FIBER OPTICS LINE SHALL BE REMOVED FROM WHERE IT CONFLICTS WITH THE AS/SVE TRENCH BETWEEN STATION 0+00 TO STATION 2+75. THE FIBER OPTICS LINE SHALL BE REPLACED BASED ON A SCHEDULE APPROVED BY SSA AND THE ENGINEER, BUT NOT OCCURRING BEFORE CONSTRUCTION IS COMPLETED IN WORK AREA 3. ALL OTHER SECTIONS OF THE FIBER OPTIC LINE SHALL BE PROTECTED. ALL UTILITIES SHALL BE PROTECTED. ASPHALT CUTS AND TRENCHING MAY BE FIELD ADJUSTED AS APPROVED BY THE ENGINEER TO PROTECT UTILITIES.
3. SEE SHEET G3 FOR TRENCH AND SAWCUT ALIGNMENT DATA.
4. SAWCUTTING & ASPHALT REMOVAL FOR SVE AND AS WELLS NOT SHOWN. REFER TO TRENCH DETAILS 9/C7.4 AND 10/C7.4.
5. PAVEMENT MARKINGS REMOVED AS PART OF ASPHALT REMOVAL SHALL BE RESTORED PRIOR TO PROJECT COMPLETION.
6. ABANDONED FEATURES FROM THE HISTORICAL PRODUCT RECOVERY NETWORK MAY BE ENCOUNTERED DURING SUBSURFACE EXCAVATION WORK. IF THESE ABANDONED FEATURES ARE ENCOUNTERED, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY AND PROVIDE ACCESS FOR THE ENGINEER TO EXAMINE THE ABANDONED FEATURES. THE ENGINEER WILL DETERMINE IF MODIFICATIONS TO THIS SCOPE OF WORK ARE REQUIRED.
7. THE EXISTING WELL APRON SHALL BE REPLACED WITH A REINFORCED WELL APRON. FOR EXISTING AREAS OUTSIDE OF WORK AREAS 1 THROUGH 6, THE CONTRACTOR SHALL MINIMIZE THE FOOT PRINT REQUIRED TO COMPLETE THESE MODIFICATIONS AND ARE LIMITED TO AN AREA OF 20 x 20 FT. A HIGH STRENGTH, QUICK SETTING CONCRETE SHALL BE USED TO MINIMIZE CURING TIME. SEE WELL APRON DETAIL ON SHEET C8.1.

LEGEND

▨	ASPHALT REMOVAL FOR TRENCHING
— —	SAWCUT LIMITS FOR ASPHALT REMOVAL
— - -	TRENCH ALIGNMENT



KEY PLAN

NTS

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

CRETE CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

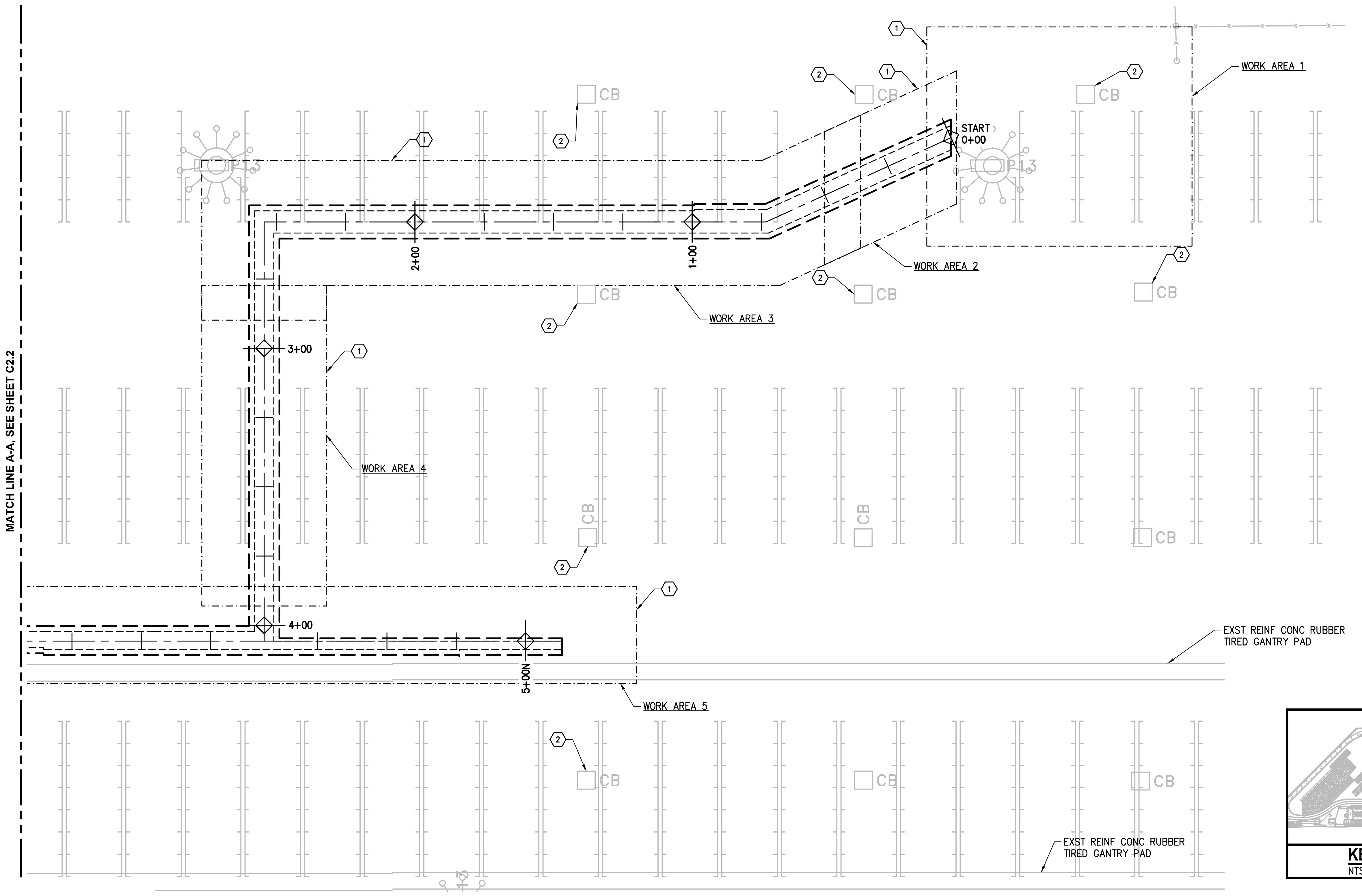
Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: **EXISTING CONDITIONS & DEMOLITION PLAN - 2 OF 2**

POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C1.2

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C001_2; Plotted: 11/21/2018 11:32 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:41 AM by MWILLIAMS



AREA 1 - PLAN

SCALE: 1" = 20'

1"=20'-0"
20 0 20 40
Scale Feet

NOTES

1. CONTRACTOR TO PROVIDE TEMPORARY FENCING TO SECURE EQUIPMENT AND SUPPLIES DURING CONSTRUCTION. SEE DETAIL 17/C8.3.

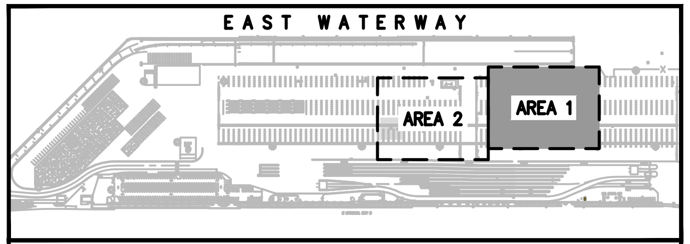
TESC NOTES

① INSTALL AND MAINTAIN EXTRUDED CURBING AROUND ALL ACTIVE WORK AREAS AT ALL TIMES DURING CONSTRUCTION.

② INSTALL AND MAINTAIN CATCH BASIN INSERTS IN ALL CATCH BASINS WITHIN 40 FEET OF THE WORK AREA (MEASURED FROM THE EDGE OF WORK AREA)

LEGEND

—·—·—	CONTRACTOR WORK AREAS
—— ——	SAWCUT LIMITS FOR ASPHALT REMOVAL
— — —	TRENCH ALIGNMENT



KEY PLAN

NTS

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **TESC PLAN - 1 OF 2**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C2.1

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C002_1; Plotted: 11/21/2018 11:32 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:44 AM by MWILLIAMS

NOTES

1. CONTRACTOR TO PROVIDE TEMPORARY FENCING TO SECURE EQUIPMENT AND SUPPLIES DURING CONSTRUCTION. SEE DETAIL 17/C8.3.

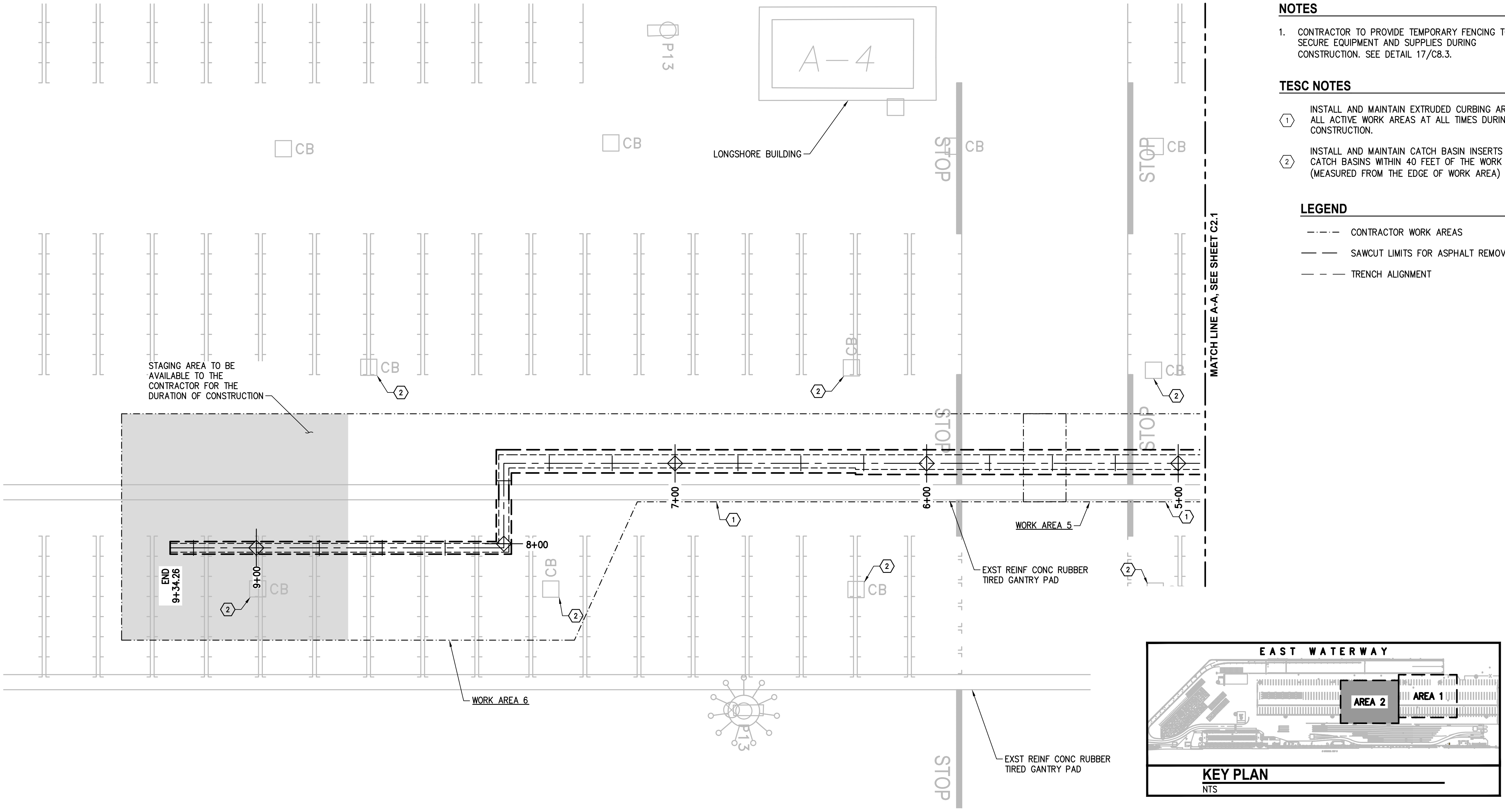
TESC NOTES

① INSTALL AND MAINTAIN EXTRUDED CURBING AROUND ALL ACTIVE WORK AREAS AT ALL TIMES DURING CONSTRUCTION.

② INSTALL AND MAINTAIN CATCH BASIN INSERTS IN ALL CATCH BASINS WITHIN 40 FEET OF THE WORK AREA (MEASURED FROM THE EDGE OF WORK AREA)

LEGEND

— · — · —	CONTRACTOR WORK AREAS
—— ——	SAWCUT LIMITS FOR ASPHALT REMOVAL
— — —	TRENCH ALIGNMENT



KEY PLAN

NTS

AREA 2 - PLAN

SCALE: 1" = 20'

N

1"=20'-0" 20 0 20 40 Scale Feet

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

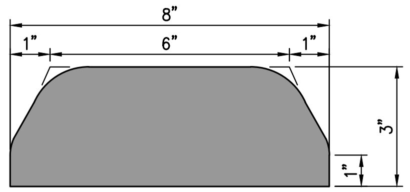
POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES

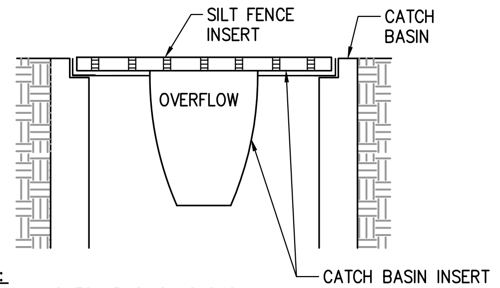
PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: TESC PLAN - 2 OF 2

POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C2.2



DETAIL 1/C2.1 1/C2.2
EXTRUDED CURB
WSDOT TYPE 1 (HOT MIX ASPHALT)
SCALE: NTS



NOTE:
INSTALL IN CATCH BASINS AS SHOWN ON DRAWINGS AND AS NEEDED.

DETAIL 2/C2.1 2/C2.2
CATCH BASIN INSERT
SCALE: NTS

GENERAL:

1. TEMPORARY AND PERMANENT CONSTRUCTION CONTROLS SHALL BE USED TO ACCOMPLISH THE FOLLOWING MINIMUM REQUIREMENTS. ADDITIONAL CONTROLS MAY BE REQUIRED WHEN MINIMUM CONTROLS ARE NOT SUFFICIENT TO PREVENT EROSION OR TRANSPORT OF SEDIMENT OR OTHER POLLUTANTS FROM THE SITE. CONTRACTOR SHALL SUBMIT TEMPORARY EROSION CONTROL PLANS IN THE WORK PLAN.
2. IT SHOULD BE UNDERSTOOD BY THE CONTRACTOR THAT THIS SITE IS IN AN ACTIVE CONTAINER TERMINAL ON A SUPERFUND WATERWAY. MAINTAINING CONTROL OF ON-SITE SOIL AND AVOIDING TRACKING TO THE TERMINAL AND SURROUNDING PROPERTIES IS OF UTMOST IMPORTANCE. NO TRUCK WASHOUT WILL BE PERMITTED ON ANY AREA OF THE SITE.
3. THE IMPLEMENTATION OF THE TEMPORARY EROSION & SEDIMENT CONTROL PLANS AND INSTALLATION, MAINTENANCE, REPLACEMENT AND UPGRADING OF THE TEMPORARY EROSION & SEDIMENT CONTROL FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL CONSTRUCTION IS SUBSTANTIALLY COMPLETED.
4. THE TEMPORARY EROSION & SEDIMENT CONTROL FACILITIES SHOWN ON THESE PLANS MUST BE PERFORMED IN CONJUNCTION WITH ALL CONSTRUCTION ACTIVITIES, AND IN SUCH A MANNER AS TO ENSURE THAT SEDIMENT LADEN WATER DOES NOT ENTER THE WATERWAY, ADJACENT PROPERTIES, OR VIOLATE APPLICABLE STANDARDS. THE TEMPORARY EROSION & SEDIMENT CONTROL FACILITIES SHOWN ON THESE PLANS ARE CONSIDERED TO BE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. THESE TEMPORARY EROSION & SEDIMENT CONTROL FACILITIES SHALL BE UPGRADED (FOR EXAMPLE, ADDITIONAL INLET PROTECTION, ETC) AS NEEDED TO ACCOUNT FOR ACTUAL SITE CONDITIONS AND FOR STORM EVENTS.
5. THIS SITE INCLUDES WORK AREAS WITHIN THE PROJECT SITE. AREAS OUTSIDE OF THE WORK AREAS SHALL BE MAINTAINED AS CLEAN AREAS AND NO SOIL OR SEDIMENT FROM THE WORK AREAS SHALL BE TRACKED TO THE ADJACENT TERMINAL OPERATIONS.
6. REFER TO THE KING COUNTY SURFACE WATER DESIGN MANUAL, APPENDIX D, BEST MANAGEMENT PRACTICES IN THE STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON CONSTRUCTION, VOLUME II, AND ALL OTHER APPLICABLE REGULATIONS TO ACCOMPLISH CONTROL OF POTENTIALLY HAZARDOUS POLLUTANTS AND SEDIMENT.
7. THE CONTRACTOR SHALL DIVERT ALL SURFACE WATER AWAY FROM THE TRENCHES. ANY EXCESS WATER THAT IS COLLECTED IN THE TRENCHES SHALL BE COLLECTED BY THE CONTRACTOR AND HAULED OFFSITE FOR DISPOSAL AT THE CONTRACTORS EXPENSE.
8. TEMPORARY EROSION & SEDIMENT CONTROL WILL BE REQUIRED AROUND ALL WORK AREAS AND STAGING AREAS.

ON THE SITE:

1. SOIL AND CONSTRUCTION STOCKPILES, DEBRIS OR AGGREGATE STOCKPILES OF ANY KIND SHALL NOT BE ALLOWED ON THIS PROJECT UNLESS APPROVED BY THE ENGINEER.
2. CONCRETE TRUCKS (INCLUDING CONTROL DENSITY FILL) SHALL NOT WASH OUT ON SITE WITHOUT APPROVAL OF THE ENGINEER.
3. WATER THAT IS COLLECTED FROM THE SITE DEWATERING OPERATIONS OR COLLECTED SURFACE WATER THAT HAS COME IN CONTACT WITH ANY CONTAMINATED SURFACE SHALL BE DISPOSED OF OFF-SITE. WATER TREATMENT DISCHARGE AND TESTING REQUIREMENTS ARE LISTED IN THE PROJECT SPECIFICATIONS.

ACCESS TO THE WORK AREAS:

1. LIMIT CONSTRUCTION VEHICLE ACCESS TO THE PRIMARY DRIVING ROUTE, ACCESS POINTS AND PREVENT TRACKING SEDIMENT ONTO PUBLIC ROADS OR WITHIN THE TERMINAL.
2. INSTALL AND MAINTAIN A VEHICLE DECONTAMINATION AND INSPECTION STATION. ALL VEHICLES SHALL BE DECONTAMINATED AND INSPECTED PRIOR TO LEAVING WORK AREAS TO ENSURE THAT SITE SOIL FROM A WORK AREA SHALL NOT BE TRACKED ONTO ADJACENT CLEAN TERMINAL AREAS OR ADJACENT PUBLIC STREETS.

MAINTAIN, INSPECT, MODIFY AS NEEDED:

1. ALL TEMPORARY AND PERMANENT EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES SHALL BE INSPECTED, MAINTAINED, AND REPAIRED AS NEEDED TO ASSURE CONTINUED PERFORMANCE OF THEIR INTENDED FUNCTION. ALL TEMPORARY EROSION AND SEDIMENT CONTROLS SHALL BE REMOVED WITHIN FIVE (5) DAYS AFTER THE FINAL SITE STABILIZATION IS ACHIEVED OR AFTER THE TEMPORARY CONTROLS ARE NO LONGER NEEDED, WHICHEVER IS LATER. TRAPPED SEDIMENT SHALL BE REMOVED AND DISPOSED OF. DISTURBED SOIL AREAS RESULTING FROM REMOVAL SHALL BE PERMANENTLY STABILIZED. SITE INSPECTIONS SHALL BE CONDUCTED BY AN ENVIRONMENTAL COMPLIANCE MANAGER WHO SHALL BE PRESENT ON-SITE OR ON-CALL AT ALL TIMES.
2. SITE SOIL SHALL NOT BE TRACKED OUTSIDE OF WORK AREAS OR OFF SITE BY ANY CONSTRUCTION TRAFFIC. SEE NOTE 4 FOR FURTHER CLARIFICATION. FOR CATCH BASINS OUTSIDE OF THE REMOVAL AREA, AT NO TIME SHALL MORE THAN FOUR INCHES OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A CATCH BASIN.
3. THE TEMPORARY EROSION & SEDIMENT CONTROL FACILITIES SHALL BE MAINTAINED, INSPECTED, AND DOCUMENTED PER THE SPECIFICATIONS.
4. ALL VEHICLES LEAVING THE WORK AREAS WILL BE INSPECTED BY THE CONTRACTOR FOR ANY VISIBLE SOIL OR OTHER MATERIALS ADHERED TO THE TRUCK SURFACE. ANY GROSS CONTAMINATION OR SOIL THAT ADHERED TO THE TRUCK OR WHEELS DURING ACTIVITIES IN THE WORK AREA, OR DURING THE LOADING PROCESS, SHALL BE EITHER BRUSHED OFF OR PRESSURE WASHED. THE BRUSHED-OFF SOIL SHALL BE SWEPT AND PLACED BACK TO THE STOCKPILE. PRESSURE-WASHED WATER SHALL BE COLLECTED AND PUMPED TO WATER STORAGE TANKS. ALL TRUCK CLEANING WORK SHALL BE CONDUCTED BY H&S QUALIFIED WORKERS WITHIN THE WORK AREA.
5. TEMPORARY EROSION & SEDIMENT CONTROL MEASURES SHALL BE FULLY REMOVED AS THE CONTRACT MOVES FROM ONE ACTIVE WORK AREA TO THE NEXT ACTIVE AREA.

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

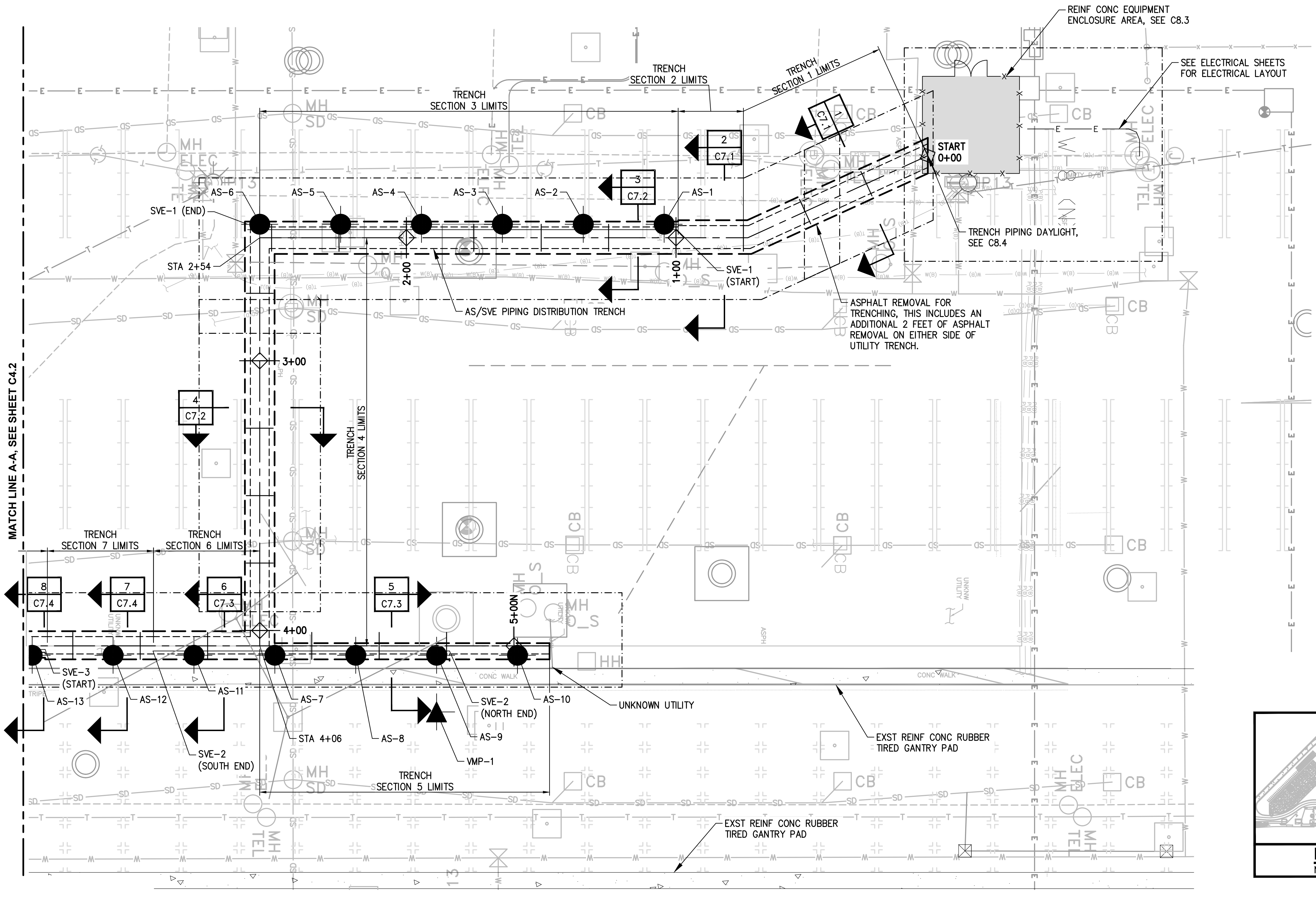
REVISIONS									
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: TESC NOTES AND DETAILS

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C3

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C003; Plotted: 11/21/2018 11:32 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:48 AM by MWILLIAMS

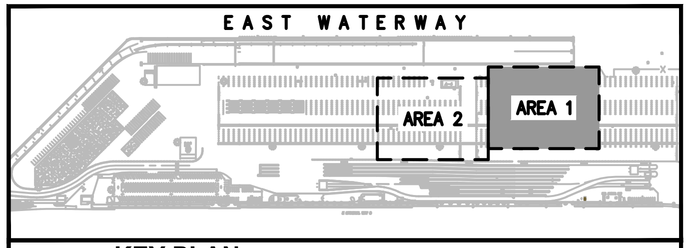


NOTES

1. SEE SHEET C8.1 AND C8.3 FOR CONSTRUCTION DETAILS OF AIR SPARGING, SOIL VAPOR EXTRACTION AND RECOVERY WELL DETAILS.
2. SEE SHEET G3 FOR TRENCH AND SAWCUT ALIGNMENT DATA.
3. SEE SHEET G3 FOR WELL ALIGNMENT DATA.
4. TRENCH FOR SVE AND AS WELLS NOT SHOWN. REFER TO 9/C7.4 AND 10/C7.4 FOR TRENCH DETAILS.

LEGEND

●	AS WELL
■	SVE WELL (VERTICAL)
◐	PRODUCT RECOVERY WELL
▲	VAPOR MONITORING WELL
▫	DECOMMISSIONED MONITORING WELLS
◎	EXISTING MONITORING WELLS
— - —	TRENCH ALIGNMENT
— —	SAWCUT LIMITS FOR ASPHALT REMOVAL
– – –	TRENCH LIMITS



KEY PLAN

NTS

AREA 1 - PLAN

SCALE: 1" = 20'

N

1"=20'-0"
20 0 20 40
Scale Feet

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

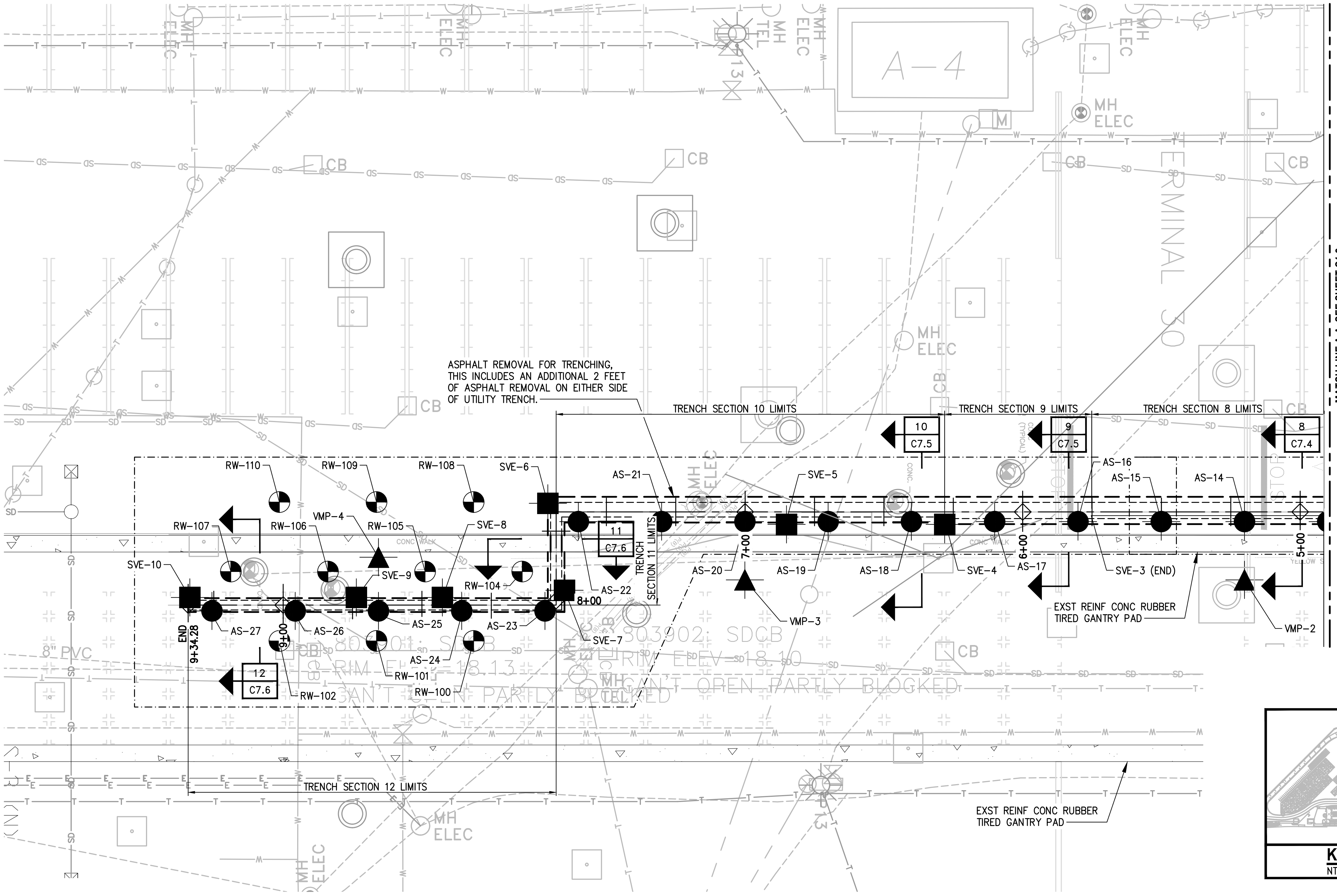
Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: AS/SVE SYSTEM & RECOVERY WELL LAYOUT - 1 OF 2

POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C4.1

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C004_1; Plotted: 11/21/2018 11:33 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:42 AM by MWILLIAMS



AREA 2 - PLAN

SCALE: 1" = 20'

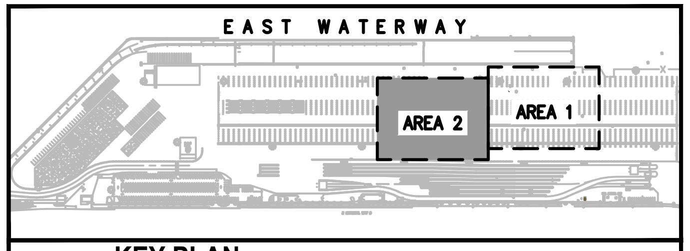
1"=20'-0" 20 0 20 40 Scale Feet

NOTES

1. SEE SHEET C8.1 AND C8.3 FOR CONSTRUCTION DETAILS OF AIR SPARGING, SOIL VAPOR EXTRACTION AND RECOVERY WELL DETAILS.
2. SEE SHEET G3 FOR TRENCH AND SAWCUT ALIGNMENT DATA.
3. SEE SHEET G3 FOR WELL ALIGNMENT DATA.
4. TRENCH FOR SVE AND AS WELLS NOT SHOWN. REFER TO 9/C7.4 AND 10/C7.4 FOR TRENCH DETAILS.

LEGEND

●	AS WELL
■	SVE WELL (VERTICAL)
◐	PRODUCT RECOVERY WELL
▲	VAPOR MONITORING WELL
□	DECOMMISSIONED MONITORING WELLS
◎	EXISTING MONITORING WELLS
— - —	TRENCH ALIGNMENT
— —	SAWCUT LIMITS FOR ASPHALT REMOVAL
- - -	TRENCH LIMITS



KEY PLAN
NTS

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

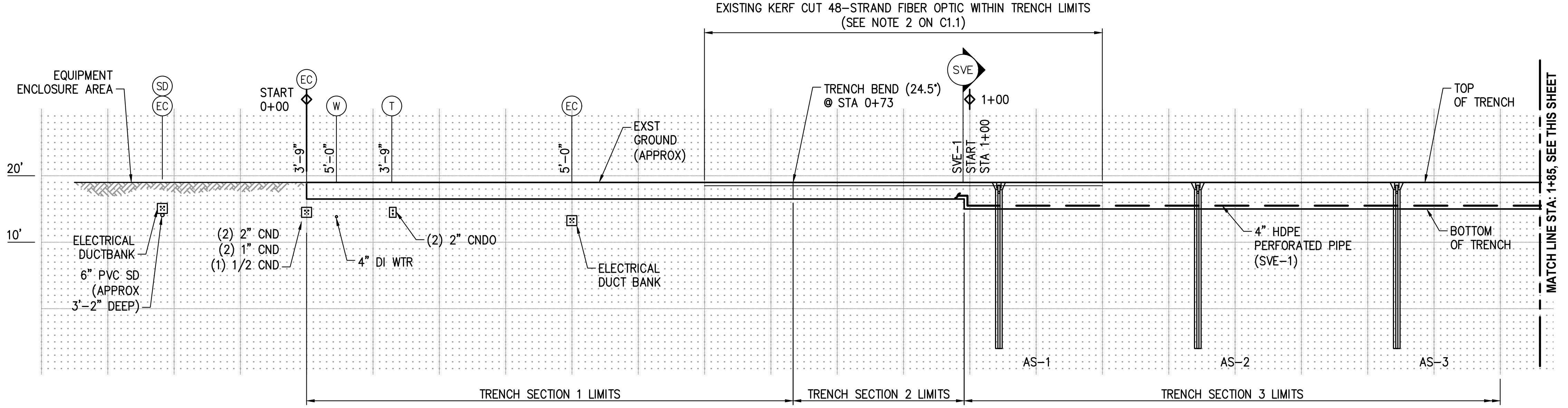
Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: **AS/SVE SYSTEM & RECOVERY WELL LAYOUT - 2 OF 2**

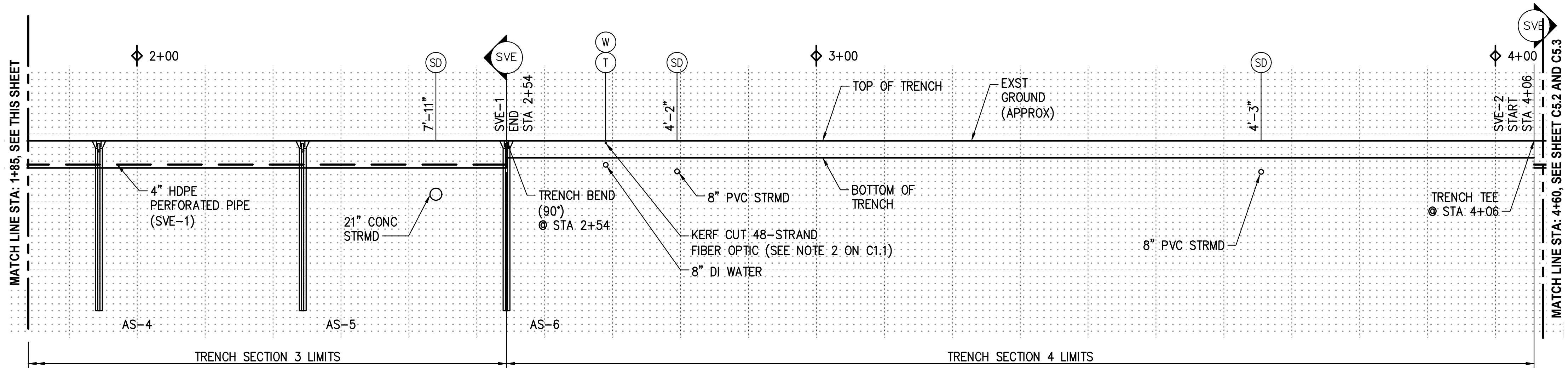
POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C4.2

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C004_2; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:49 AM by MWILLIAMS



PROFILE

TRENCH ALIGNMENT (MAIN)
STA: (START) 0+00 TO 1+85
SCALE: 1"=10'



PROFILE

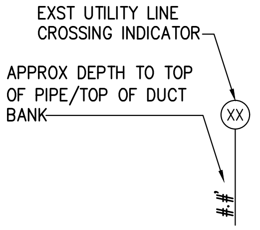
TRENCH ALIGNMENT (MAIN)
STA: 1+85 TO 4+06
SCALE: 1"=10'

NOTES

1. AS AND VERTICAL SVE WELL LOCATIONS ARE OFFSET FROM PIPE TRENCH (SHOWN FOR REFERENCE).
2. AS/SVE PIPING NOT SHOWN FOR CLARITY WITH EXCEPTION OF PERFORATED PIPE FOR HORIZONTAL SVE WELLS (SVE-1 AND SVE-2).
3. EXST UTILITY DEPTHS ARE APPROX BASED ON RECORD DWGS AND/OR GROUND PENETRATING RADAR READINGS. CONTRACTOR SHALL VERIFY DEPTH OF UTILITIES AT ALL UTILITY CROSSING PRIOR TO TRENCHING.
4. CONTRACTOR SHALL USE TRENCHLESS METHOD TO INSTALL AS/SVE PIPING BELOW RUBBER TIRED GANTRY PAD. RUBBER TIRED GANTRY PAD SHALL REMAIN INTACT.
5. SOLID HDPE SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED UPSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS.

LEGEND

Ⓦ	EXISTING WATER LINE CROSSING
(SD)	EXISTING STORM DRAIN CROSSING
Ⓣ	EXISTING TELECOMMUNICATIONS CROSSING
(EC)	EXISTING ELECTRICAL CONDUIT CROSSING
(PRT)	EXISTING PRODUCT RECOVERY TRENCH CROSSING
(SVE)	LIMITS OF HORIZONTAL SOIL VAPOR EXTRACTION WELL
SVE-#	SOIL VAPOR EXTRACTION WELL
AS-#	AIR SPARGING WELL



1"=10'-0"
10 5 0 10 20
Scale Feet

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER 35210

REVISIONS

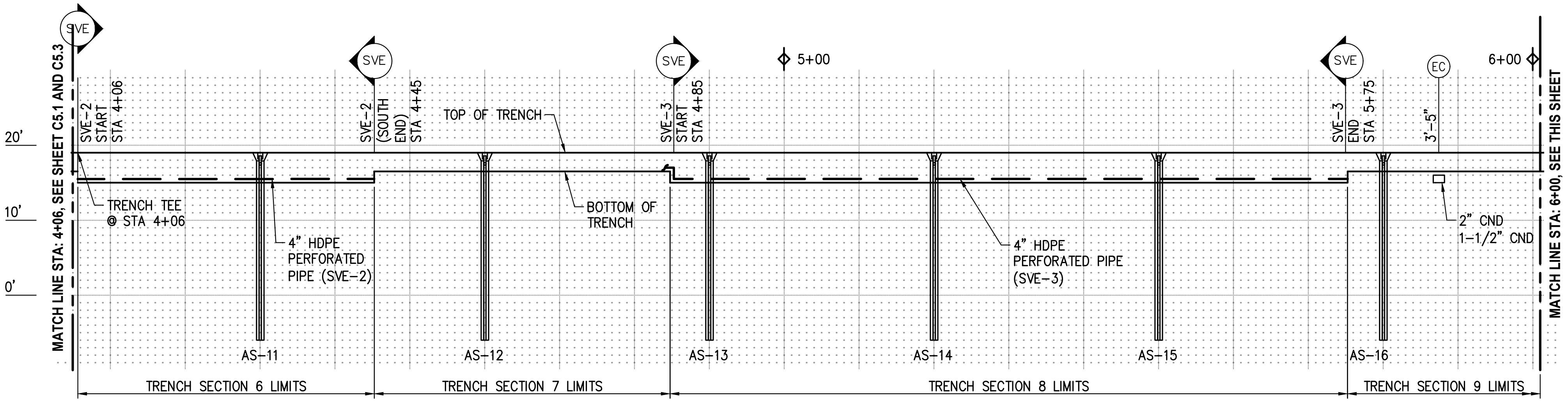
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	ALP	60% DESIGN	ALP	.	.	.	.	.
2	12-6-17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5-12-18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11-21-18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **AS/SVE SYSTEM PROFILE - 1 OF 3**

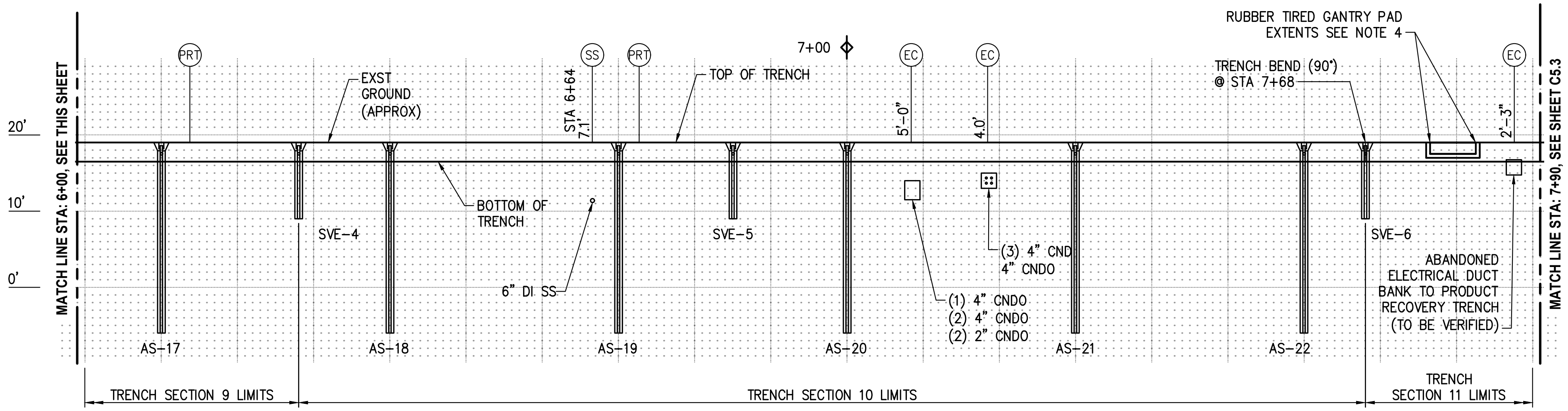
POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C5.1

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C005_1; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:50 AM by MWILLIAMS



PROFILE

TRENCH ALIGNMENT (MAIN)
STA: 4+06 TO 6+00
SCALE: 1"=10'



PROFILE

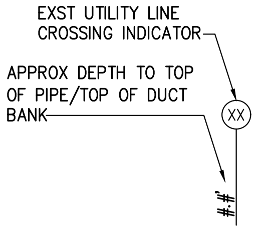
TRENCH ALIGNMENT (MAIN)
STA: 6+00 TO 7+90
SCALE: 1"=10'

NOTES

1. AS AND VERTICAL SVE WELL LOCATIONS ARE OFFSET FROM PIPE TRENCH (SHOWN FOR REFERENCE).
2. AS/SVE PIPING NOT SHOWN FOR CLARITY WITH EXCEPTION OF PERFORATED PIPE FOR HORIZONTAL SVE WELLS (SVE-1 AND SVE-2).
3. EXST UTILITY DEPTHS ARE APPROX BASED ON RECORD DWGS AND/OR GROUND PENETRATING RADAR READINGS. CONTRACTOR SHALL VERIFY DEPTH OF UTILITIES AT ALL UTILITY CROSSING PRIOR TO TRENCHING.
4. CONTRACTOR SHALL USE TRENCHLESS METHOD TO INSTALL AS/SVE PIPING BELOW RUBBER TIRED GANTRY PAD. RUBBER TIRED GANTRY PAD SHALL REMAIN INTACT.
5. SOLID HDPE SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED UPSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS.

LEGEND

Ⓦ	EXISTING WATER LINE CROSSING
(SD)	EXISTING STORM DRAIN CROSSING
(SS)	EXISTING SANITARY SEWER CROSSING
(EC)	EXISTING ELECTRICAL CONDUIT CROSSING
(PRT)	EXISTING PRODUCT RECOVERY TRENCH CROSSING
◀(SVE)▶	LIMITS OF HORIZONTAL SOIL VAPOR EXTRACTION WELL
SVE-#	SOIL VAPOR EXTRACTION WELL
AS-#	AIR SPARGING WELL



1"=10'-0"
10 5 0 10 20
Scale Feet

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER 35210

REVISIONS

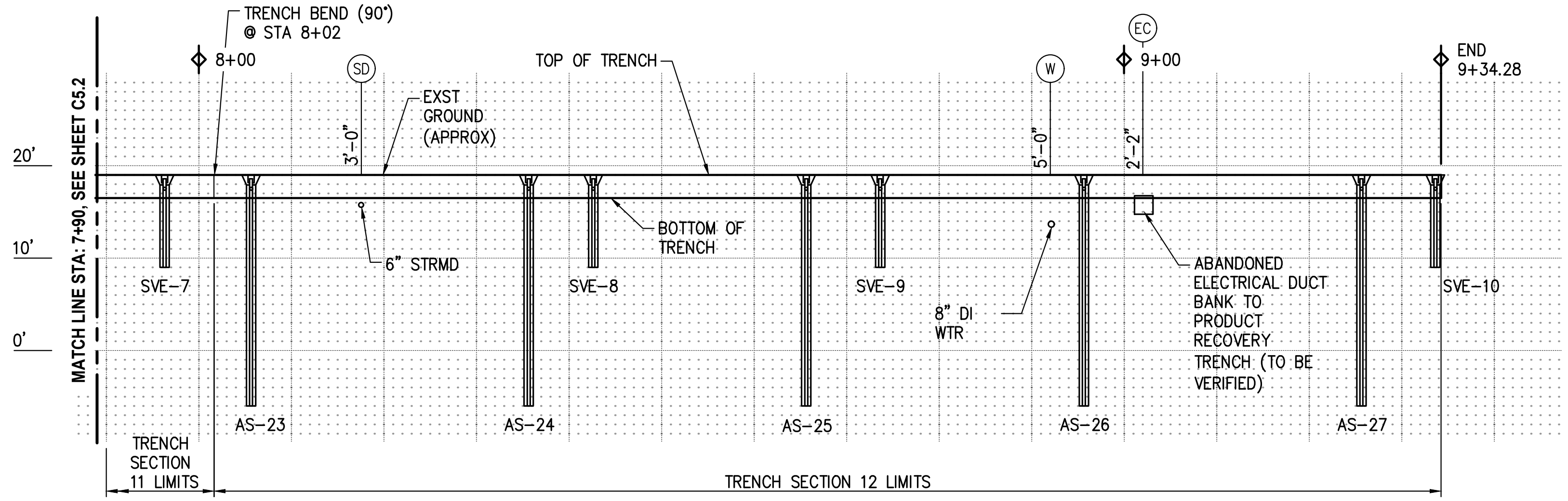
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	ALP	60% DESIGN	ALP	.	.	.	.	.
2	12-6-17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5-12-18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11-21-18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **AS/SVE SYSTEM PROFILE - 2 OF 3**

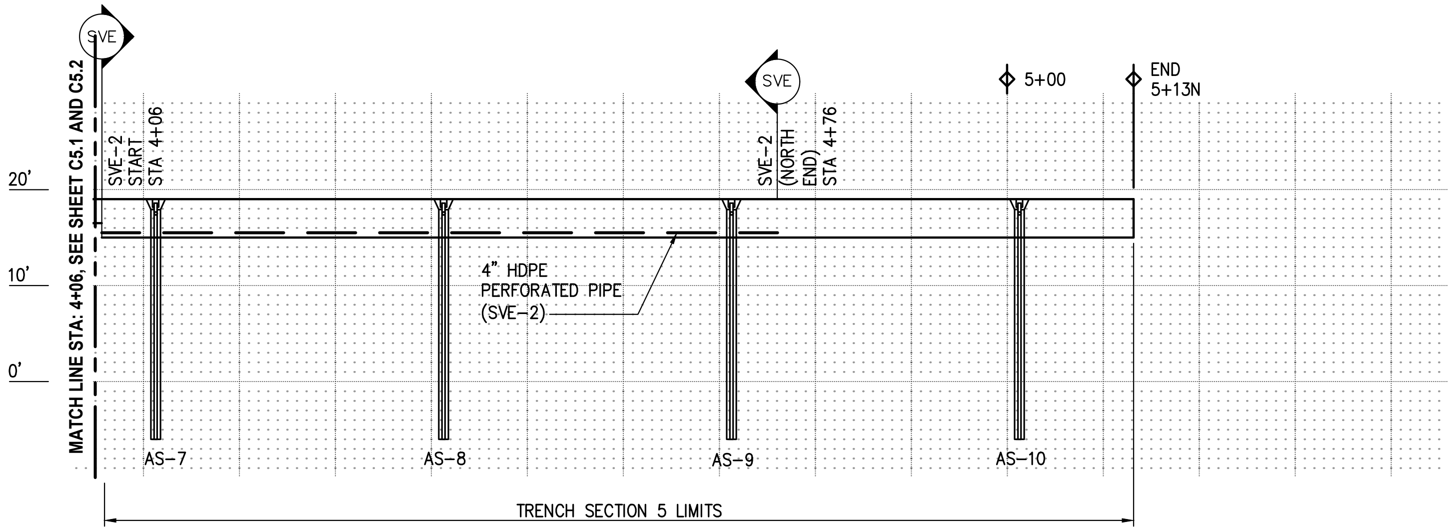
POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C5.2

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C005_2; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 9:36 AM by MWILLIAMS



PROFILE

TRENCH ALIGNMENT (MAIN)
STA: 7+90 TO 9+34 (END)
SCALE: 1"=10'



PROFILE

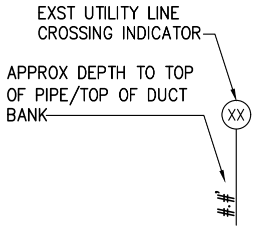
TRENCH ALIGNMENT (NORTH LATERAL)
STA: 4+06 TO 5+13 NORTH
SCALE: 1"=10'

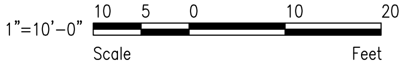
NOTES

1. AS AND VERTICAL SVE WELL LOCATIONS ARE OFFSET FROM PIPE TRENCH (SHOWN FOR REFERENCE).
2. AS/SVE PIPING NOT SHOWN FOR CLARITY WITH EXCEPTION OF PERFORATED PIPE FOR HORIZONTAL SVE WELLS (SVE-1 AND SVE-2).
3. EXST UTILITY DEPTHS ARE APPROX BASED ON RECORD DWGS AND/OR GROUND PENETRATING RADAR READINGS. CONTRACTOR SHALL VERIFY DEPTH OF UTILITIES AT ALL UTILITY CROSSING PRIOR TO TRENCHING.
4. CONTRACTOR SHALL USE TRENCHLESS METHOD TO INSTALL AS/SVE PIPING BELOW RUBBER TIRED GANTRY PAD. RUBBER TIRED GANTRY PAD SHALL REMAIN INTACT.
5. SOLID HDPE SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED UPSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS.

LEGEND

Ⓦ	EXISTING WATER LINE CROSSING
(SD)	EXISTING STORM DRAIN CROSSING
(SS)	EXISTING SANITARY SEWER CROSSING
(EC)	EXISTING ELECTRICAL CONDUIT CROSSING
(PRT)	EXISTING PRODUCT RECOVERY TRENCH CROSSING
◀(SVE)	LIMITS OF HORIZONTAL SOIL VAPOR EXTRACTION WELL
SVE-#	SOIL VAPOR EXTRACTION WELL
AS-#	AIR SPARGING WELL





CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER
35210

REVISIONS

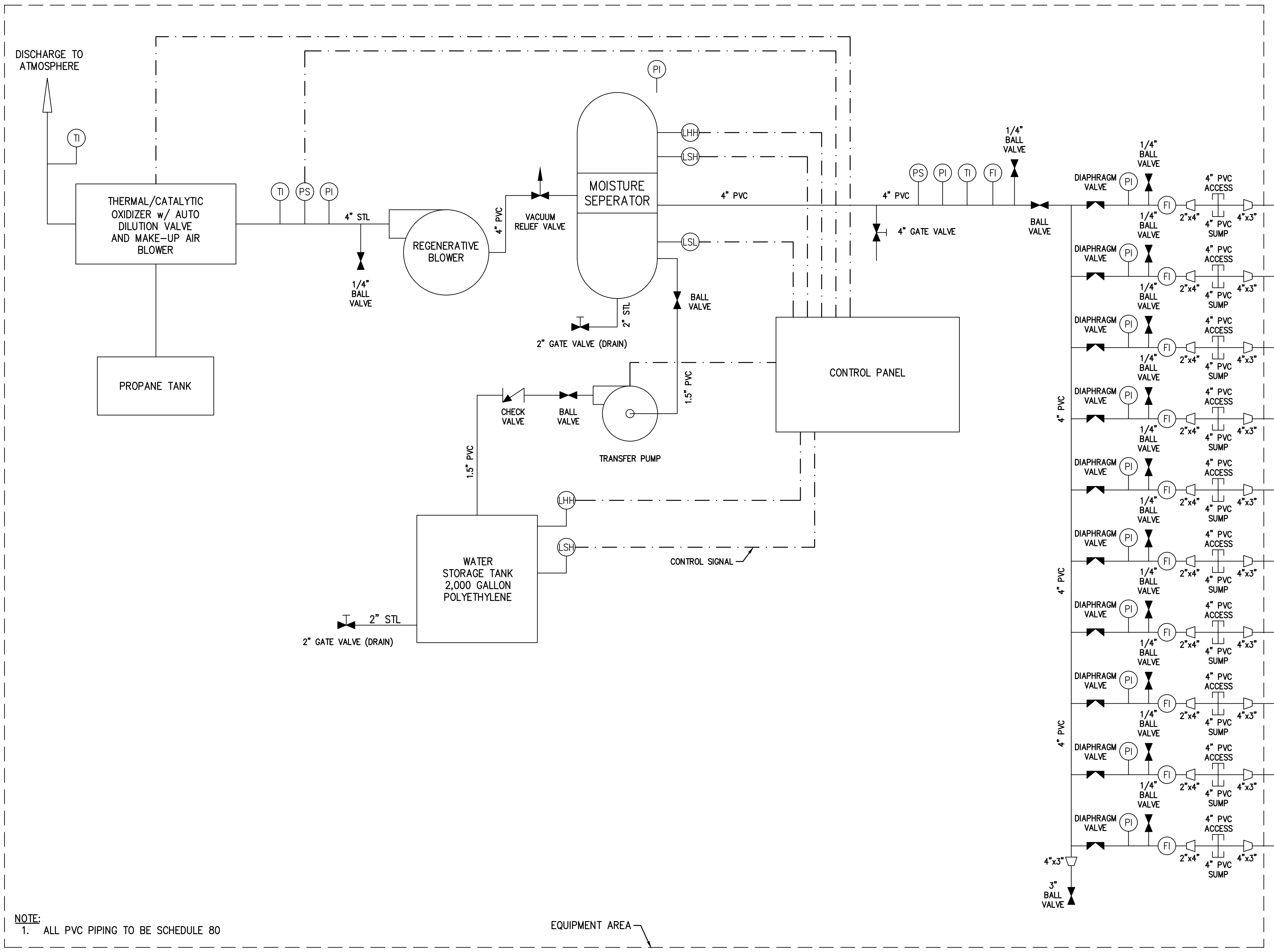
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	11-21-18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

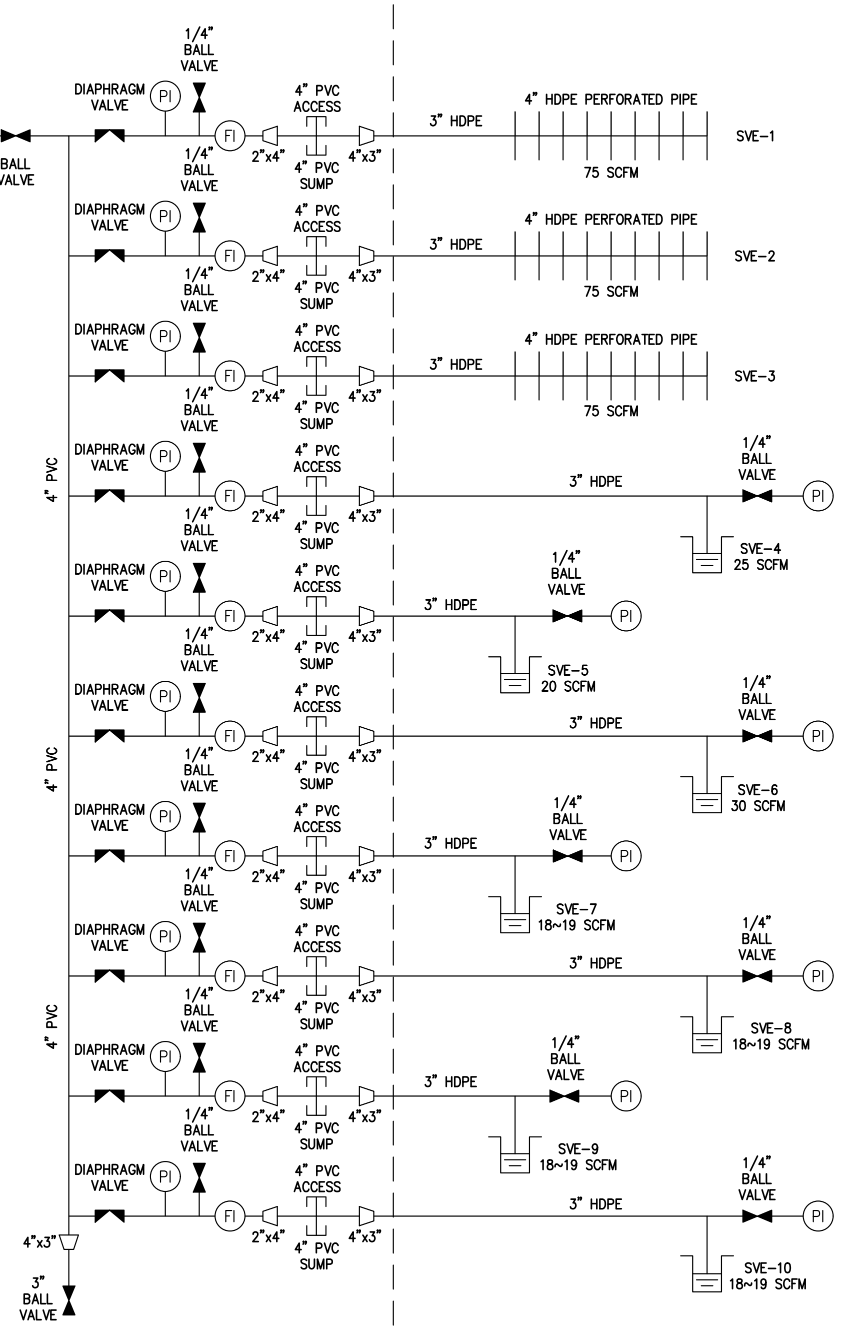
Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: AS/SVE SYSTEM PROFILE - 3 OF 3

POS WORK PROJECT NUMBER WP-U00212
CONSULTANT'S PROJECT NUMBER 9834
POS PROJECT TRACKING NUMBER 30-1801 C5.3

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C005_3; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:51 AM by MWILLIAMS



NOTE:
1. ALL PVC PIPING TO BE SCHEDULE 80



LEGEND

PI	PRESSURE INDICATOR
FI	FLOW INDICATOR
T	TEMPERATURE INDICATOR
PS	PRESSURE SWITCH
TS	TEMPERATURE SWITCH
LSL	LEVEL SWITCH LOW
LSH	LEVEL SWITCH HIGH
LHH	LEVEL SWITCH HIGH-HIGH
AS	AIR SPARGE WELL
SVE	SOIL VAPOR EXTRACTION WELL
LEL	LOWER EXPLOSIVE LIMIT

DIAGRAM

VAPOR EXTRACTION SYSTEM
SCALE: NTS

CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS STATED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

REVISIONS

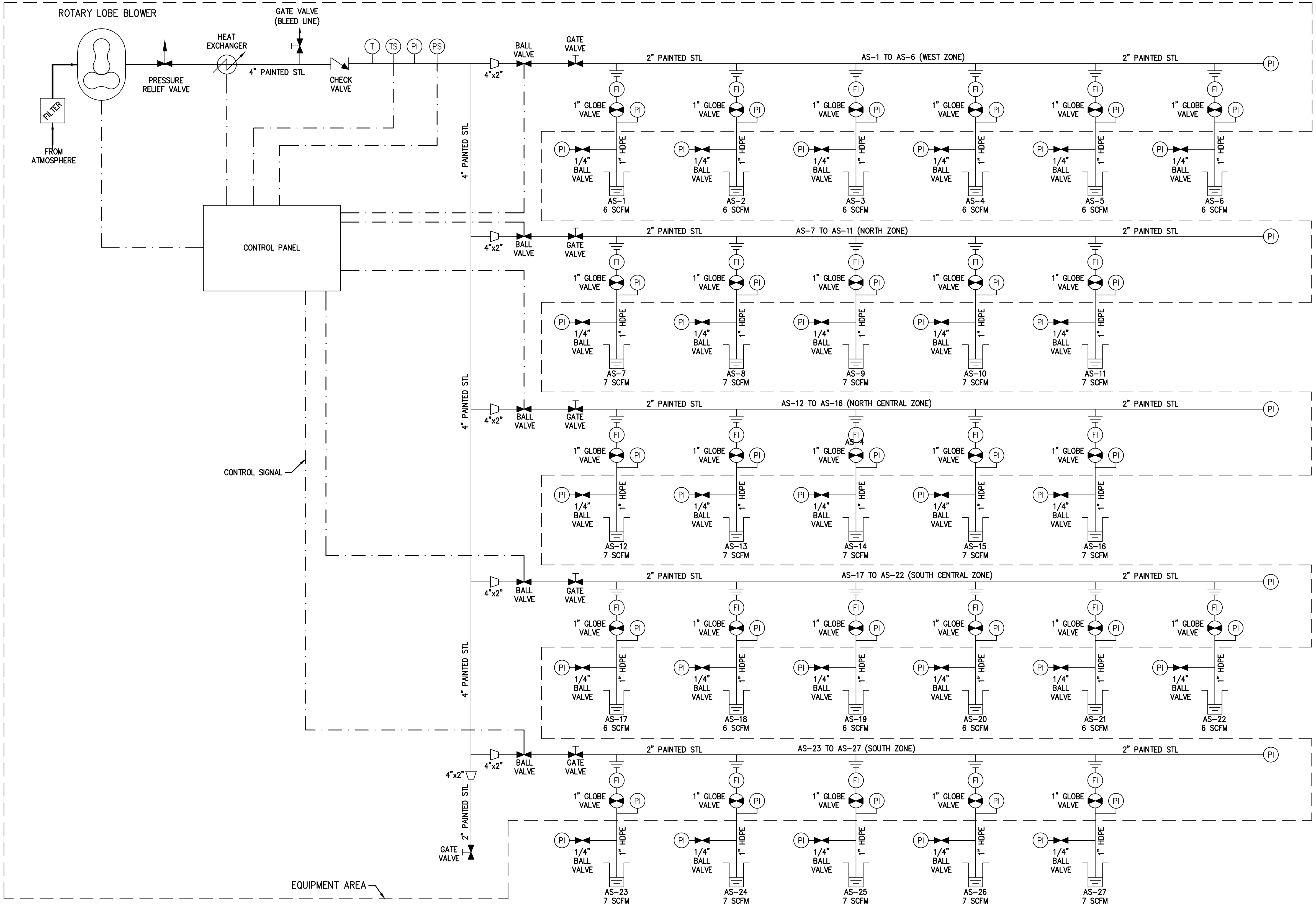
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **AS/SVE P & ID - 1 OF 2**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C6.1

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C006_1; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:30 AM by MWILLIAMS



LEGEND

PI	PRESSURE INDICATOR
FI	FLOW INDICATOR
T	TEMPERATURE INDICATOR
PS	PRESSURE SWITCH
TS	TEMPERATURE SWITCH
LSL	LEVEL SWITCH LOW
LSH	LEVEL SWITCH HIGH
LHH	LEVEL SWITCH HIGH-HIGH
AS	AIR SPARGE WELL
SVE	SOIL VAPOR EXTRACTION WELL
LEL	LOWER EXPLOSIVE LIMIT

CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555

DIAGRAM

AIR SPARGE SYSTEM
SCALE: NTS

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS STATED
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

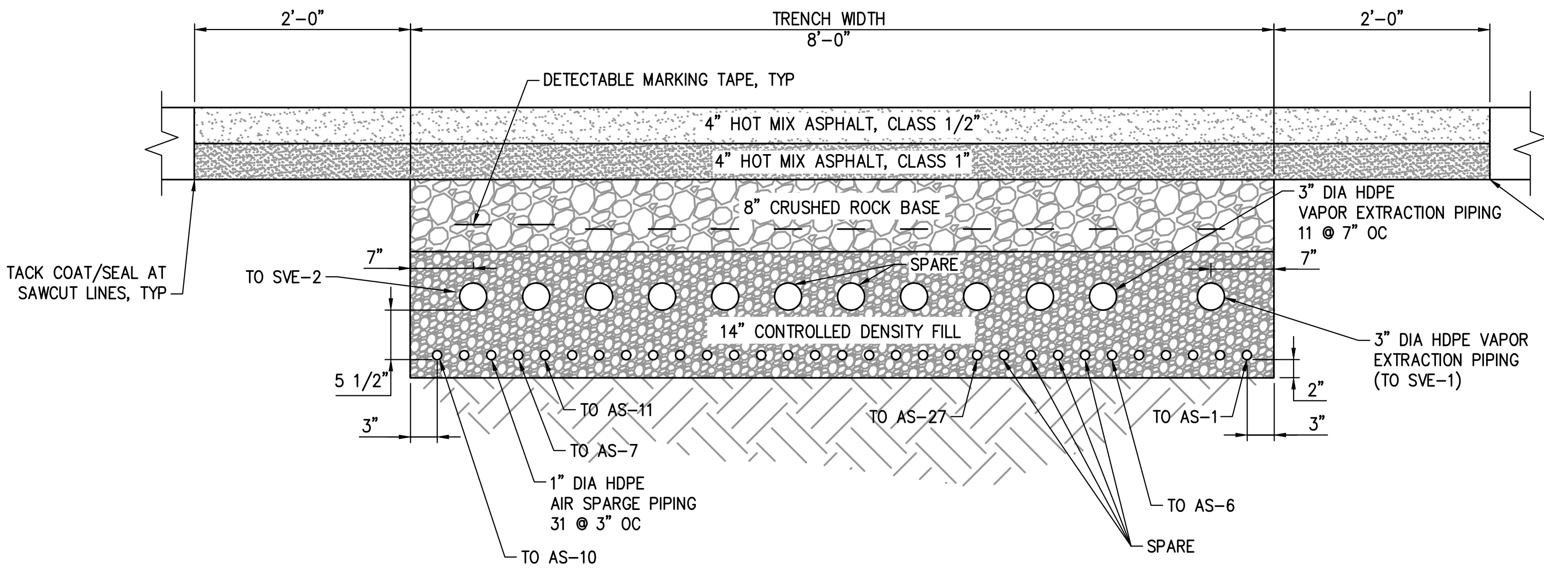
Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: **AS/SVE P & ID - 2 OF 2**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C6.2

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C006_2; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:25 AM by MWILLIAMS



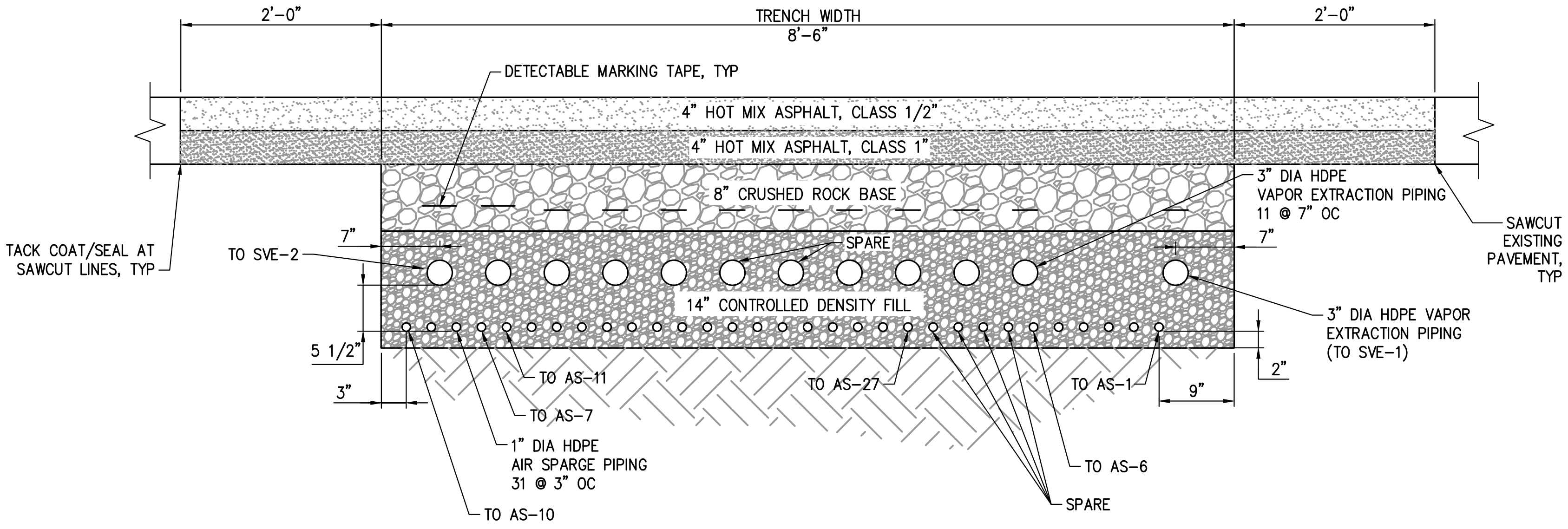
SECTION

1
C4.1

TRENCH
STA 0+00 TO STA 0+73
SCALE: NTS

NOTES

1. PROPOSED PIPE AND TRENCH DEPTHS ARE NOMINAL BASED ON A CONSTANT EXISTING GROUND SURFACE. ACTUAL GROUND SURFACE VARIES.
2. SOLID SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED TO DRAIN DOWNSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS. AS AND PERFORATED SVE PIPING SHALL BE INSTALLED NOMINALLY LEVEL BUT MAY BE SLOPED GRADUALLY UPSTREAM AND/OR DOWNSTREAM TO MINIMIZE UTILITY CONFLICTS.
3. CONTRACTOR TO FIELD MODIFY PIPE DEPTHS AS NECESSARY TO SATISFY THE REQUIREMENTS OF NOTE 2 ABOVE. CONTRACTOR SHALL MAINTAIN PIPE SPACING DURING BACKFILL AS SHOWN ON THE DRAWINGS.
4. TRENCH FOR PERFORATED HDPE PIPING MAY BE SHIFTED HORIZONTALLY WITHIN THE LIMITS OF THE WIDER TRENCH ABOVE.
5. CONTRACTOR SHALL MINIMIZE DISTURBANCE OUTSIDE OF THE TRENCH WIDTH WHEN PASSING BENEATH THE RUBBER TIRED GANTRY PAD CROSSING.
6. FOR TRENCH SECTIONS 2 THROUGH 8, THE NUMBER OF AS/SVE PIPES IN THE TRENCH VARIES OVER THE SECTION STATION RANGE NOTED, DECREASING MOVING AWAY FROM THE EQUIPMENT PAD AT STATION 0+00.
7. AS/SVE TRENCH CONTAINS 2 SPARE 3" SVE PIPES AND 4 SPARE 1" AS PIPES (STA 0+00 TO STA 9+34).
8. PLACE CLASS 1/2" HOT MIX ASPHALT IN TWO 2-INCH LIFTS.
9. PLACE CLASS 1" HOT MIX ASPHALT IN ONE 4-INCH LIFT.



SECTION

2
C4.1

TRENCH
STA 0+73 TO STA 1+00 (SEE NOTE 6)
SCALE: NTS

CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER
35210

REVISIONS

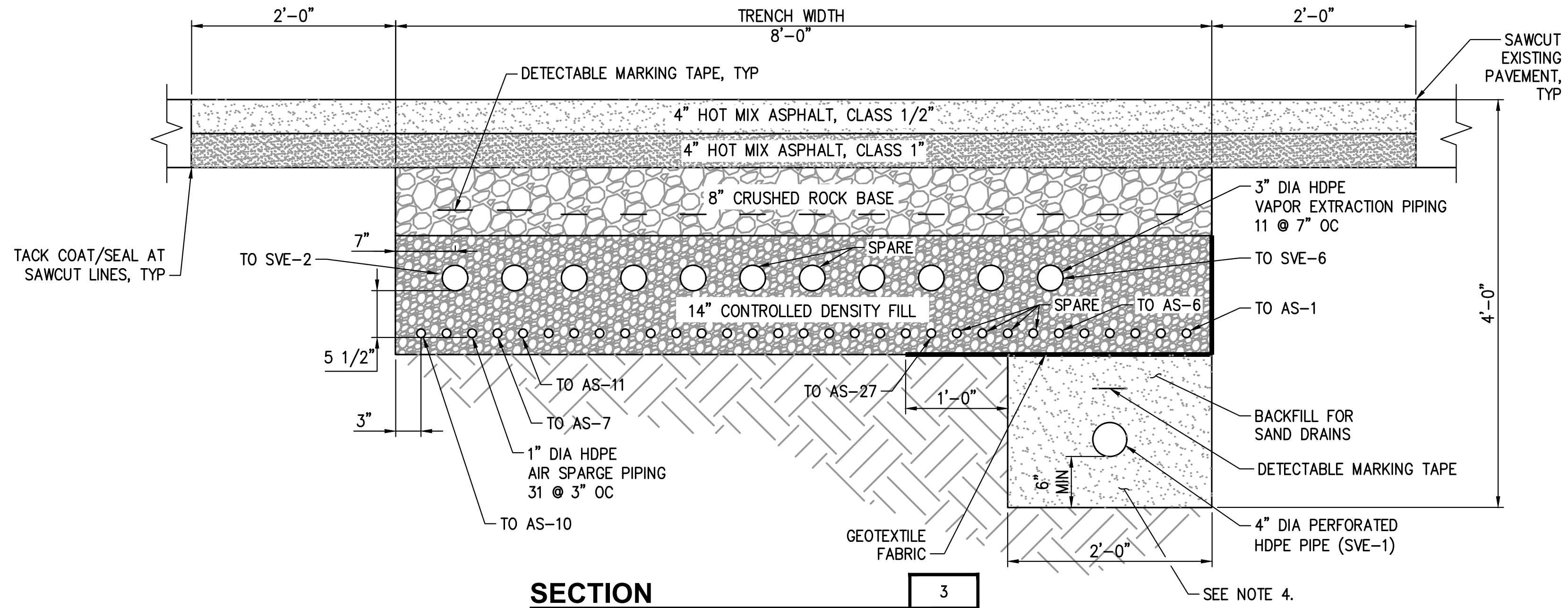
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	CDF	60% DESIGN	ALP	.	.	.	.	.
2	12-6-17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5-12-18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11-21-18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **AS/SVE TRENCH DETAILS - 1 OF 6**

POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C7.1

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C007_1; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:32 AM by MWILLIAMS

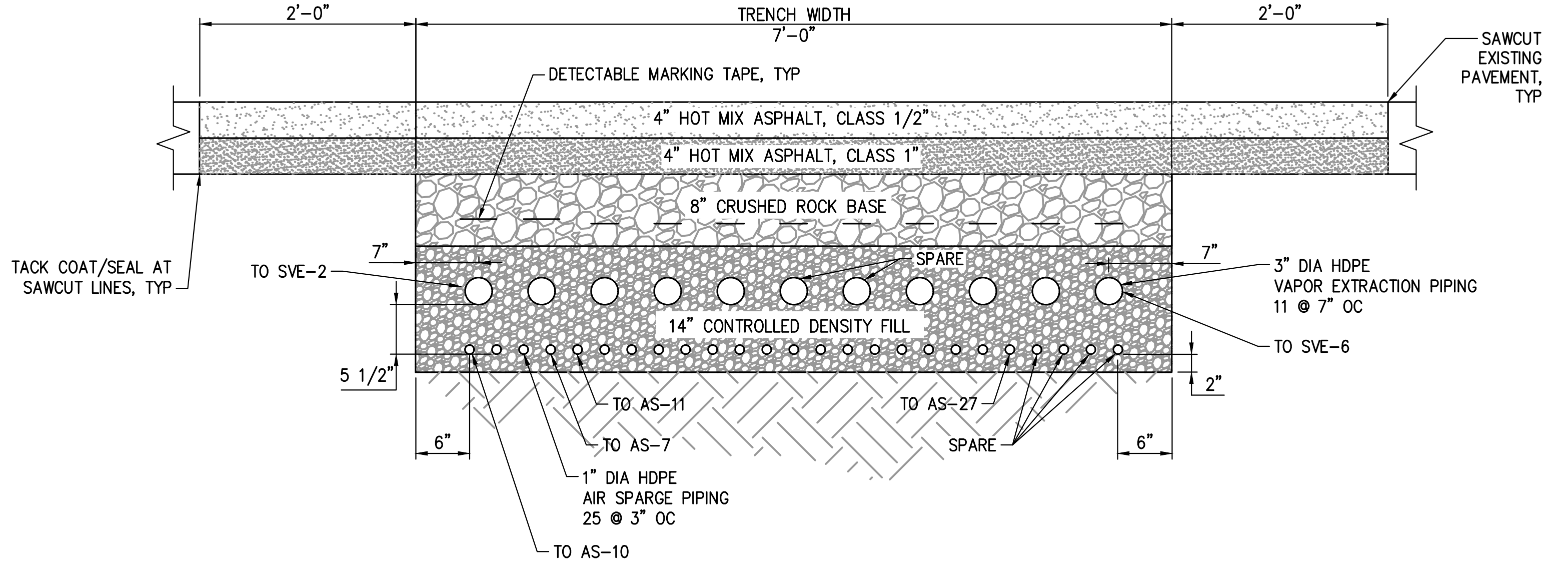


SECTION 3 / C4.1

TRENCH
STA 1+00 TO STA 2+54 (SEE NOTE 6)
SCALE: NTS

NOTES

1. PROPOSED PIPE AND TRENCH DEPTHS ARE NOMINAL BASED ON A CONSTANT EXISTING GROUND SURFACE. ACTUAL GROUND SURFACE VARIES.
2. SOLID SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED TO DRAIN DOWNSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS. AS AND PERFORATED SVE PIPING SHALL BE INSTALLED NOMINALLY LEVEL BUT MAY BE SLOPED GRADUALLY UPSTREAM AND/OR DOWNSTREAM TO MINIMIZE UTILITY CONFLICTS.
3. CONTRACTOR TO FIELD MODIFY PIPE DEPTHS AS NECESSARY TO SATISFY THE REQUIREMENTS OF NOTE 2 ABOVE. CONTRACTOR SHALL MAINTAIN PIPE SPACING DURING BACKFILL AS SHOWN ON THE DRAWINGS.
4. TRENCH FOR PERFORATED HDPE PIPING MAY BE SHIFTED HORIZONTALLY WITHIN THE LIMITS OF THE WIDER TRENCH ABOVE.
5. CONTRACTOR SHALL MINIMIZE DISTURBANCE OUTSIDE OF THE TRENCH WIDTH WHEN PASSING BENEATH THE RUBBER TIRED GANTRY PAD CROSSING.
6. FOR TRENCH SECTIONS 2 THROUGH 8, THE NUMBER OF AS/SVE PIPES IN THE TRENCH VARIES OVER THE SECTION STATION RANGE NOTED, DECREASING MOVING AWAY FROM THE EQUIPMENT PAD AT STATION 0+00.
7. AS/SVE TRENCH CONTAINS 2 SPARE 3" SVE PIPES AND 4 SPARE 1" AS PIPES (STA 0+00 TO STA 9+34).
8. PLACE CLASS 1/2" HOT MIX ASPHALT IN TWO 2-INCH LIFTS.
9. PLACE CLASS 1" HOT MIX ASPHALT IN ONE 4-INCH LIFT.



SECTION 4 / C4.1

TRENCH
STA 2+54 TO STA 4+06 (SEE NOTE 6)
SCALE: NTS

CALL 2 DAYS BEFORE YOU DIG
1-800-424-5555

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C007_2; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:33 AM by MWILLIAMS

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: MPW
SCALE: NONE
DATE: 11-21-18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER 35210

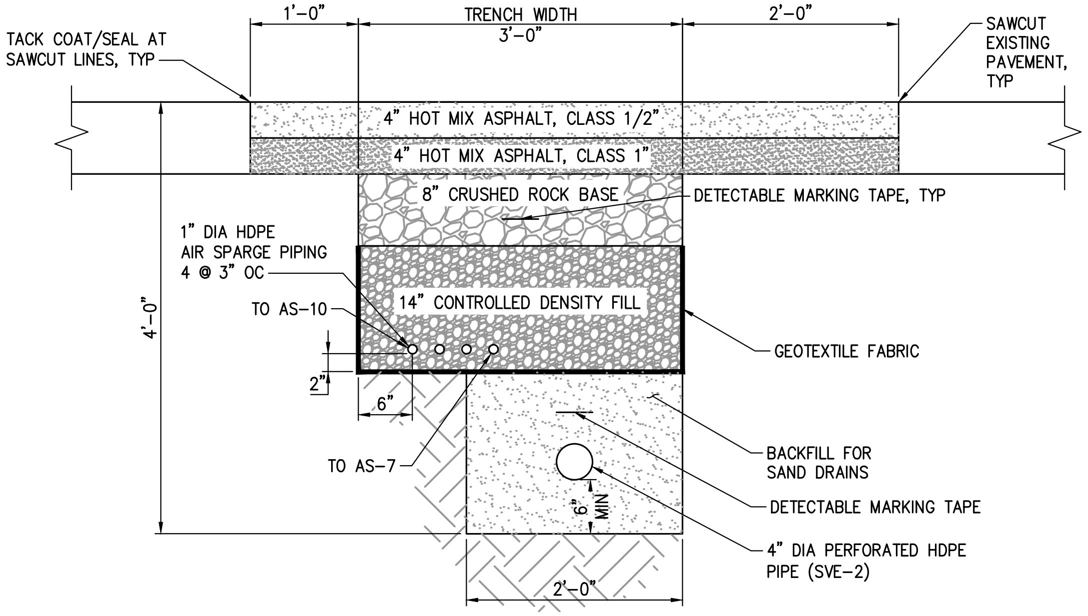
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	CDF	60% DESIGN	ALP	.	.	.	.	.
2	12-6-17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5-12-18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11-21-18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **AS/SVE TRENCH DETAILS - 2 OF 6**

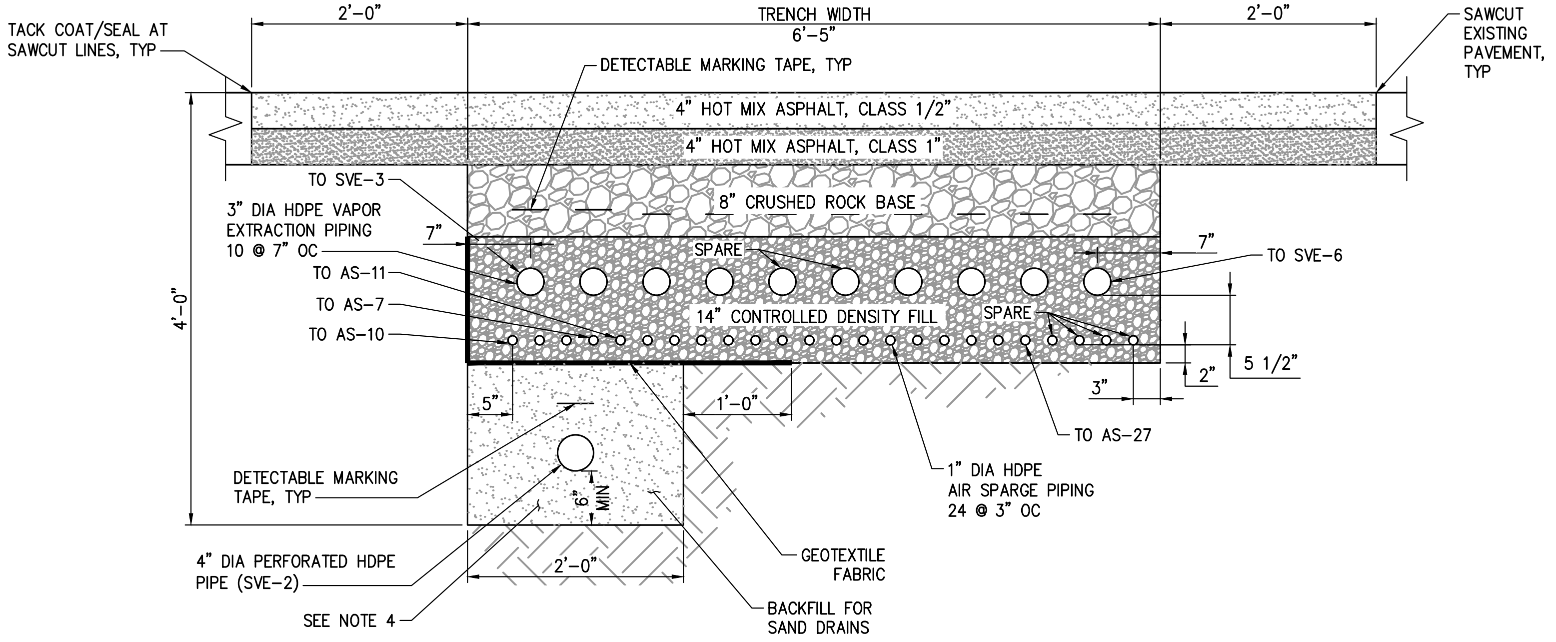
POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C7.2



SECTION

TRENCH
STA 4+06 TO STA 5+13N (SEE NOTE 6)
SCALE: NTS

5
C4.1



SECTION

TRENCH
STA 4+06 TO STA 4+45 (SEE NOTE 6)
SCALE: NTS

6
C4.1

NOTES

1. PROPOSED PIPE AND TRENCH DEPTHS ARE NOMINAL BASED ON A CONSTANT EXISTING GROUND SURFACE. ACTUAL GROUND SURFACE VARIES.
2. SOLID SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED TO DRAIN DOWNSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS. AS AND PERFORATED SVE PIPING SHALL BE INSTALLED NOMINALLY LEVEL BUT MAY BE SLOPED GRADUALLY UPSTREAM AND/OR DOWNSTREAM TO MINIMIZE UTILITY CONFLICTS.
3. CONTRACTOR TO FIELD MODIFY PIPE DEPTHS AS NECESSARY TO SATISFY THE REQUIREMENTS OF NOTE 2 ABOVE. CONTRACTOR SHALL MAINTAIN PIPE SPACING DURING BACKFILL AS SHOWN ON THE DRAWINGS.
4. TRENCH FOR PERFORATED HDPE PIPING MAY BE SHIFTED HORIZONTALLY WITHIN THE LIMITS OF THE WIDER TRENCH ABOVE.
5. THE CONTRACTOR SHALL MINIMIZE DISTURBANCE OUTSIDE OF THE TRENCH WIDTH WHEN PASSING BENEATH THE RUBBER TIRED GANTRY PAD CROSSING.
6. FOR TRENCH SECTIONS 2 THROUGH 8, THE NUMBER OF AS/SVE PIPES IN THE TRENCH VARIES OVER THE SECTION STATION RANGE NOTED, DECREASING MOVING AWAY FROM THE EQUIPMENT PAD AT STATION 0+00.
7. AS/SVE TRENCH CONTAINS 2 SPARE 3" SVE PIPES AND 4 SPARE 1" AS PIPES (STA 0+00 TO STA 9+34)
8. PLACE CLASS 1/2" HOT MIX ASPHALT IN TWO 2-INCH LIFTS.
9. PLACE CLASS 1" HOT MIX ASPHALT IN ONE 4-INCH LIFT.

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

CRETE
CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: MPW
SCALE: NONE
DATE: 11-21-18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER
35210

REVISIONS

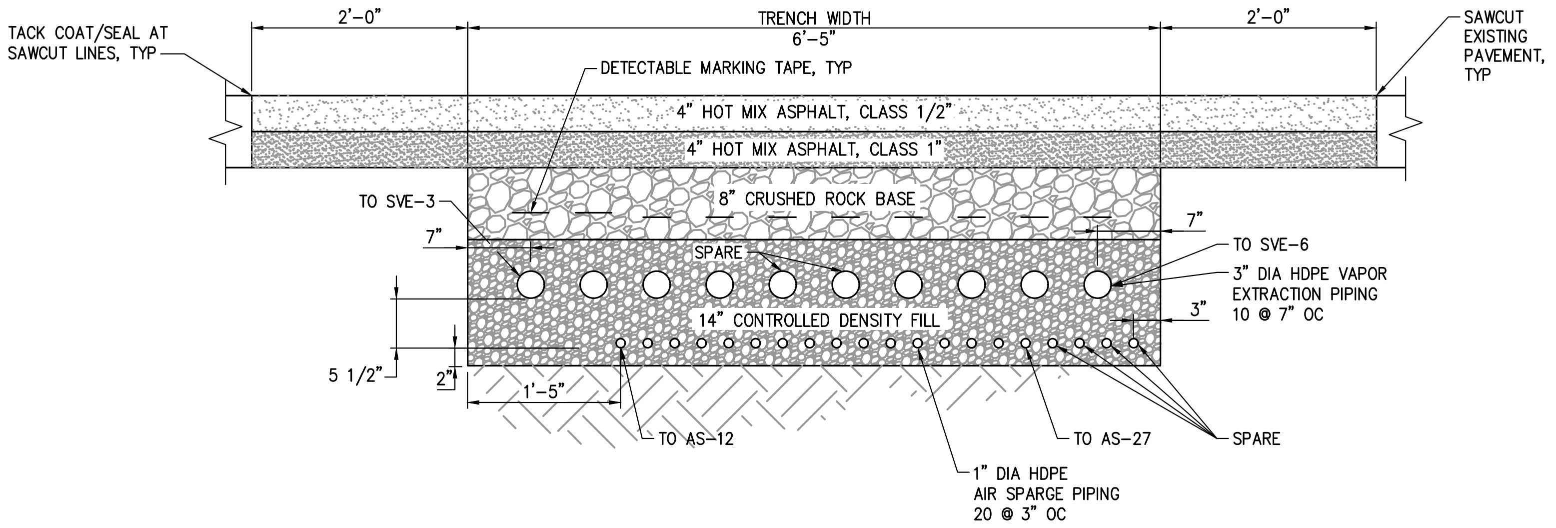
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	CDF	60% DESIGN	ALP	.	.	.	.	.
2	12-6-17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5-12-18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11-21-18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

SEAPORT FACILITIES
PROJECT NAME: **TERMINAL 30
CLEANUP**
SHEET TITLE: **AS/SVE TRENCH DETAILS - 3 OF 6**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C7.3

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C007_3; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:34 AM by MWILLIAMS

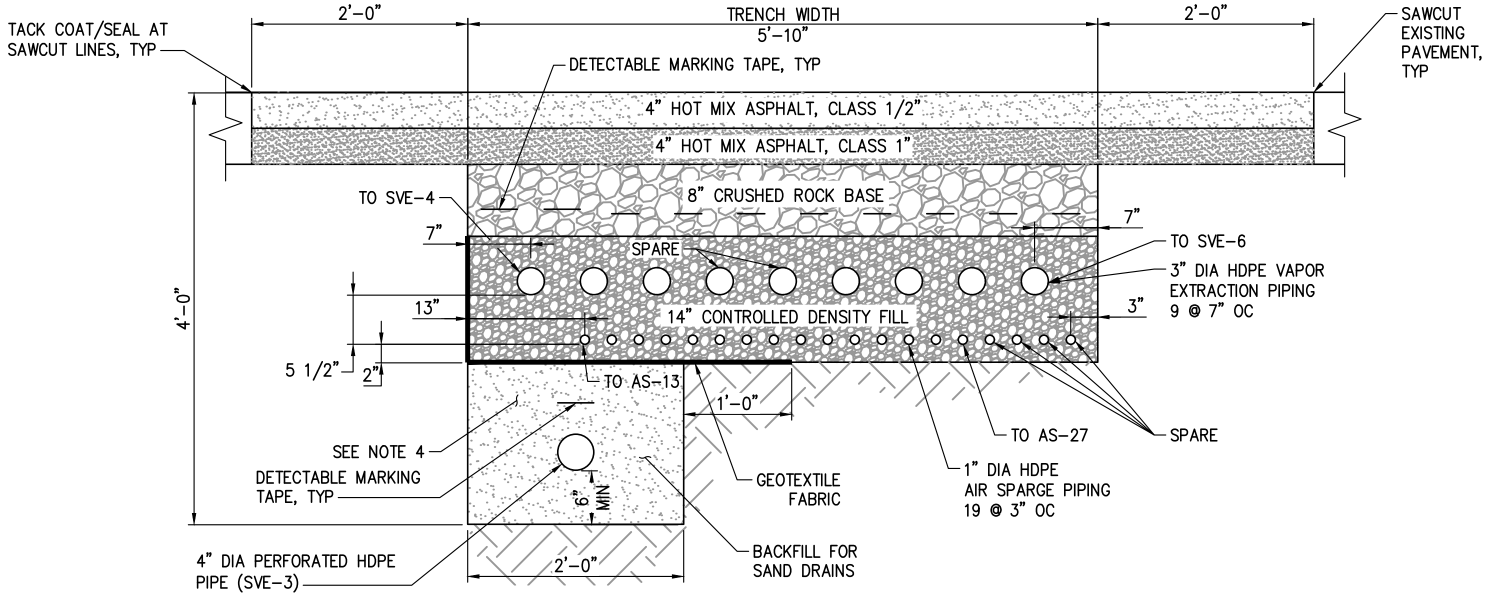


SECTION

7

C4.1

TRENCH
STA 4+45 TO STA 4+85 (SEE NOTE 6)
SCALE: NTS



SECTION

8

C4.1

TRENCH
STA 4+85 TO STA 5+75 (SEE NOTE 6)
SCALE: NTS

NOTES

1. PROPOSED PIPE AND TRENCH DEPTHS ARE NOMINAL BASED ON A CONSTANT EXISTING GROUND SURFACE. ACTUAL GROUND SURFACE VARIES.
2. SOLID SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED TO DRAIN DOWNSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS. AS AND PERFORATED SVE PIPING SHALL BE INSTALLED NOMINALLY LEVEL BUT MAY BE SLOPED GRADUALLY UPSTREAM AND/OR DOWNSTREAM TO MINIMIZE UTILITY CONFLICTS.
3. CONTRACTOR TO FIELD MODIFY PIPE DEPTHS AS NECESSARY TO SATISFY THE REQUIREMENTS OF NOTE 2 ABOVE. CONTRACTOR SHALL MAINTAIN PIPE SPACING DURING BACKFILL AS SHOWN ON THE DRAWINGS.
4. TRENCH FOR PERFORATED HDPE PIPING MAY BE SHIFTED HORIZONTALLY WITHIN THE LIMITS OF THE WIDER TRENCH ABOVE.
5. CONTRACTOR SHALL MINIMIZE DISTURBANCE OUTSIDE OF THE TRENCH WIDTH WHEN PASSING BENEATH THE RUBBER TIRED GANTRY PAD CROSSING.
6. FOR TRENCH SECTIONS 2 THROUGH 8, THE NUMBER OF AS/SVE PIPES IN THE TRENCH VARIES OVER THE SECTION STATION RANGE NOTED, DECREASING MOVING AWAY FROM THE EQUIPMENT PAD AT STATION 0+00.
7. AS/SVE TRENCH CONTAINS 2 SPARE 3" SVE PIPES AND 4 SPARE 1" AS PIPES (STA 0+00 TO STA 9+34).
8. PLACE CLASS 1/2" HOT MIX ASPHALT IN TWO 2-INCH LIFTS.
9. PLACE CLASS 1" HOT MIX ASPHALT IN ONE 4-INCH LIFT.

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C007_4; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:35 AM by MWILLIAMS

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: MPW
SCALE: NONE
DATE: 11-21-18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER
35210

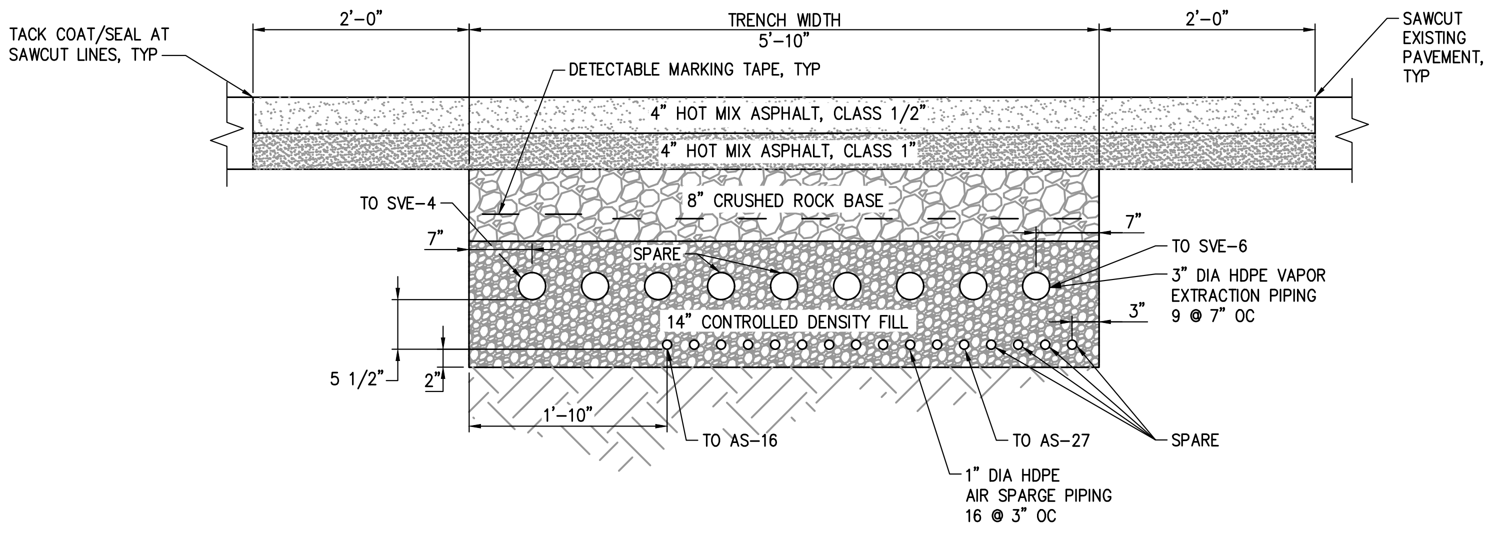
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	CDF	60% DESIGN	ALP	.	.	.	.	.
2	12-6-17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5-12-18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11-21-18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30
CLEANUP
SHEET TITLE: **AS/SVE TRENCH DETAILS - 4 OF 6**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C7.4

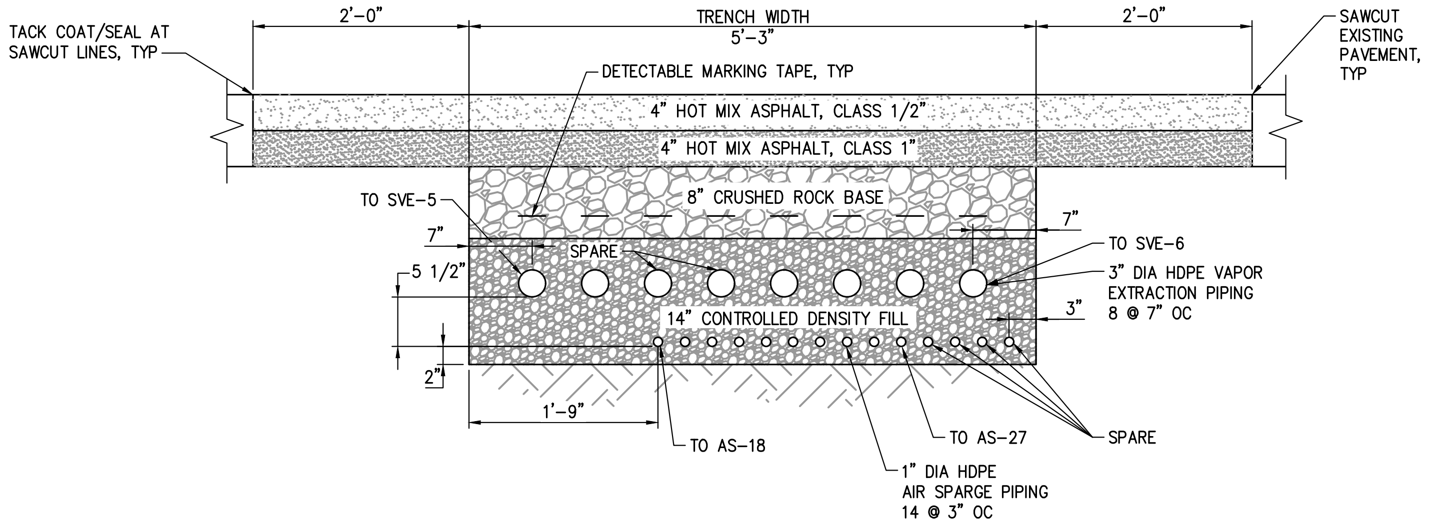


SECTION

9

C4.2

TRENCH
STA 5+75 TO STA 6+28 (SEE NOTE 6)
SCALE: NTS



SECTION

10

C4.2

TRENCH
STA 6+28 TO STA 7+68 (SEE NOTE 6)
SCALE: NTS

NOTES

1. PROPOSED PIPE AND TRENCH DEPTHS ARE NOMINAL BASED ON A CONSTANT EXISTING GROUND SURFACE. ACTUAL GROUND SURFACE VARIES.
2. SOLID SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED TO DRAIN DOWNSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS. AS AND PERFORATED SVE PIPING SHALL BE INSTALLED NOMINALLY LEVEL BUT MAY BE SLOPED GRADUALLY UPSTREAM AND/OR DOWNSTREAM TO MINIMIZE UTILITY CONFLICTS.
3. CONTRACTOR TO FIELD MODIFY PIPE DEPTHS AS NECESSARY TO SATISFY THE REQUIREMENTS OF NOTE 2 ABOVE. CONTRACTOR SHALL MAINTAIN PIPE SPACING DURING BACKFILL AS SHOWN ON THE DRAWINGS.
4. TRENCH FOR PERFORATED HDPE PIPING MAY BE SHIFTED HORIZONTALLY WITHIN THE LIMITS OF THE WIDER TRENCH ABOVE.
5. CONTRACTOR SHALL MINIMIZE DISTURBANCE OUTSIDE OF THE TRENCH WIDTH WHEN PASSING BENEATH THE RUBBER TIRED GANTRY PAD CROSSING.
6. FOR TRENCH SECTIONS 2 THROUGH 8, THE NUMBER OF AS/SVE PIPES IN THE TRENCH VARIES OVER THE SECTION STATION RANGE NOTED, DECREASING MOVING AWAY FROM THE EQUIPMENT PAD AT STATION 0+00.
7. AS/SVE TRENCH CONTAINS 2 SPARE 3" SVE PIPES AND 4 SPARE 1" AS PIPES (STA 0+00 TO STA 9+34).
8. PLACE CLASS 1/2" HOT MIX ASPHALT IN TWO 2–INCH LIFTS.
9. PLACE CLASS 1" HOT MIX ASPHALT IN ONE 4–INCH LIFT.

**CALL 2 DAYS
BEFORE YOU DIG
1–800–424–5555**

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: CJG
SCALE: NONE
DATE: 11–21–18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER 35210

REVISIONS

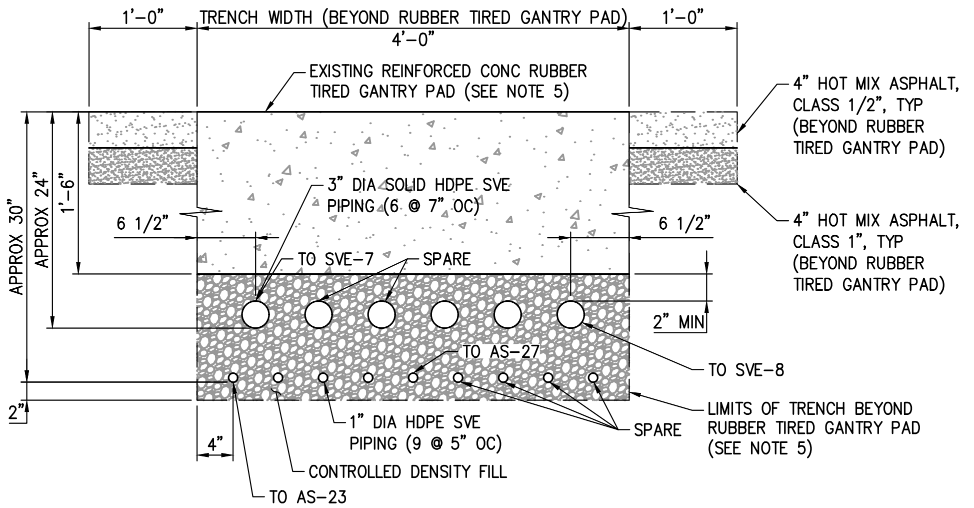
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8–24–17	CDF	60% DESIGN	ALP	.	.	.	.	.
2	12–6–17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5–12–18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11–21–18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30
CLEANUP
SHEET TITLE: **AS/SVE TRENCH DETAILS - 5 OF 6**

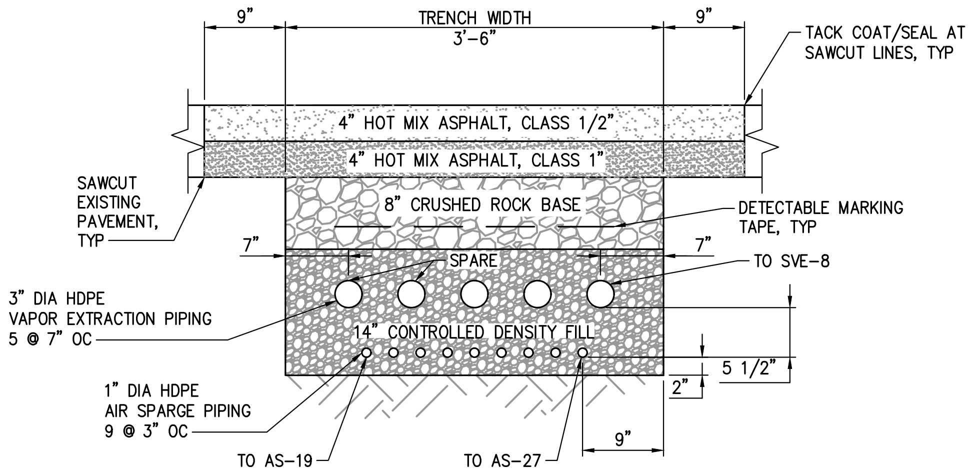
POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C7.5

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C007_5; Plotted: 11/21/2018 11:34 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:39 AM by MWILLIAMS



SECTION 11 C4.2

RUBBER TIRED
GANTRY PAD CROSSING
STA 7+68 TO STA 8+02 (SEE NOTE 6)
SCALE: NTS

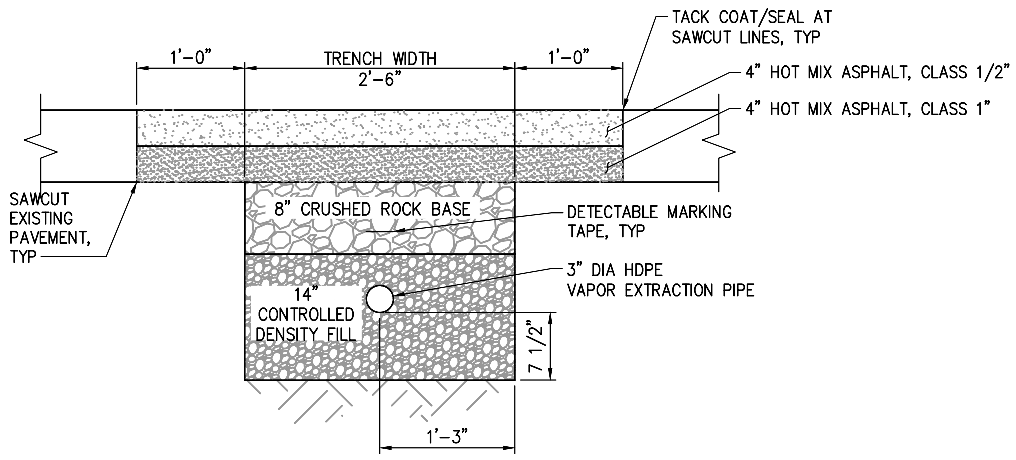


SECTION 12 C4.2

TRENCH
STA 8+02 TO STA 9+34 (SEE NOTE 6)
SCALE: NTS

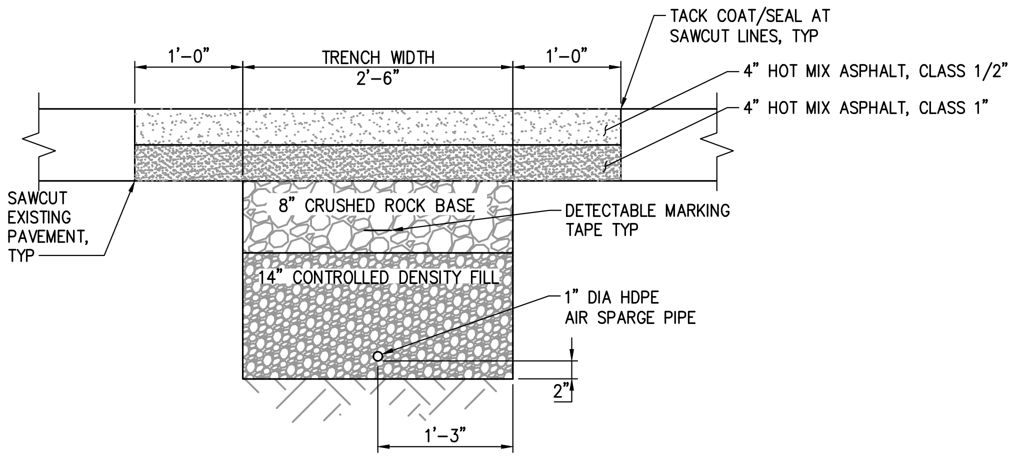
NOTES

1. PROPOSED PIPE AND TRENCH DEPTHS ARE NOMINAL BASED ON A CONSTANT EXISTING GROUND SURFACE. ACTUAL GROUND SURFACE VARIES.
2. SOLID SOIL VAPOR EXTRACTION PIPING SHALL BE INSTALLED LEVEL OR SLOPED TO DRAIN DOWNSTREAM AS NECESSARY TO CLEAR RUBBER TIRED GANTRY PAD AND MINIMIZE UTILITY CONFLICTS. AS AND PERFORATED SVE PIPING SHALL BE INSTALLED NOMINALLY LEVEL BUT MAY BE SLOPED GRADUALLY UPSTREAM AND/OR DOWNSTREAM TO MINIMIZE UTILITY CONFLICTS.
3. CONTRACTOR TO FIELD MODIFY PIPE DEPTHS AS NECESSARY TO SATISFY THE REQUIREMENTS OF NOTE 2 ABOVE. CONTRACTOR SHALL MAINTAIN PIPE SPACING DURING BACKFILL AS SHOWN ON THE DRAWINGS.
4. TRENCH FOR PERFORATED HDPE PIPING MAY BE SHIFTED HORIZONTALLY WITHIN THE LIMITS OF THE WIDER TRENCH ABOVE.
5. CONTRACTOR SHALL MINIMIZE DISTURBANCE OUTSIDE OF THE TRENCH WIDTH WHEN PASSING BENEATH THE RUBBER TIRED GANTRY PAD CROSSING.
6. FOR TRENCH SECTIONS 2 THROUGH 8, THE NUMBER OF AS/SVE PIPES IN THE TRENCH VARIES OVER THE SECTION STATION RANGE NOTED, DECREASING MOVING AWAY FROM THE EQUIPMENT PAD AT STATION 0+00.
7. AS/SVE TRENCH CONTAINS 2 SPARE 3" SVE PIPES AND 4 SPARE 1" AS PIPES (STA 0+00 TO STA 9+34).
8. PLACE CLASS 1/2" HOT MIX ASPHALT IN TWO 2–INCH LIFTS.
9. PLACE CLASS 1" HOT MIX ASPHALT IN ONE 4–INCH LIFT.



DETAIL 13 C1.1 13 C1.2 13 C4.1 13 C4.2

SVE WELLHEAD TRENCH
SCALE: NTS



DETAIL 14 C1.1 14 C1.2 14 C4.1 14 C4.2

AS WELLHEAD TRENCH
SCALE: NTS

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

CRETE CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: CDF
DRAWN BY: CJG
SCALE: NONE
DATE: 11–21–18
CHECKED BY: ALP
CHECKED/APPROVED BY: CDF

COLLEEN D. FISCHER 35210

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8–24–17	CDF	60% DESIGN	ALP	.	.	.	.	.
2	12–6–17	CDF	90% DESIGN	ALP	.	.	.	.	.
3	5–12–18	CDF	100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
4	11–21–18	CDF	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	ALP	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

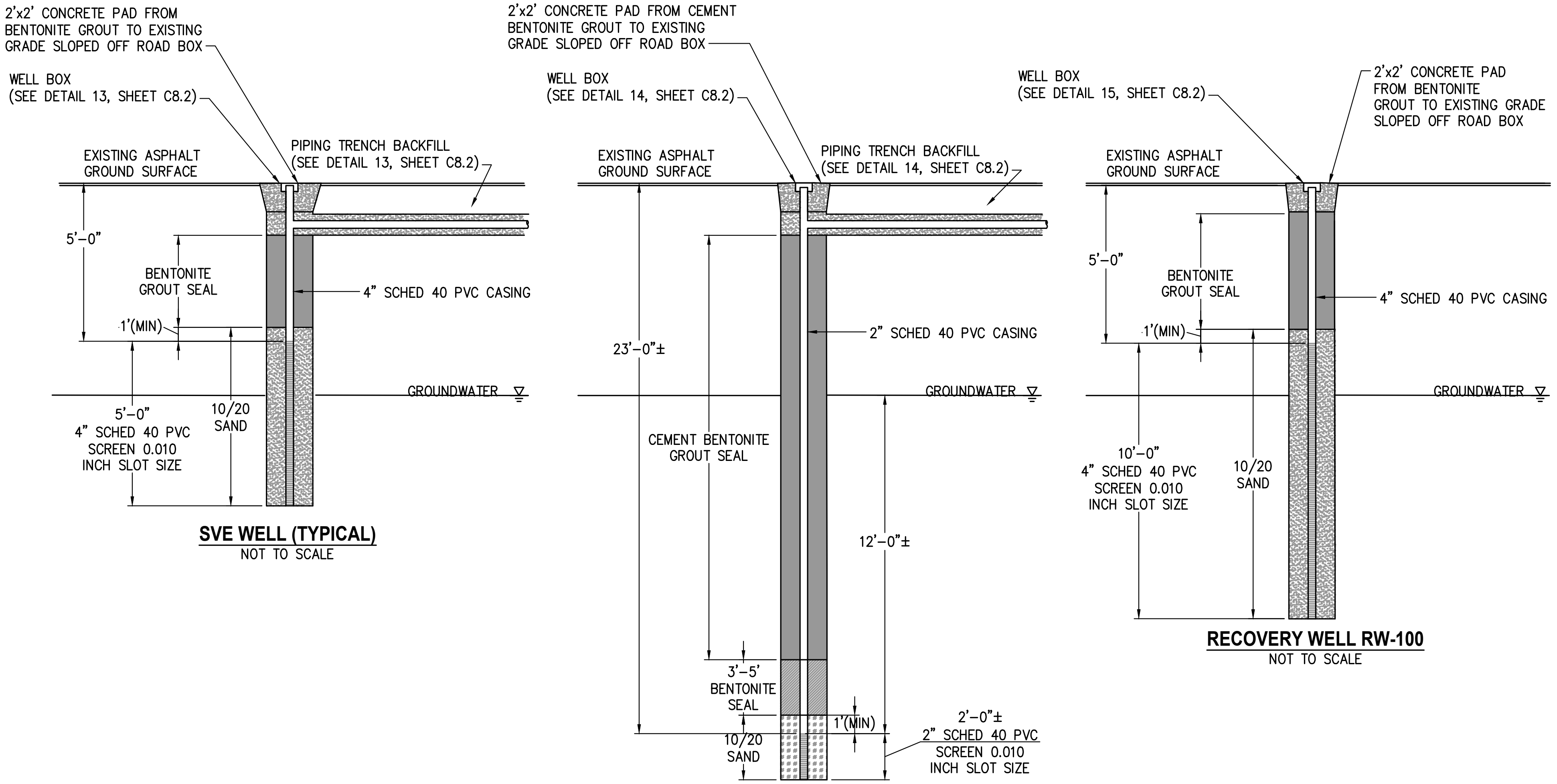
Port of Seattle SEAPORT FACILITIES

PROJECT NAME: **TERMINAL 30 CLEANUP**

SHEET TITLE: **AS/SVE TRENCH DETAILS - 6 OF 6**

POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C7.6

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C007_6; Plotted: 11/21/2018 11:35 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:39 AM by MWILLIAMS

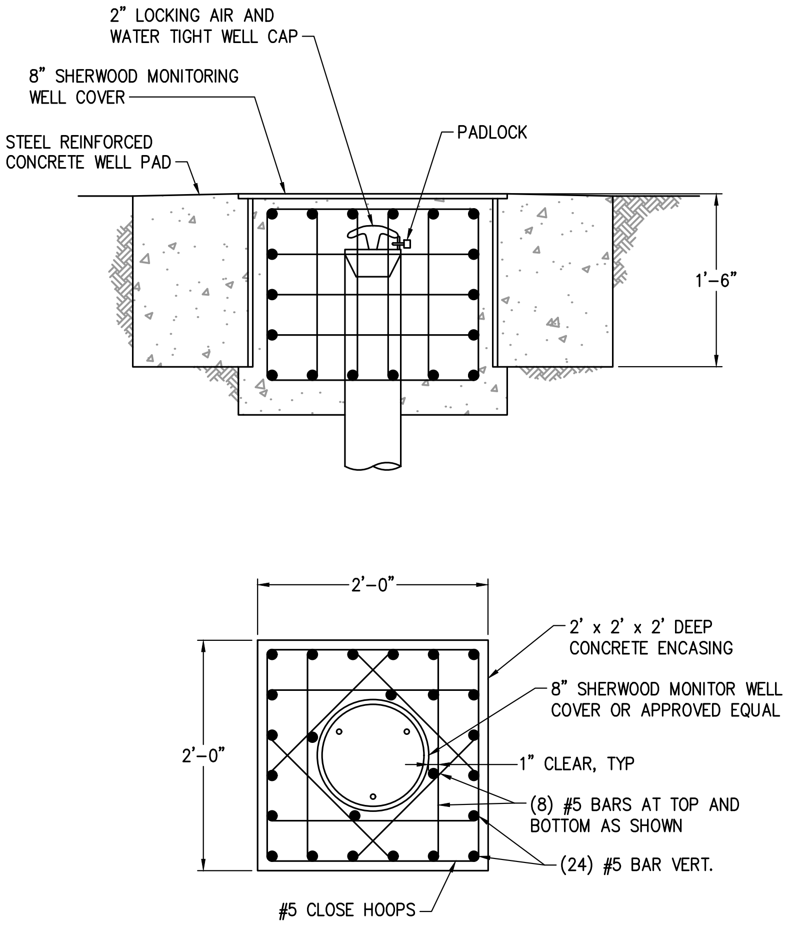


SVE WELL (TYPICAL)
NOT TO SCALE

AS-1
NOT TO SCALE

RECOVERY WELL RW-100
NOT TO SCALE

DETAIL 11 C4.1 11 C4.2
GENERAL WELL CONSTRUCTION
SCALE: NTS



DETAIL – –
PORT WELLHEAD
SCALE: NTS

CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

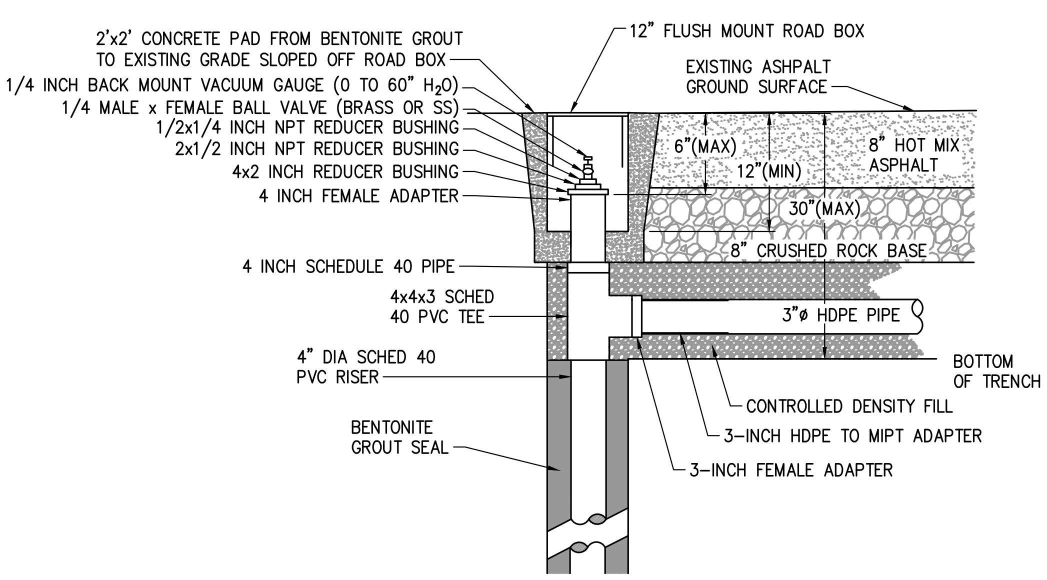
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

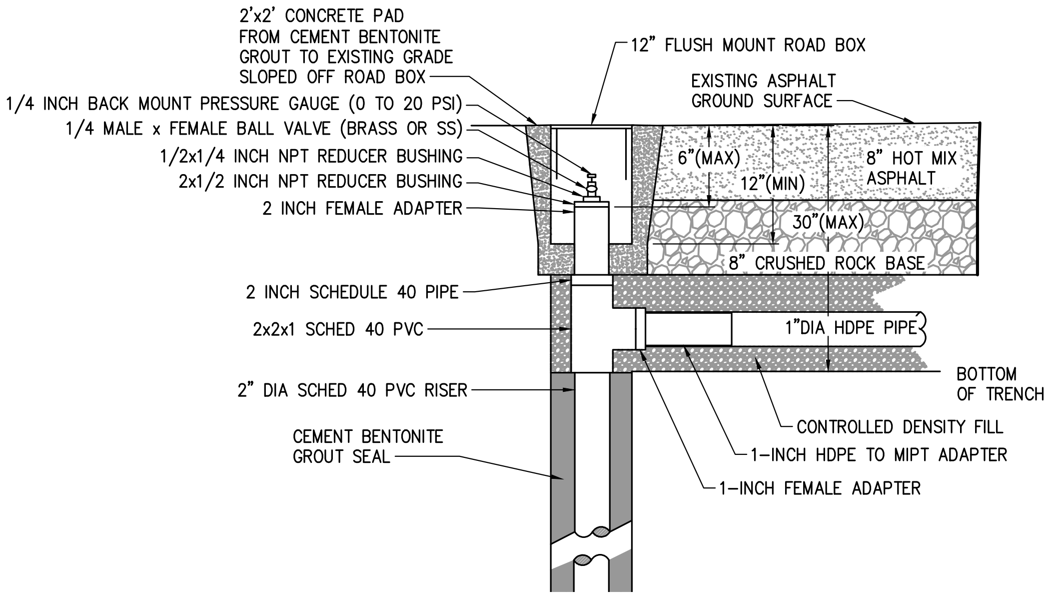
SEAPORT FACILITIES
PROJECT NAME: **TERMINAL 30 CLEANUP**
SHEET TITLE: **AS/SVE SYSTEM & RECOVERY WELL DETAILS - 1 OF 4**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C8.1



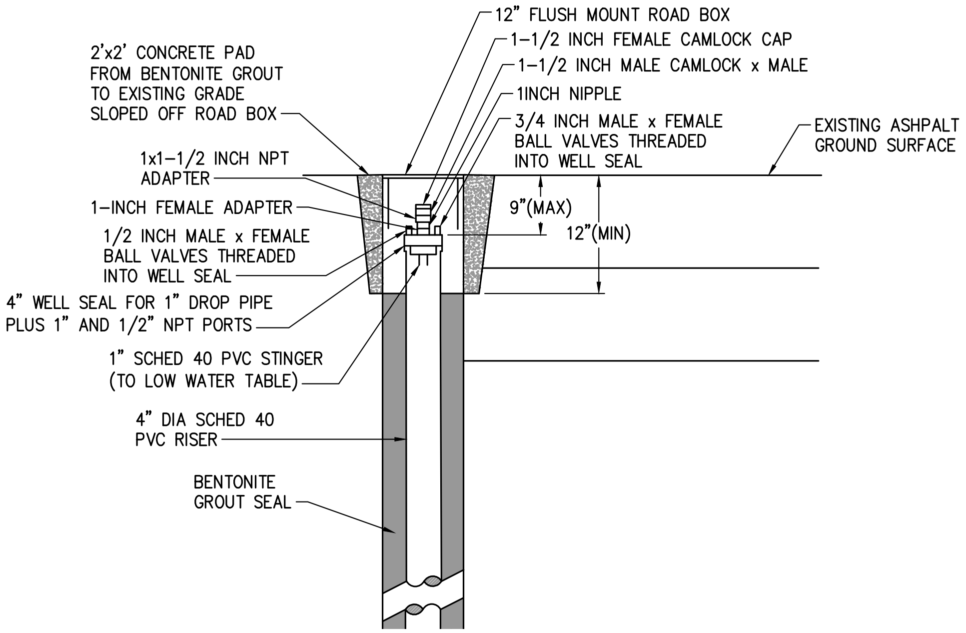
DETAIL 13 / C4.1 13 / C4.2

SVE WELLHEAD (TYPICAL)
SCALE: NTS



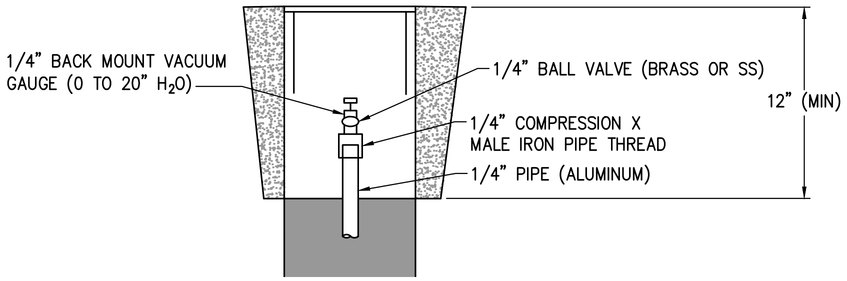
DETAIL 14 / C4.1 14 / C4.2

AS WELLHEAD (TYPICAL)
SCALE: NTS



DETAIL 15 / C4.1 15 / C4.2

RECOVERY WELLHEAD (TYPICAL)
SCALE: NTS



DETAIL 16 / C4.1 16 / C4.2

VAPOR MONITORING WELL HEAD (TYPICAL)
SCALE: NTS

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

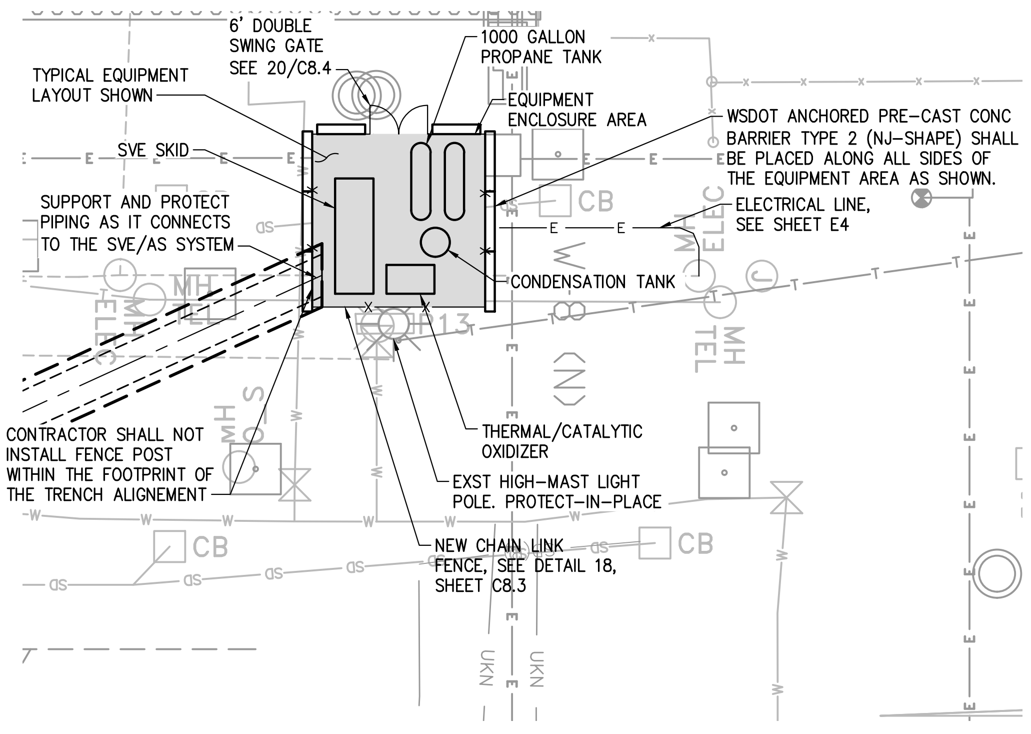
Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

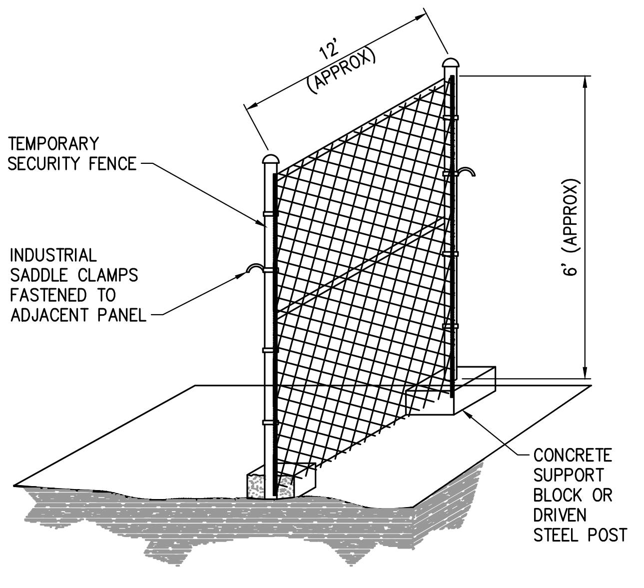
SHEET TITLE: **AS/SVE SYSTEM & RECOVERY WELL DETAILS - 2 OF 4**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C8.2

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C008_2; Plotted: 11/21/2018 11:35 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:43 AM by MWILLIAMS



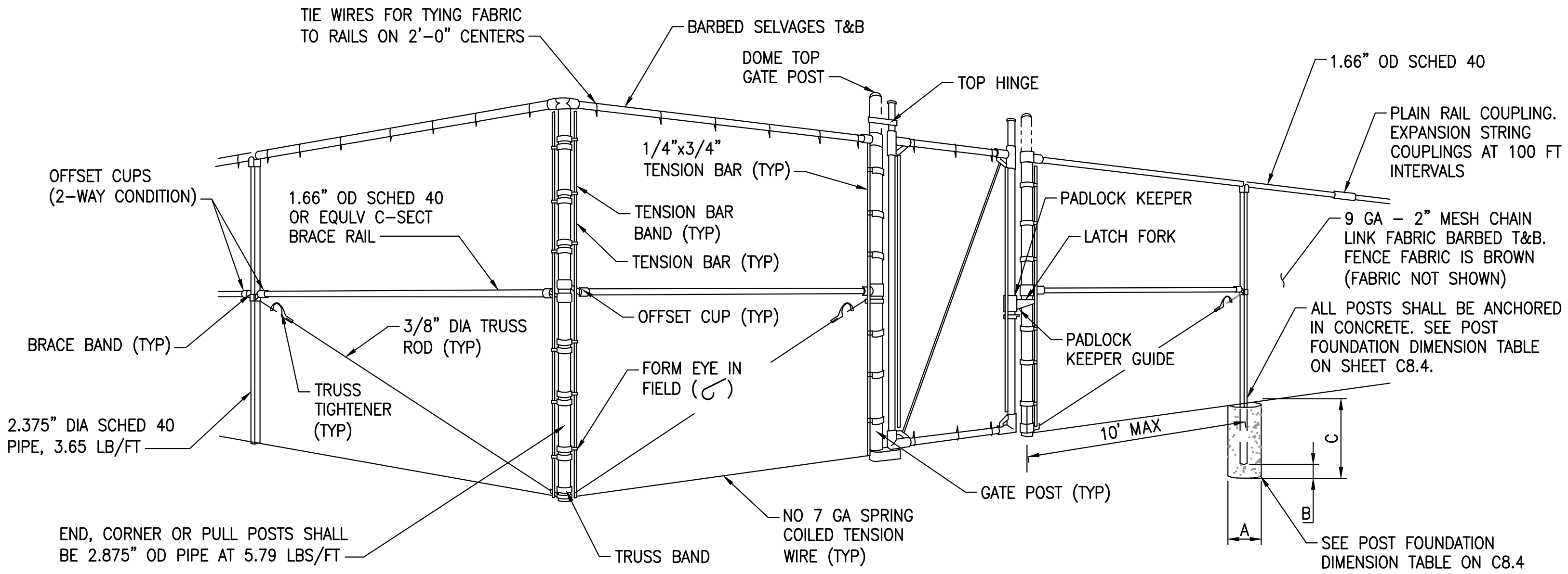
PLAN
EQUIPMENT ENCLOSURE AREA LAYOUT
SCALE: 1"=20'



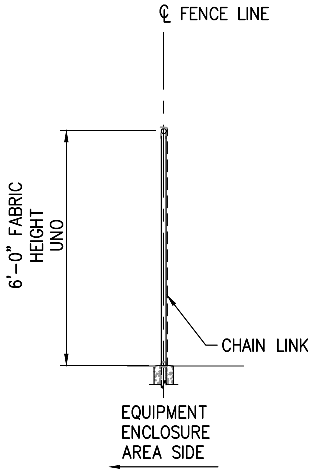
DETAIL
TEMPORARY SECURITY FENCE
SCALE: NTS
17 C2.1 17 C2.2

NOTES

1. ALL FENCE AND GATE FABRIC, FRAMEWORK, FITTINGS, AND TIES SHALL BE GALVANIZED AND PVC COATED, COLOR BLACK, SEE SPECIFICATIONS.
2. BOTTOM OF FABRIC SHALL BE NO MORE THAN 2" ABOVE FINISH GRADE.
3. SEE SITE PLAN FOR FENCING LOCATION.



DETAIL
TYPICAL FENCE & GATE CONFIGURATION
SCALE: NTS
18 C8.3



DETAIL
TYPICAL FENCE
SCALE: NTS
19 C8.3

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

REVISIONS

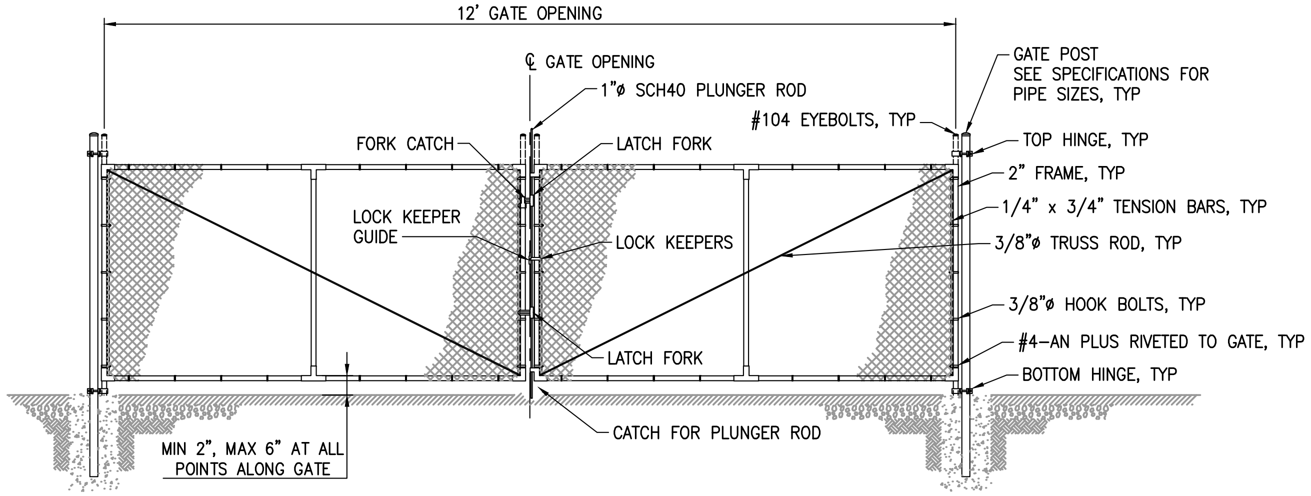
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

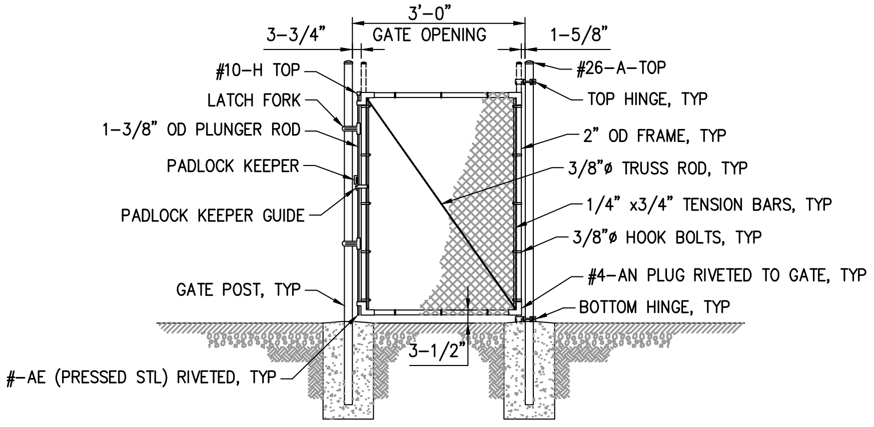
Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **AS/SVE SYSTEM & RECOVERY WELL DETAILS - 3 OF 4**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 C8.3

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C008_3; Plotted: 11/21/2018 11:35 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:44 AM by MWILLIAMS



DETAIL
DOUBLE SWING GATE
SCALE: NTS
20
C8.4



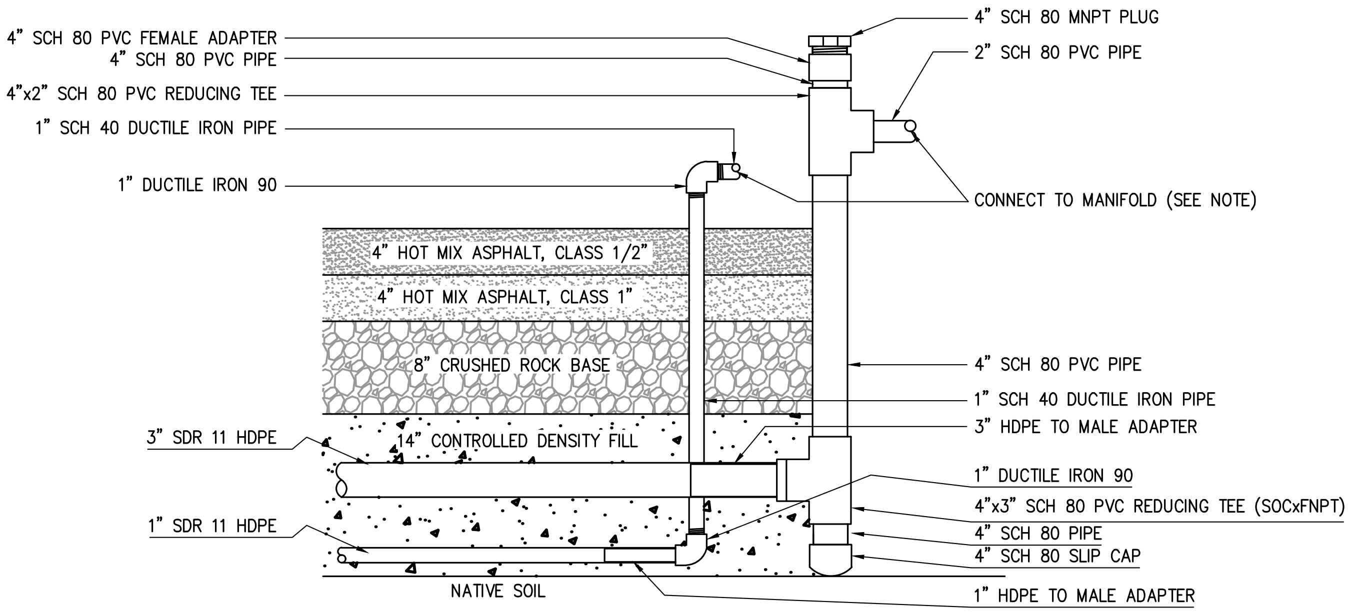
DETAIL
SINGLE SWING GATE
SCALE: NTS
21
C8.4

NOTES

1. ALL FENCE AND GATE FABRIC, FRAMEWORK, FITTINGS, AND TIES SHALL BE GALVANIZED AND PVC COATED, COLOR BLACK, SEE SPECS.
2. BOTTOM OF FABRIC SHALL BE NO MORE THAN 2" ABOVE FINISH GRADE.
3. SEE SITE PLAN FOR FENCING LOCATION.

POST FOUNDATION DIMENSIONS AND REINFORCEMENT

LOCATION	A	B	C	STEEL REINF AND NOTES
FENCE & PERSONNEL GATE POSTS				
LINE	0'-10"	0'-6"	3'-0"	NONE
CORNER	1'-0"	0'-6"	3'-6"	NONE
END	1'-0"	0'-6"	3'-6"	NONE
GATE	1'-6"	0'-6"	4'-6"	NONE



DETAIL
TRENCH PIPING DAYLIGHT (TYPICAL)
SCALE: NTS
22
C4.1

NOTE:
CONTRACTOR SHALL CONNECT RISER PIPES TO EQUIPMENT SKID MANIFOLD USING HOSE OR PIPE THAT ARE DESIGNED FOR THE APPROPRIATE APPLICATION (E.G. COMPRESSED AIR SERVICE), AS APPROVED BY ENGINEER.

**CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555**

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: NONE
DATE: 11-21-18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS
30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
4	11-21-18	JCS	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: AS/SVE SYSTEM & RECOVERY WELL DETAILS - 4 OF 4

POS WORK PROJECT NUMBER: WP-U00212
CONSULTANT'S PROJECT NUMBER: 9834
POS PROJECT TRACKING NUMBER: 30-1801 C8.4

ABBREVIATIONS

AF	AMPERE FRAME
AIC	AMPERES INTERRUPTING CAPACITY
AMP	AMP, AMPERE
AS	AMPERE SWITCH
AWG	AMERICAN WIRE GAUGE
CLR	CLEAR
CND	CONDUIT
CONT	CONTINUOUS
DIA	DIAMETER
EQPT	EQUIPMENT
ETC	ET CETERA
EXST	EXISTING
GND	GROUND
HH	HAND HOLE
HPWR	HORSE POWER
KAIC	KILO AMPERE INTERRUPTING CAPACITY
KVA	KILOVOLT AMPERE
LV	LOW VOLTAGE
MCP	MOTOR CIRCUIT PROTECTOR
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NTS	NOT TO SCALE
0,PH	PHASE
PEC	PHOTOELECTRIC CELL
SST	STAINLESS STEEL
SYM	SYMMETRICAL
THHN	HEAT-RESISTANT THERMOPLASTIC
THWN	MOISTURE-AND-HEAT RESISTANT THERMOPLASTIC
TYP	TYPICAL
UL	UNDERWRITERS LABORATORIES
VOL	VOLT
W	WATT
XFMR	TRANSFORMER
±	APPROXIMATELY
'	FOOT
"	INCH
&	AND
#	NUMBER

GENERAL NOTES

1. ALL WORK SHALL COMPLY WITH THE LATEST APPROVED EDITION OF THE NATIONAL ELECTRICAL CODE (NEC) AS ADOPTED BY THE GOVERNING AGENCY, AND ALL OTHER APPLICABLE FEDERAL STATE AND LOCAL CODES. WHERE THE PLANS SHOW MORE RESTRICTIVE REQUIREMENTS, THE PLANS SHALL GOVERN. NOTHING ON THESE PLANS SHALL BE INTERPRETED AS AUTHORITY TO VIOLATE ANY CODE OR REGULATION.

2. IN THE EVENT OF A CONFLICT OR INCONSISTENCY BETWEEN ITEMS INDICATED ON THE PLANS AND/OR SPECIFICATIONS OR WITH CODE REQUIREMENTS, THE NOTE, SPECIFICATION OR CODE WHICH PRESCRIBES AND ESTABLISHES THE MORE COMPLETE JOB OR THE HIGHER STANDARD SHALL PREVAIL.

3. ALL CIRCUIT BREAKERS, FUSES AND ELECTRICAL EQUIPMENT SHALL HAVE AN INTERRUPTING RATING NOT LESS THAN THE MAXIMUM SHORT CIRCUIT CURRENT TO WHICH THEY MAY BE SUBJECTED.

4. ALL MATERIALS AND EQUIPMENT SHALL BE NEW AND SHALL BEAR THE UNDERWRITERS LABEL (UL) AND SHALL BE INSTALLED IN THE MANNER FOR WHICH IT IS DESIGNED AND APPROVED.

5. ALL FEEDER CONDUCTORS AND BRANCH CIRCUIT WIRING SHALL BE TYPE THHN-THWN COPPER UNLESS NOTED OTHERWISE. ALL WIRE SHALL BE UL LISTED, RATED FOR 600 VOLTS, # 10 AWG MINIMUM SIZE UNLESS NOTED OTHERWISE. INSTALL ALL CONDUCTORS IN CONDUITS WITH A MINIMUM NUMBER OF BENDS.

6. PROVIDE SUPPORT FOR ALL ELECTRICAL EQUIPMENT TO COMPLY WITH THE SEISMIC REQUIREMENTS OF THE BUILDING CODE AND ALL LOCAL CITY ORDINANCES.

7. THE CONTRACTOR SHALL MAKE POWER CONNECTIONS TO ALL EQUIPMENT FURNISHED BY OTHERS, WHICH REQUIRES POWER CONNECTIONS. THE CONTRACTOR SHALL SEAL ELECTRICAL CONDUIT ENTERING AREAS OF TEMPERATURE CHANGE BY CONDUIT SEAL TYPE FITTINGS TO PREVENT AIR MIGRATION AND CONDENSATION.

8. THE ENTIRE ELECTRICAL SYSTEM SHALL BE GROUNDED PER THE NATIONAL ELECTRICAL CODE. ALL GROUND WIRES SHALL BE UL LISTED COPPER, WITH UL LISTED GROUNDING CONNECTORS. GROUND ALL ELECTRICAL EQUIPMENT, INCLUDING METALLIC FRAMES, HOUSINGS, COVERS, ENCLOSURES, PANELS, SWITCHRACKS, SUPPORTS, ETC. IN ACCORDANCE WITH THE NEC. THE ENTIRE WIRING SYSTEM SHALL BE TESTED FOR SHORT CIRCUITS, GROUNDS AND INSULATION RESISTANCE BETWEEN CONDUCTORS AND TO GROUND.

9. FURNISH AND INSTALL ALL WIRES, BOXES, SWITCHES, RECEPTACLES, SERVICE DEVICES, AND DISTRIBUTION EQUIPMENT REQUIRED FOR A COMPLETE AND OPERATIONAL ELECTRICAL SYSTEM. ALL STARTERS, FUSED DISCONNECTS, BREAKERS, FUSES, CONTACTORS, SWITCHES, J-BOXES CONDUIT, CONDUIT OUTLET BODIES AND WIRES THAT ARE NOT SUPPLIED BY THE EQUIPMENT MANUFACTURER IN A PREWIRED PANEL ARE BY THE CONTRACTOR UNLESS OTHERWISE NOTED.

10. THE CONTRACTOR SHALL FAMILIARIZE HIMSELF WITH EXISTING SITE CONDITIONS. THE CONTRACTOR SHALL RECEIVE, STORE AND INSTALL ALL ELECTRICAL ITEMS FURNISHED BY THE OWNER. THE CONTRACTOR SHALL PROVIDE A SET OF AS-BUILT DRAWINGS SHOWING ALL CHANGES MADE DURING CONSTRUCTION AND ANY DEVIATIONS FROM THE ELECTRICAL DRAWINGS.

11. LOADS SERVED BY CIRCUIT BREAKERS IN POWER PANEL SHALL BE IDENTIFIED WITH ENGRAVED BAKELITE NAMEPLATES ATTACHED WITH SST SCREWS. ALL SWITCHES AND CIRCUIT BREAKERS, DISCONNECTING MOTORS SHALL BE WITHIN SIGHT OF MOTORS OR FIXTURES NOT OVER 50 FEET OR BE CAPABLE OF BEING LOCKED IN THE OPEN POSITION.

12. THE ELECTRICAL DRAWINGS ARE DIAGRAMMATIC AND DO NOT SHOW ALL OFFSETS, BENDS, FITTINGS, JUNCTIONS BOXES, CONDUIT OUTLET BODIES AND EXPANSION FITTINGS REQUIRED TO MEET FIELD CONDITIONS. DETERMINE ACTUAL MATERIAL AND HARDWARE REQUIREMENTS AND VERIFY ALL DIMENSIONS BY FIELD INSPECTION.

13. WHERE CROSSING ANY EXISTING SUBSTRUCTURES WITH NEW SUBSURFACE IMPROVEMENTS, THE CONTRACTOR SHALL TRENCH CAREFULLY TO LOCATE ALL ACTIVE AND IDLE SUBSTRUCTURES AT THESE CROSSINGS. THE CONTRACTOR SHALL BE RESPONSIBLE TO REPAIR ALL EQUIPMENT AND SUBSTRUCTURES DAMAGED DURING CONSTRUCTION AT NO ADDITIONAL COST TO THE PORT.

14. IN AREAS SUBJECT TO VEHICULAR TRAFFIC AND HEAVY LOADING, MINIMUM DEPTH OF DIRECT BURIAL AND CONCRETE ENCASED CONDUIT SHALL BE 36 INCHES FROM FINISHED SURFACE. OTHER AREAS NOT SUBJECT TO TRAFFIC LOADING, MINIMUM BURIAL DEPTH OF CONDUITS SHALL BE 24 INCHES.

CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JRY
DRAWN BY: ECP
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JRY
CHECKED/APPROVED BY: TWS

TYLER W. SPARKS 51324

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JRY	60% DESIGN	TWS	.	.	.	.	.
2	12-6-17	JRY	90% DESIGN	TWS	.	.	.	.	.
3	5-12-18	JRY	100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
4	11-21-18	JRY	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: **ELECTRICAL NOTES & ABBREVIATIONS**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 E1

File: Q:\SEA\9834\CADD_Active_SheetSet\301801E001; Plotted: 11/21/2018 11:35 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:55 AM by MWILLIAMS

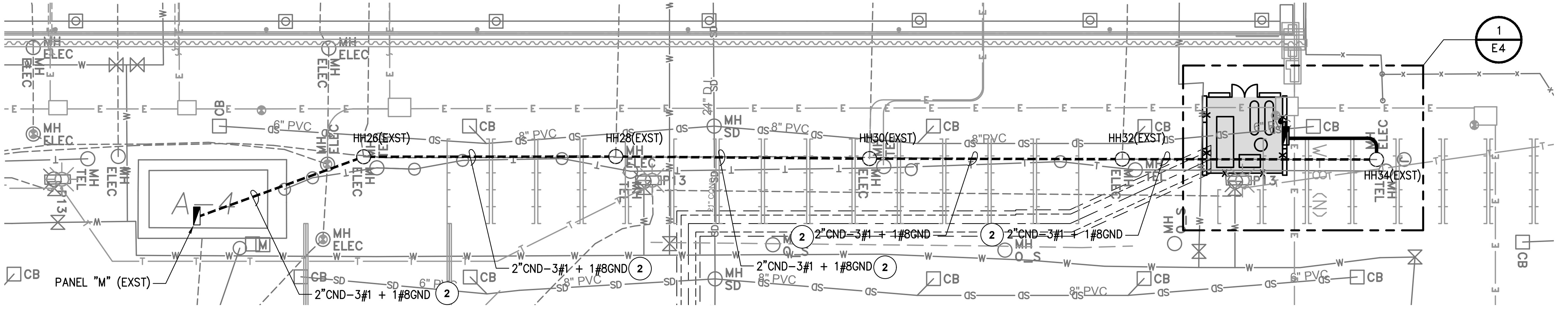
File: Q:\SEA\9834\CADD_Active_SheetSet\301801E002; Plotted: 11/21/2018 11:35 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:56 AM by MWILLIAMS

CONSTRUCTION NOTES

② EXISTING 2"CND, REMOVE EXISTING 3#4 AWG & 1#4GND. PULL 3#1 & 1#8GND WIRES.

LEGEND

— — —	EXISTING TO REMAIN
———	NEW CONSTRUCTION
⊕ #	CONSTRUCTION NOTE
◪	PANELBOARD
◌	HANDHOLE



PLAN

SCALE: 1" = 30'

N

1"=30'-0" 30 0 30 60
Scale Feet

CALL 2 DAYS BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.

moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JRY
DRAWN BY: ECP
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JRY
CHECKED/APPROVED BY: TWS

TYLER W. SPARKS
51324

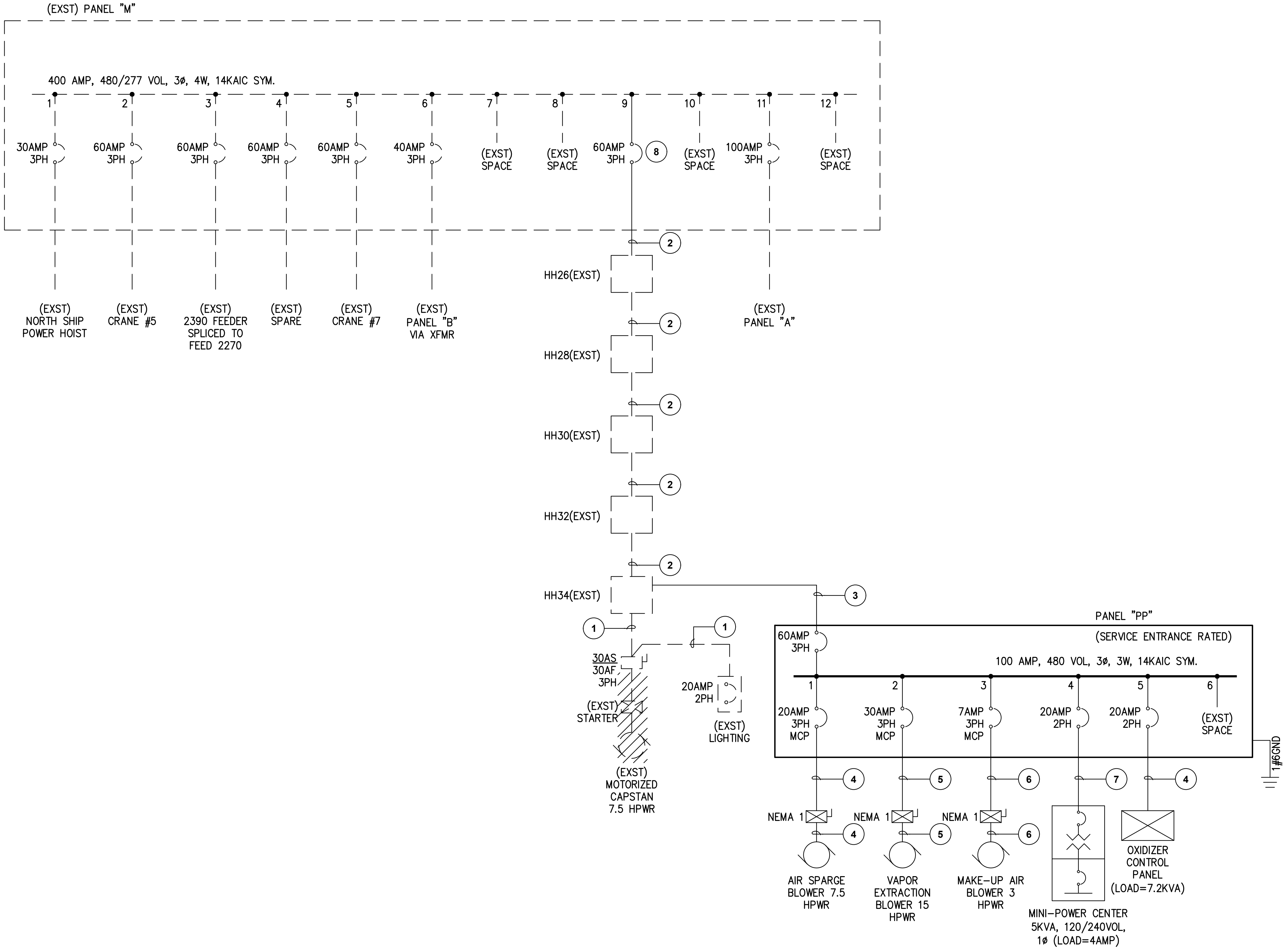
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JRY	60% DESIGN	TWS	.	.	.	.	.
2	12-6-17	JRY	90% DESIGN	TWS	.	.	.	.	.
3	5-12-18	JRY	100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
4	11-21-18	JRY	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **ELECTRICAL SITE PLAN**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 E2



ONE-LINE DIAGRAM

SCALE: NTS

CONSTRUCTION NOTES

① EXISTING TO REMAIN.

② EXISTING 2"CND, REMOVE EXISTING 3#4 AWG & 1#4GND. PULL 3#1 & 1#8GND WIRES.

③ 2"CND – 3#1 & 1#8GND, AND (1)2"CND–SPARE.

④ 3/4"CND – 3#12 & 1#12GND.

⑤ 3/4"CND – 3#12 & 1#12GND.

⑥ 3/4"CND – 3#12 & 1#12GND.

⑦ 3/4"CND – 2#12 & 1#12GND.

⑧ REPLACE EXISTING 40AMP/3PH CIRCUIT BREAKER WITH 60AMP/3PH CIRCUIT BREAKER IN PANEL "M". MATCH EXISTING CIRCUIT BREAKER MAKE, MODEL, AND AIC RATING.

LEGEND

– – –	EXISTING TO REMAIN
———	NEW CONSTRUCTION
30AMP 3PH	LV CIRCUIT BREAKER, RATING AS SHOWN
30AS 30AF 3PH	DISCONNECT SWITCH, RATING AS SHOWN
⊠	MOTOR STARTER
5KVA 120/240VOL 1PH	MINI-POWER CENTER, RATING AS SHOWN
#	CONSTRUCTION NOTE
○	MOTOR, RATING AS INDICATED
////////	EQUIPMENT TO BE DEMOLISHED
——⊣	GROUND
⊠	COMBINATION STARTER DISCONNECT SWITCH
⌜ ⌝	HANDHOLE

LOAD ANALYSIS

PANEL "M" PEAK DEMAND = 273.4AMP
25% PEAK DEMAND = 68.4AMP
NEW LOAD (PANEL "PP") = 38.5AMP
25% LARGEST MOTOR = 3.5AMP

TOTAL LOAD, AMPS = 383.8AMP

CALL 2 DAYS
BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JRY
DRAWN BY: ECP
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JRY
CHECKED/APPROVED BY: TWS

TYLER W. SPARKS
51324

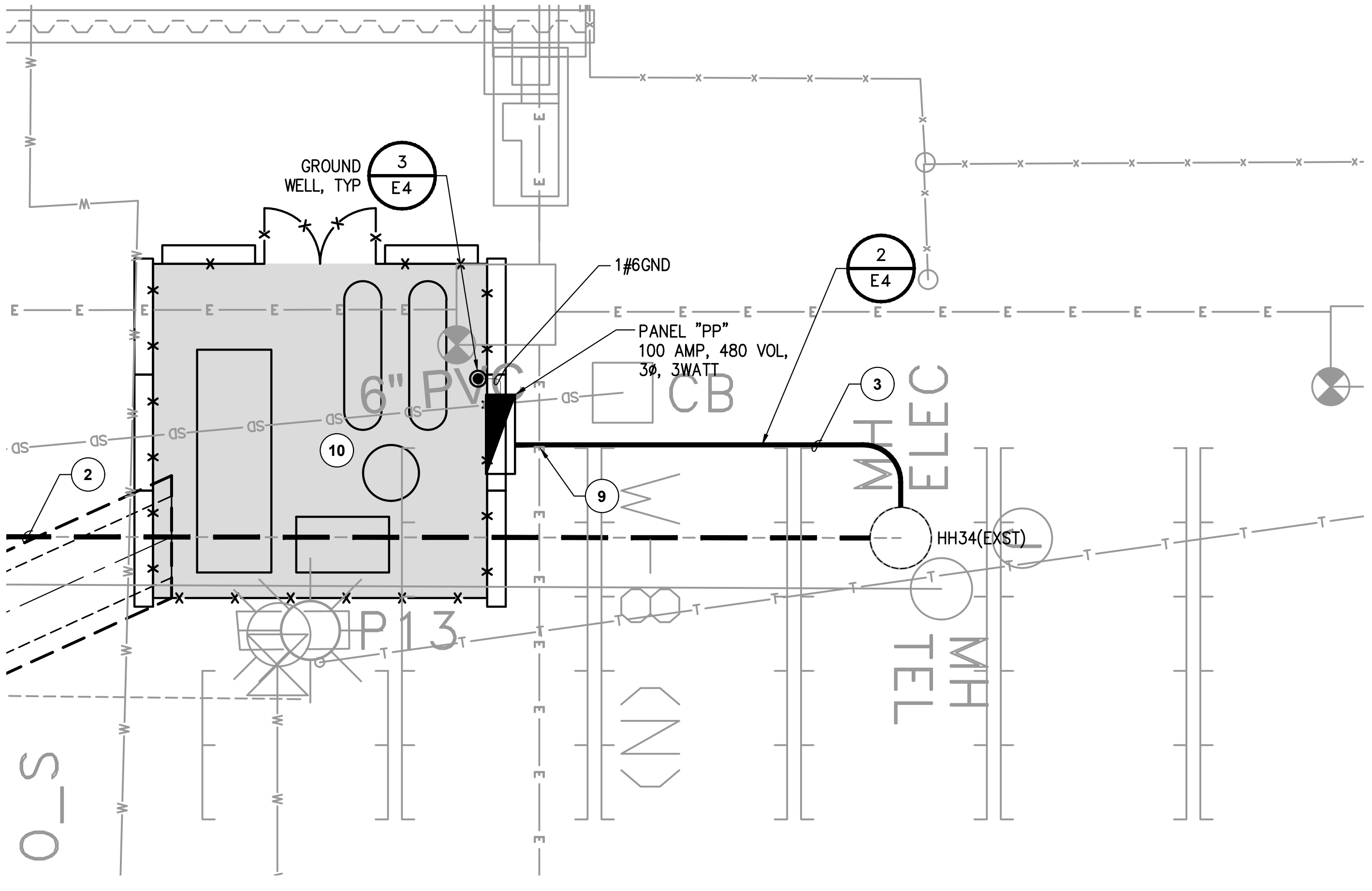
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JRY	60% DESIGN	TWS	.	.	.	.	.
2	12-6-17	JRY	90% DESIGN	TWS	.	.	.	.	.
3	5-12-18	JRY	100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
4	11-21-18	JRY	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: ELECTRICAL ONE-LINE DIAGRAM

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 E3

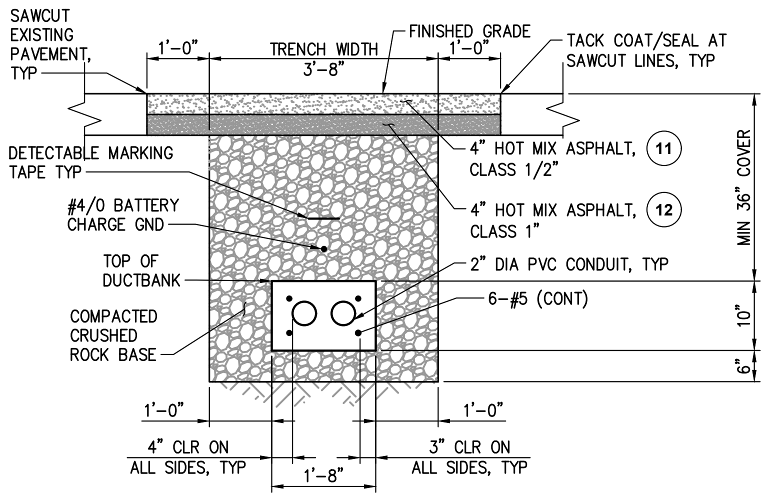


ENLARGED PLAN

EQUIPMENT ENCLOSURE AREA
SCALE: 1" = 10'

1
E2

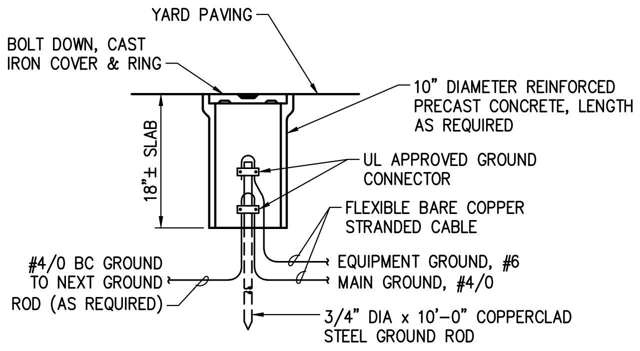
1"=10'-0"
10 5 0 10 20
Scale Feet



DETAIL

TYPICAL CONC ENCASED DUCTBANK
SCALE: NTS

2
E4



DETAIL

GROUND WELL
SCALE: NTS

3
E4

CONSTRUCTION NOTES

②	EXISTING 2"CND, REMOVE EXISTING 3#4 AWG & 1#4GND. PULL 3#1 & 1#8GND WIRES.
③	2"CND – 3#1 & 1#8GND, AND (1)2"CND–SPARE.
⑨	ROUTE DUCTBANK 6" BELOW EXISTING DUCTBANK. MAINTAIN PROPER CARE, AVOID DAMAGING EXISTING DUCTBANK.
⑩	CONTRACTOR SHALL PROVIDE GROUNDING CONNECTION TO ALL METALLIC PARTS (INCLUDING MOTORS, PANELS, SWITCHES, CONTROL CABINETS) THAT ARE EXPOSED AND LIKELY TO GET ENERGIZED, PER NEC CODE REQUIREMENTS.
⑪	PLACE CLASS 1/2" HOT MIX ASPHALT IN TWO 2–INCH LIFTS.
⑫	PLACE CLASS 1" HOT MIX ASPHALT IN ONE 4–INCH LIFT.

LEGEND

– – –	EXISTING TO REMIAN
———	NEW CONSTRUCTION
(#)	CONSTRUCTION NOTE
◢	PANELBOARD
○	HANDHOLE

CALL 2 DAYS BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JRY
DRAWN BY: ECP
SCALE: AS NOTED
DATE: 11-21-18
CHECKED BY: JRY
CHECKED/APPROVED BY: TWS

TYLER W. SPARKS
51324

R E V I S I O N S

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JRY	60% DESIGN	TWS	.	.	.	.	.
2	12-6-17	JRY	90% DESIGN	TWS	.	.	.	.	.
3	5-12-18	JRY	100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
4	11-21-18	JRY	FINAL 100% DESIGN (NOT FOR CONSTRUCTION)	TWS	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: **ELECTRICAL DETAILS**

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 E4

File: Q:\SEA\9834\CADD_Active_SheetSet\301801E004; Plotted: 11/21/2018 11:35 AM by WILLIAMS, MARISOL; Saved: 11/21/2018 10:57 AM by MWILLIAMS

Appendix B

T-30 Cleanup Design Specifications

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The project includes the installation and operation of a fully functional Air Sparge (AS) and Soil Vapor Extraction (SVE) remediation system at the Terminal 30 project. Work also includes the installation of product recovery wells and systems. This AS/SVE system is being installed to reduce the concentration of total petroleum hydrocarbons (TPH) in soil and groundwater within the project area. A Thermal Oxidizer (TO) shall also be installed to treat off-gases from the SVE system prior to discharge to the atmosphere. The Work shall include, but not limited to:

1. Site preparation including installing sedimentation control measures at storm drains and along work areas as described in Section 01 57 13, establishing temporary facilities as required.
2. Perform pre-construction survey, if necessary, of utilities, fences and features in areas of planned remedial activities that may be impacted by excavation or any other aspect of work.
3. Demolish any previously unidentified subsurface structures and abandoned utilities encountered, as needed, to accommodate excavation and pipeline installation.
4. Install temporary controls to protect the Work in progress.
5. Install vertical AS wells, SVE wells (vertical and horizontal), vapor monitoring points, and product recovery wells.
6. Excavate pipe trenching and install AS/SVE piping as shown on the Drawings.
7. Trench, backfill, and perform surface restoration for electrical service.
8. Provide and install AS/SVE equipment, complete with enclosures and controls.
9. Provide and install air treatment equipment, complete with enclosures and controls.
10. Complete surface restoration as shown on the Drawings.
11. Perform system startup and initial testing.
12. Perform system operation and maintenance.
13. Decontaminate equipment and personnel.

1.02 LOCATION

A. The work area is located on Port of Seattle Terminal 30 at 2431 East Marginal Way South, Seattle, WA 98134

1.03 PROJECT LOGISTICS

A. This work is being completed in an active container terminal. The drawings include restrictions related to working within the terminal.

B. Contractor shall conduct all business through the following Terminal 30 TWIC security gates:

1. All vehicles and site visitors shall enter and exit through the main Terminal 30 TWIC security gate, located at the north end of the site shown on the Drawings.
2. All on-site contractor personnel and subcontractors shall use the south TWIC security man gate at the “Contractor trailer, parking & support area” shown on the Drawings once they have been approved to do so and have been registered a at the main Terminal 30 TWIC security gate.
3. The Contractor shall not queue any trucks or equipment on the site or in the vicinity of the security gates at any time during construction.

C. Contractor work areas are shown on the Drawings. Contractor shall be restricted to these areas only. The access may change during the construction of the Contract work and Contractor shall comply with the changes or if notified by the Engineer.

D. Terminal operations shall not be stopped to accommodate this work.

E. Hours of Work/Closures:

1. Standard Project Work Hours
2. Holiday Closures
    (1) 2019: TBD
3. Work outside of the standard work shift hours, as defined in this specification section, can be requested and may be granted by the Engineer. No work outside of the standard work hours, as defined in this section, shall be allowed without written approval by the Engineer

F. TWIC cards are required for ALL workers on the Terminal, including delivery/truck drivers. See Section 01 14 14 – Seaport Personnel Identification Access Control for more information.

1.04 PROJECT PHASING OR SEQUENCING REQUIREMENTS

A. The Contractor shall coordinate the progress of its Work with the established requirements for completion and phasing described as follows:

1.05 WORK PERFORMED UNDER SEPARATE CONTRACTS

A. Additional security may be required at TWIC gates to accommodate Contractor personnel. The Port shall provide and pay for any additional security personnel deemed necessary by the Engineer to accommodate work activities.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 RELATED WORK DESCRIBED ELSEWHERE

A. The provisions and intent of the Contract, including the General Conditions, Supplementary Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is in accordance with current Department of Homeland Security (DHS) and U.S. Coast Guard regulations.

1.02 SECURITY REQUIREMENTS

A. Identification/Access Badges:

1. All Contractor personnel working in secure and restricted areas (as defined in Title 33, Code of Federal Regulations (CFR) Parts 104, 105 and 106) on this project shall have valid Department of Homeland Security issued Transportation Worker Identification Credential (TWIC) in accordance with Title 33, CFR, Part 101.514.

2. A portion of this Contract requires work to be performed within an area of the Seaport controlled for security reasons. That area is defined as the area within a Coast Guard Regulated facility subject to the provisions of the Maritime Transportation Security Act (MTSA) of 2002 and Title 33 CFR, Part 105, delineated by security fence, and all other restricted areas indicated on applicable drawings, or as posted on the Seaport premises (“restricted/secured area”), or otherwise defined under each Terminal Facility Security Plan. No Contractor personnel are allowed to work in these restricted areas without a valid TWIC.

B. Restricted Area Training:

1. All individuals requiring unescorted access to restricted areas will be required to provide documentation that they have successfully completed basic security awareness training as required in 33 CFR 105.215. This training must be completed prior to allowing unescorted access to restricted areas of Port of Seattle marine terminals subject to 33 CFR 105.

1.03 ISSUANCE OF IDENTIFICATION BADGES

A. In order to obtain a TWIC, the Contractor must apply for a TWIC card through the TWIC program as administered by the Transportation Security Administration (TSA). Information on this program can be found on the internet at http://www.tsa.gov/twic.

B. All work and expenses required to obtain a TWIC or for other activities required in this section shall be borne by the Contractor as part of the Contract.

1.04 RULES AND REGULATIONS REGARDING IDENTIFICATION BADGES

A. TWIC cards must be worn at all times on the outermost garment above waist height in order to gain access to and remain in restricted areas.

B. Any employee found in a restricted area without a valid TWIC will be escorted from that location and not be allowed to return until wearing a proper TWIC. This will be reported to the National Response Center as a security breach.

C. Employees shall be allowed access to the restricted areas only as necessary to travel to and from the construction/job site. Any employee found in any portion of the restricted areas other than the construction/job site or the area to and from the construction/job site will no longer be permitted to work at the Seaport in a restricted area.

D. Escorting:

1. Contractor personnel shall not be allowed to provide TWIC escorting services.

E. Lost or Stolen TWIC.

1. All TWIC's that are lost, stolen, or otherwise unaccounted for must be <u>immediately</u> reported to the Transportation Security Agency TWIC help desk 1-866-DHS-TWIC.
2. After the applicant reports the card as lost, stolen, or damaged, the help desk will contact the card production facility to trigger production of a replacement TWIC. The replacement credential will be sent to the enrollment center designated by the applicant for pick up.
3. TSA will add the lost, stolen, or damaged credential to the list of revoked cards to decrease the chance that the credential could be used by an unauthorized person to gain unescorted access. This list of revoked cards (the 'hotlist') will be available on the TWIC portal to appropriate individuals within the maritime community (Vessel Security Officer, Facility Security Officer, Coast Guard Captain of the Port) in order to monitor access to secure areas. Once the replacement TWIC arrives at the enrollment center, the applicant will pick up and pay the card replacement fee. The replacement card will have the same expiration date as the original.

F. Unsecured Doors/Gates: Contractors and their employees will be held accountable for doors and gates located within their work sites that provide direct or indirect access to restricted or secured areas of the Port by unauthorized individuals. Doors and gates that provide such access must <u>NOT,</u> under <u>ANY</u> circumstances, be left open and unattended. Individuals who have been issued TWIC cards are required to challenge any individual attempting unauthorized access to restricted areas and report all violations to the terminal security staff immediately.

G. Contractors requiring access through vehicle gates not normally staffed must make arrangements for access through the Facility Security Officer or designated security staff on the marine terminal.

1.05 FAILURE TO COMPLY

A. Compliance with these regulations and TSA directives will be monitored by the Seaport Security Coordinator, other Port personnel or other regulatory agencies. Failure on the part of the Contractor to comply may result in fines or other monetary considerations levied against the Port. In the event an action or absence of action, by the Contractor with regard to the TSA directive leads to any damages against the Port, the Contractor shall be liable for, and reimburse the Port for, all costs involved.

1.06 SPECIAL REQUIREMENTS, WORK IN U.S. CUSTOMS AREA

A. Work conducted inside areas controlled by the U.S. Customs Service in maritime terminals of the Port, may require special clearance and identification issued by the Customs Service. In addition, the Customs Service may require that a bond be provided by the Contractor, as security for all work conducted within their area.

B. It shall be the Contractor’s responsibility to coordinate with the U.S. Customs Service, secure necessary clearance from them, and provide bonds as required. All costs for securing U.S. Customs identification and clearance, and the providing of their required bonding, shall be at the Contractor’s expense. No separate or extra payment of any kind will be made to the Contractor for satisfying these requirements.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION

A. This section identifies the requirements for identifying and measuring work and applying for contract payments.

1.02 REQUIRED SUBMITTALS

A. Preconstruction Submittals:

1. Submittals shall be made in accordance with the requirements of Section 01 32 19 - Preconstruction Submittals and as specified herein.

2. As part of the Preconstruction Submittal, submit a Schedule of Values, which is a complete cost breakdown of all lump sum bid items, whether for the entire Contract or lump sum bid items, showing the value assigned to each part of the Work (activity), including allowance for overhead and profit. Upon acceptance of the Schedule of Values by the Engineer, it shall be used as a basis for all lump sum progress payments.

   a. The cost of each activity shall be a portion of the lump sum price as it relates to each activity. The cost shall include labor, material, overhead and fee. Normally, cost for order/delivery activities will not be allowed. The cost of material and equipment shall be associated with the installation of such material and equipment unless otherwise required by the Engineer. The total cost of all activities shall equal the lump sum bid price for the bid item or total Contract as applicable.

   b. On material where the Contractor anticipates requesting payment in advance of installation, it shall be identified as a separate line item in the Schedule of Values.

3. As a Preconstruction Submittal , submit the force account labor and equipment rates:

   a. Submit for the Contractor and each subcontractor, a list of labor rates for each trade applicable to the scope of work to be performed. These submitted rates shall be broken down to include the base wage, fringes, FICA, SUTA, FUTA, industrial insurance and medical aid premiums as stated in the General Conditions. The rates shall not contain any travel time, safety, loss efficiency factors, overhead or profit. Rates shall be submitted for straight time, overtime and double time. Once the rates have been reviewed and accepted, they will become the basis for pricing labor in Change Order Work. Contractor shall provide proof of all labor rate costs as required by the Engineer including the submission of a copy of the most current Workers Compensation Rate Notice from Labor & Industries and a copy of the Unemployment Insurance Tax Rate notice from the Employment Security Department. If labor rates change during the course of the project the Contractor may submit new rates for acceptance.

   b. Submit for the Contractor and each subcontractor, a list of equipment and rates applicable to the scope of work to be performed. The equipment rates shall conform to the rates shown in the current Rental Rate Blue Book as modified by AGC\WSDOT Equipment Rental Agreement as stated in the General Conditions. In the event a specific piece of equipment does not appear or is applicable to the Rental Rate Blue Book as modified by the AGC\WSDOT Rental Rate Agreement specified rate, a rate shall be developed based on the terms of the Rental Rate Blue Book criteria. Once these rates are reviewed and accepted, they shall be used as the basis for pricing Change Order work.

c. No change orders will be processed for the Contractor or subcontractor until the respective labor and equipment rates have been submitted and accepted.

B. Applications for Payment:

1. For each application for payment the Contractor shall submit the following:

a. Completed “Application and Certificate for Payment” on form as required by Division 1 or as established by the Engineer.

b. Schedule and narrative update as required by the applicable schedule section of the Project Manual.

c. Certification that as-built drawings are current per Section 01 77 00 - Project Closeout.

d. Certification of Payment to subcontractors and suppliers. Also, the Contractor shall submit, with each application for progress payment, a completed form titled “Monthly Amounts Paid to All Subcontractor Participants.” The Prime Contractor is to include all of its Subcontractors on this form.

e. “Application and Certificate of Payment” shall be submitted on the date specified General Conditions.

C. Final Application for Payment:

1. Refer to Section 01 77 00 - Project Closeout and the General Conditions, for other requirements. For application for payment, the Contractor shall submit the following:

a. Completed “Application and Certificate for Payment” on form as required in Division 1 or as established by the Engineer showing the Work 100% complete.

1.03 PREPARATION OF APPLICATIONS FOR PAYMENT

A. All required information on the forms shall be legible.

B. Execute certification of signature of authorized officer.

C. Identify percentage complete for each item on the accepted Schedule of Values.

D. List each authorized Change Order, listing Change Order number and dollar amount as for an original item of Work.

E. A letter certifying payment to subcontractors as required by the General Conditions.

1.04 PAYMENT FOR STORED MATERIAL

A. Payment for stored items will be in accordance with –the General Conditions.

B. Proof of Need. With payment request for stored material, submit a copy of purchase order and payment voucher clearly identifying the material, specification reference, Contract number, and price. The following additional documentation may be included:

1. Notarized certification of payment from supplier.
2. Copy of canceled check to supplier.
3. Lien release from supplier.

C. Stored material items may be included in monthly application for payment only after drawings and data submittals, if any are required, have been completed per Contract Documents.

D. Verification of price and payment: the Contractor shall demonstrate that the costs of materials have been paid and will establish the Port's title to such materials or equipment or otherwise protect the Port's interest including applicable insurance and transportation for those items stored off-site.

E. Partial payment for materials and equipment in advance of installation shall not constitute acceptance thereof and will not relieve Contractor of full responsibility for condition and subsequent acceptance by the Port. Faulty materials discovered will be rejected even through partial payment may have been made.

1.05 SUBSTANTIATING DATA

A. When the Port requires substantiating information, submit data within seven (7) days of request justifying line item amounts in question.

1.06 UNIT PRICES

A. Any unit prices listed in the Bid Form are complete including labor, plant, equipment, products, fees, and any incidental charges; and including allowance for overhead and profit. Unit prices are not for work required by the Drawings and Specifications that are stated as lump sums in the Base Bid.

1.07 MEASUREMENTS STANDARDS

A. Measurement and payment descriptions for each item listed in the Bid Form are as set forth throughout the applicable sections of the Contract Documents and as noted herein.

1. All bid items of work acceptably completed under the Contract will be measured by the Engineer according to United States standard measure.
2. Measurements will be made as hereinafter provided unless otherwise provided for by their individual measurement specifications.
3. The method of measurement and computations to be used in determination of quantities of material furnished or of Work performed under the Contract will be those methods generally recognized as conforming to accepted engineering practice and will be carried to the proper significant figures or fractions of units for each item to conform to the usual practice of the Port Engineering Department.
4. Items of Work for which payment is made by a "Lump Sum" will be measured as a complete unit. Partial payment, if made, will be made

according to (the completed percentage of the Lump Sum unit as determined by the Engineer) (the completed percentage of the various components of the lump sum item detailed in a Schedule of Values).

B. Weighing Equipment:

1. Scales for the weighing of natural, manufactured or processed construction materials obtained from natural deposits, stockpiles or bunkers, which are required to be proportioned or measured and paid for by weight, shall be furnished, erected and maintained by the Contractor, or be certified, permanently installed commercial scales.
2. In the event the Contractor elects to furnish, erect and maintain weighing equipment at the site, such equipment shall meet the requirements and conditions set forth in State of Washington Standard Specifications for Road, Bridge and Municipal Construction, current edition.

C. Measurement of Quantities:

1. Unless otherwise specified, measurements will be made horizontally or vertically. In determining the area for items bid on a square yard basis, the measurements will be on the neat dimension indicated on the drawings or as altered by the Engineer.
2. Structures will be measured according to neat lines indicated on the drawings or as altered by the Engineer to fit field conditions.
3. All items which are measured by the linear foot, such as sewers, water mains, pipe culverts, gutters, under-drains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise noted on the drawings or specifications. Drainage system pipes, including but not limited to storm drain, sewer or IWS, are measured to the inside face of the manhole or catch basin. Pressurized pipes, including but not limited to water mains, are measured to the point of connection.
4. In computing volumes of excavation and embankment, the method used will be average end-area method, or as stated in the appropriate sections of the specifications.
5. The term “gage,” when used in connection with the measurement of plates, means the U.S. Standard Gage, except that when reference is made to measurement of galvanized sheets used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing, the term “gage” or thickness means that specified in AASHTO M 36, M 167, M 196, M 197 or M 219. Corrugated siding or roofing or coated material gage shall refer to material measurement before coating or covering.
6. When the term “gage” refers to the measurement of wire, it means the wire gage specified in AASHTO M 32.
7. The term “ton” means the short ton consisting of 2,000 pounds avoirdupois. All materials that are measured or proportioned by weight shall be weighed in accordance with the standards set forth in this section. Trucks used to haul material being measured by weight, shall be weighed empty and each truck shall bear a plainly legible identification mark.

8. Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. When required by the Engineer, the loads shall be leveled when the vehicles arrive at the point of delivery to facilitate measurement.

9. When a complete structure or structural unit or piece of equipment is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

10. When standard manufactured items are specified, such as railroad rail, ties, fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions, not including bolts or other connectors. Unit Prices bid should include allowances for any bolts and connectors. Unless more stringently controlled by tolerance in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

11. No measurement will be made for work performed or materials placed outside of lines indicated on the plans or established by the Engineer; materials wasted, used or disposed of in a manner not called for under the Contract; material rejected after it has been placed, by reason of the failure of the Contractor to conform to the provisions of the Contract; hauling and disposing of rejected materials; material remaining on hand after completion of the work; or other Work or material payment for which is contrary to the provisions of the Contract.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION - Not used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project

End of Section

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes product options available to the Contractor, plus procedures for securing acceptance of proposed substitutions during construction in coordination with the requirements set forth in the General Conditions.

1.02 SUBSTITUTION REQUIREMENTS

A. If the Contractor wishes to furnish or use substitute materials, equipment, or processes in connection with this Contract, the Contractor shall make a written application to the Engineer for consideration of the substitute, together with a certification by the Contractor that the proposed substitute will adequately perform the functions called for in the project design, is of similar and equal substance to the equipment, material, or process named, is suited to the same use, complies with all codes, laws, or regulations affecting the Work and is capable of performing the same function as the materials, equipment, or process named in the Contract Documents. Substitutions shall be provided at no additional cost or time impact to the project. The Contractor is responsible to coordinate all associated Work that may be affected by the substitution. The application shall also state whether or not acceptance of the substitute will require a change in the Contract Documents to adapt the design to the substitute and whether or not the use of the substitute is subject to payment of any license fee or royalty by the Contractor.

B. All variations of the proposed substitute from the materials, equipment, or process named in the specifications shall be identified in the Contractor’s application, including variations between maintenance, repair and replacement service entities.

C. Should any proposed product substitution require any re-design Work by the Design Consultant or the Design Consultant’s consultants to accommodate the substitute product, costs for such re-design Work shall be the responsibility of the Contractor.

1.03 SUBMITTALS

A. Substitution submittal procedure:

1. All substitution submittals shall be accompanied by the attached Substitution Request Form completely filled out in CMS. Limit each request form to one proposed substitution.
2. Submit complete sets of substitution request forms and supporting data as required by Section 01 33 00 - Submittals.
3. Clearly indicate with red arrows on the supporting data the proposed substitution and accessories.

1.04 EVALUATION AND REVIEW

A. The evaluation and acceptance or rejection of the proposed substitute shall not be grounds for an increase in the Contract Time or the Contract Sum.

B. The Engineer may require that the Contractor furnish, at no additional expense to the Port, additional data concerning the proposed substitute. The Engineer will be allowed a reasonable time within which to evaluate the proposed substitute. The Engineer will be the sole judge of the acceptability of the proposed substitute.

1.05 TIME

A. The Contractor shall allow forty-five (45) days for review and evaluation of requests for substitutions.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

Section Substitution Request Form

TO:
PROJECT NAME:

We hereby submit for consideration, the following product instead of the specified item for the above project:

Section Paragraph Specified Item

Proposed Substitution:

ATTACH COMPLETE DIMENSIONAL INFORMATION, ENGINEERING CALCULATIONS, AND TECHNICAL DATA INCLUDING LABORATORY TESTS, IF APPLICABLE.

INCLUDE COMPLETE INFORMATION ON CHANGES TO DRAWINGS OR SPECIFICATIONS WHICH PROPOSED SUBSTITUTION WILL REQUIRE FOR ITS PROPER INSTALLATION.

SUBMIT WITH REQUEST ALL NECESSARY SAMPLES AND SUBSTANTIATING DATA TO PROVIDE EQUAL QUALITY, PERFORMANCE, AND APPEARANCE TO THAT WHICH IS SPECIFIED. CLEARLY MARK MANUFACTURER'S LITERATURE TO INDICATE EQUALITY IN PERFORMANCE. DIFFERENCES IN QUALITY OF MATERIALS AND CONSTRUCTION SHALL BE INDICATED.

THE UNDERSIGNED STATES THAT THE FOLLOWING PARAGRAPHS, UNLESS MODIFIED ON ATTACHMENTS, ARE CORRECT:

1. THE PROPOSED SUBSTITUTION DOES NOT AFFECT DIMENSIONS SHOWN ON DRAWINGS.
2. THE UNDERSIGNED WILL PAY FOR CHANGES TO THE BUILDING DESIGN, INCLUDING ENGINEERING DESIGN, DETAILING AND CONSTRUCTION COSTS CAUSED BY THE REQUESTED SUBSTITUTION.
3. THE PROPOSED SUBSTITUTION WILL HAVE NO ADVERSE AFFECT ON OTHER TRADES, THE CONSTRUCTION SCHEDULE, OR SPECIFIED WARRANTY REQUIREMENTS.
4. MAINTENANCE AND SERVICE PARTS WILL BE LOCALLY AVAILABLE FOR THE PROPOSED SUBSTITUTION.
5. THE PROPOSED SUBSTITUTION WILL HAVE NO AFFECT ON APPLICABLE CODES.
6. THE MANUFACTURER'S GUARANTEE OR WARRANTIES OF PROPOSED PRODUCT IS EQUIVALENT TO; OR EXCEEDS THAT OF THE SPECIFIED PRODUCT.

List of names and location of three similar projects on which product was used, date of installation, and Architect's name and phone number.

CERTIFICATION OF EQUAL
PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUAL PERFORMANCE:
UNDERSIGNED

ATTESTS THAT FUNCTION AND QUALITY ARE EQUAL TO OR SUPERIOR TO SPECIFIED ITEMS

Submitted By:

Name Title

Above must be a person having authority to legally bind Contractor's firm to the above terms.

Firm

Address

City / State Zip

Telephone Date

PART 1 GENERAL

1.01 SUMMARY

A. Provide project organization information indicating Contractor's project personnel and contact information, and their experience records for acceptance.

1.02 QUALIFICATIONS

A. Contract project personnel shall have the following qualifications:

1. Project Manager - at least 10 years of experience in managing similar projects.
2. Superintendent - at least 10 years of supervisory experience in similar projects.
3. Foreman – at least 5 years of foreman experience in similar projects.

B. The following Contract project personnel shall be submitted separately and have the following qualifications:

1. Contractor's Site Safety Officer Personnel per Section 01 35 29 – Safety Management.
2. Contractor's Quality Control Personnel per Section 01 45 16.13a – Contractor's Quality Control.
3. Contractor's Erosion and Sediment Control Lead per Section 01 57 13 – Temporary Erosion and Sediment Control Planning and Execution.
4. Contractor's Pollution Prevention Plan Inspector per Section 01 57 23 – Pollution Prevention Planning and Execution.
5. Contractor's CMS Personnel per Section 01 78 39 – Contract Management System.

1.03 REQUIRED SUBMITTALS

A. Submit as part of Preconstruction Submittals a project organization diagram and qualifications and resumes for your project management team, outlining areas of responsibility and authority. Submit the qualifications for individuals that are proposed for each of the positions indicated below. At a minimum, include on your project team the following personnel:

1. General Manager: The Contractor's employee authorized to resolve disputes per the General Conditions.
2. Project Manager: Part-time on-site.
3. Superintendent: Full-time on-site.
4. Foreman: Full-time on-site.
5. Administrator of your Quality Control program: Full-time on-site.

B. Keep organization diagram current.

C. Resubmit qualifications for acceptance by the Engineer whenever above personnel change.

D. The Port reserves the right to accept or reject the Contractor's proposed personnel.

E. Contractor personnel shall not be replaced without prior written notice to and acceptance by the Port. Resubmit evidence that the proposed personnel successfully meet the qualifications.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION - Not used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Contractor shall perform the following Project Coordination Requirements:

  1. Coordinate the Work of all Subcontractors with the Work of the Contractor

    a. Distribute information and coordinate necessary action of subcontractors and suppliers in response to information and direction provided by the Port (i.e., Requests for Information, Requests for Proposal, executed Change Orders, etc.)

    b. For temporary utilities

    c. Among the work of the trades specified in technical specification sections.

    d. Ensure that notification to and inspections by permitting agencies are completed in a timely manner

  2. Coordinate the schedules of all subcontractors to:

    a. Verify timely deliveries of products for installation by other trades

    b. Verify that labor and materials are adequate to maintain schedules

    c. Manage the schedule in sequence for all subcontractors

  3. Contractor’s Daily Construction Report (Form CM03)

    a. Daily construction reports utilizing Form CM 03 will be submitted to the Engineer daily. Along with the other information shown on this form, a summary of all schedule activities worked on each day is required. Divide the activities worked on by trade and employer. Identify activities by activity number per the accepted schedule. Identify activities that are behind schedule. State the cause and amount of the delay and propose what action is necessary to bring the activity back on schedule. If multiple daily shifts are used, submit a report for each shift. See Appendix A.

    b. Include required information for <u>all</u> subcontractors at any tier working on the Contract in addition to Prime Contractor.

  4. Conduct conferences among all subcontractors, and other concerned parties, as necessary to:

    a. Maintain coordination and schedules

    b. Resolve matters in dispute

    c. Coordinate utility outages

  5. Participate in Project meetings:

    a. As required by these specifications

    b. Report progress of the work

    c. Recommend needed changes in schedules

    d. Transmit minutes of meetings to all other trades, as appropriate

6. Temporary Utilities Required During Construction:
    a. Coordinate submittals, installation, operation and maintenance, to verify compliance with Project requirements and with Contract Documents, see Section 01 50 00 – Temporary Facilities and Controls
    b. Verify adequacy of service at required locations
7. All Required Submittals: Prior to submittal, in accordance with Section 01 33 00 - Submittals, review for compliance with Contract Documents. The Contractor shall <u>review and coordinate</u> all subcontractor submittals of any tier. All submittals must be submitted by the Contractor, and not by others
8. Coordination Drawings:
    a. Prepare, as required to ensure coordination of work of, or affected by, mechanical and electrical work, or to resolve conflicts
    b. Submit to the Engineer for review
    c. Reproduce and distribute accepted copies to all concerned parties
9. Observe required testing; maintain a record of tests as required by the Quality Control section of these specifications
10. Verify that subcontractors maintain accurate record documents
11. Substitutions:
    a. Review proposals and requests:
        (1) Check for compliance with Contract Documents
        (2) Verify compatibility with work and equipment of other trades
    b. Submit to the Engineer for acceptance in accordance with Section 01 25 00 - Substitutions
12. Observe the work for compliance with requirements of Contract Documents
    a. Maintain list of observed deficiencies and discrepancies
13. Promptly report and correct deficiencies or discrepancies in accordance with Section 01 45 16.13a - Contractor’s Quality Control.
14. Assemble documentation for handling of disputes involving mechanical, electrical or other trades.
15. Utility and Equipment Operations:
    a. Check to ensure that utilities and specified connections are complete and that equipment is in operable condition
    b. Coordinate the acceptance of new and remodeled equipment through the Engineer after Contractor functional testing is completed.
16. Punchlist Inspection:
    a. Prior to inspection, check that equipment is clean, repainted as required, tested and operational and that the Contractor’s punch list is prepared and delivered to the Engineer

b. Assist Engineer; prepare consolidated list of items to be completed or corrected after inspection

17. Assemble As-built Record Document information and ensure that completed record documents are submitted to the Engineer in accordance with Section 01 78 29 – As-Built Project Record Documents.

1.02 PROJECT SCHEDULE

A. The Schedule shall be prepared as required by Section 01 32 16 – Bar Chart Schedule and designate areas of activity of the Contractor and subcontractors for the various items of work for the Project. The Schedule shall be prepared, submitted for review, and accepted by the Engineer as specified in these Contract Documents.

B. Contractor shall:

1. Maintain Schedule throughout construction period; record changes in responsibilities due to:
    a. Accepted modifications to Contract
    b. Accepted substitutions
    c. Changes to work responsibility
2. Reproduce and distribute revised Schedule promptly after each change to:
    a. Affected subcontractors
    b. Engineer

1.03 EXCAVATION COORDINATION

A. Call Before You Dig. Washington State law, RCW 19.122.010 requires anyone planning to excavate, to know what is below the ground surface before they dig. Any entity, including but not limited to the Contractor or any subcontractor conducting excavation operations on Port projects shall comply with the law which at a minimum requires the following actions.

1. Before excavating 12” or deeper on Port projects, the Contractor shall call the Washington Utility Notification Center’s One Call System at 811 or 1-800-424-5555 to provide notice two days before the scheduled start of earthwork. On busy days (M-W) hold time can be very lengthy. Entering your locate request online, via ITIC, eliminates the hold time. To learn more about ITIC visit www.callbeforeyoudig.org.
2. Utility locating is provided by Port of Seattle Engineering Survey and requires the submission of Port Form 811 via an email to posutility@portseattle.org (see Appendix B).
    a. Form submission requires the 811 ticket number obtained from the One Call system notification.
3. If a project’s excavation operations are completed within 45 days of notification, only one call and form needs to be made for each project, however, certain projects may have different requirements which will be discussed at the pre-construction meeting. Projects with longer-term excavation operations require a call every 45 days of the last notification.

1.04 REQUESTED INFORMATION

A. Requests for Information (RFI): In the event there is a question regarding intent of the documents by the Contractor, or any subcontractors, the Contractor shall submit a written RFI to the Engineer. There will be no additional compensation to the Contractor for the preparation of a RFI. All costs are considered incidental to the scope of work in question.

B. Contractor may submit an RFI to the Engineer to clarify or confirm minor discrepancies, conflicts, errors or omissions in the Contract Documents.

C. Each RFI shall bear the Contract name and work order number; date of submission to the Engineer; requested response date; name and position of the person submitting request; pertinent drawing and detail number; grid location and building level; specification section number; or other references as appropriate.

D. Prepare a separate RFI for each item or issue.

E. The Port will provide a response to the RFI within 14 days, typically. It is understood that some RFI's may require shorter response durations. If the Contractor requires a shorter response duration it must be clearly noted on the RFI. The Engineer will make a reasonable attempt to accommodate the Contractor's request.

F. RFI's shall be submitted by the Contractor to the Engineer utilizing the CMS RFI Workflow.

G. Any response to an RFI issued by the Engineer does not constitute a change to the Contract or a commitment to extend or to pay. If the Contractor believes the response received to be an additional cost or impact to the prosecution of the Project the Contractor must follow the requirements of the Contract listed in Article G-05 Changes and G-09 Claims.

1.05 COMMUNICATION REQUIREMENTS AND COORDINATION FORMS

A. Terminal Operator has a general understanding of the project as detailed in the Contract Documents. However, day-to-day project activity that may impact their operations is not known. The Contractor shall establish and maintain a system for communications with Project stakeholders through the Engineer.

B. All communications about the project, including press releases, posting to public websites, social media or shared publications, must be approved through the Port's Public Affairs department, via the Engineer. The Contractor shall direct all media inquiries to the Port.

C. The Contractor shall not publish any project information, including those referenced above, without first obtaining permission from the Port's Public Affairs department, via the Engineer. This includes communications that take place after Physical Completion is issued.

1.06 UTILITY DEACTIVATION AND REACTIVATION PLANS AND SHUTDOWNS

A. The Contractor shall submit a shutdown plan to the Engineer for review. The plan shall outline the proposed procedure to deactivate and reactivate utility services, lines and equipment required to be disrupted, disassembled, cut into, or modified during the course of the work.

B. All shutdowns are subject to operational requirements and shall be coordinated with the Engineer to mitigate impacts to Port Operations.

C. Plan Content: The plan shall include but not be limited to:

1. Shutdown and restart schedules.
2. Sequences required to deactivate, depressurize, and reactivate the utility service lines and equipment.
3. Detailed description of proof positive verification or tests to assure that utility service line and equipment are properly deactivated before proceeding with the work.
4. Methods of: discharging residual fluids from lines and equipment; value sequencing; electrical load shedding for deactivating and reactivating service lines, equipment and the system reactivation procedure.
5. Incorporation of the specific deactivation and reactivation requirements of the relevant technical specifications.
6. Compliance with safety standards.
7. Coordination required with the Port or utility owners.

D. It is the Contractor’s responsibility to fully understand and verify the condition of any utility service lines, and equipment at all times directly prior to and during the course of the work. The Contractor shall be responsible for all damages resulting from its actions.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

Port of Seattle

CM-03 (4/96)

CONTRACTOR'S DAILY CONSTRUCTION REPORT

PROJECT TITLE:____ DATE:_____________________

CONTRACTOR:____ WEATHER:________________

CONTRACT NO:_____________________________

TEMPERATURE::
AM:_________PM:_________

WORK ORDER NO:__________________________

PRIME/SUBCONTRACTOR'S WORK FORCE

Activity or CO#	*Number of Personnel*	*Trade*	*Employer*	*Total Hours*	**Otys*	***Act. Comp*

*** If applicable**
**** Activity Complete? State yes or no.**

EQUIPMENT

Act or CO #	*Equipment Type*	*Rented or Owned*	*Qty.*	**Status* *Up*	 *Down*	 *Std-by*	*Description of Operation*	*Total Hours*

* Is equipment operational (Up), broken down (Down), or operational but not used (Stand-By).

INSPECTION and/or TESTING PERFORMED TODAY

CONSTRUCTION STATUS (Activities behind schedule, State cause and action required)

Contractor's Representative Signature

CM _____ RE_____ FILE _____

PART 1 GENERAL

1.01 DESCRIPTION

A. In general, project meetings will be held weekly at the job site unless agreed otherwise with the Engineer. The Engineer will conduct project meetings throughout the construction period

B. The purpose of the project meetings is to enable orderly review of progress during construction and to provide for systematic discussion and analysis of problems that might arise between the Port, Designer or Contractor relative to execution of the Work.

1.02 AUTHORITY DESIGNATION

A. Persons designated by the Contractor to attend and participate in project meetings shall have all required authority to commit the Contractor to solutions as agreed upon in the project meetings.

1.03 AGENDA DEVELOPMENT

A. Agenda Items: To the maximum extent possible, inform the Engineer at least twenty-four (24) hours in advance of the project meeting regarding any agenda items desired for discussion.

1.04 MEETINGS

A. Pre-construction Meeting
  1. The Engineer will conduct this meeting prior to NTP.
  2. Location: At a Port facility to be specified by the Engineer.
  3. Attendance:
    a. Port's Project team.
    b. Designer and professional consultants for mechanical, electrical, civil, and structural disciplines, as applicable.
    c. Contractor's project manager and superintendent
    d. Major Subcontractors, as appropriate
    e. Major suppliers, as appropriate

B. Weekly Project Meetings
  1. The Engineer will conduct weekly meetings to coordinate the Work, answer questions, and resolve problems. Meetings will begin weekly after Pre-construction meeting.
  2. Location: At a Port facility to be specified by the Engineer.
  3. Attendance:
    a. Engineer
    b. Architect and Consultants as needed
    c. Contractor's project manager and superintendent
    d. Major subcontractors

e. Others, as appropriate

C. Special Meetings

1. The Engineer will call special meetings at the project site or at other locations to coordinate the Work, answer questions and resolve problems. The Contractor shall attend.

1.05 PRE-INSTALLATION MEETINGS

A. The Contractor shall schedule Pre-Installation Meetings at least five (5) days prior to commencing any portion of the Work where such meeting is required by the Specifications or as requested by the Engineer.

B. Require attendance of parties directly affecting, or affected by the Work.

C. Contractor to prepare agenda, lead the meeting, compile record minutes, and distribute copies within two days after meeting to participants.

D. Review conditions of installation, preparation and installation procedures, and coordination with related work.

1.06 PRE-PROJECT CLOSE OUT MEETING

A. At approximately 80% of Contract completion or 60-days before the Substantial Completion date, whichever occurs first, the Engineer will hold a meeting with the Contractor to discuss acceptance/closeout process, to schedule the events and to review responsibilities.

1.07 MINUTES

A. The Engineer typically prepares minutes of project meetings and will distribute copies.

B. The minutes compiled by the Engineer will be the official record minutes and all clarifications or corrections shall be transmitted in writing to the Engineer within three (3) working days of date of receipt of the minutes.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION

A. The Work under this Contract will be planned, scheduled, executed and reported using a bar chart schedule. The bar chart Schedules described here serve as a communication tool between the Port and the Contractor, and the Contractor and its subcontractors. The Contractor shall use the schedules to establish a joint understanding of the assumptions regarding the work, and the various constraints and opportunities that are possible within the plan. As the work progresses the project team is expected to use these schedules to assess impacts and to formulate the best methods to complete the work on, or ahead of, the contractual completion dates. Specifically, the purpose is as follows:

1. To assure adequate planning, scheduling and reporting during execution of the Contract.
2. To assure coordination of the work by and between the Contractor and the various subcontractors and suppliers.
3. To assist the Contractor and Engineer in monitoring the progress of the work and to contemporaneously evaluate proposed changes to the Contract and the project schedule.
4. To assist the Contractor and Engineer in the preparation and evaluation of the Contractor's monthly progress payment.

B. Schedules shall be in a bar chart format with a logical association of predecessor or successor ties between the activities. The Schedules shall be produced using Primavera or Microsoft Project (the most current version). The Contractor may request to use different software as a substitution, in accordance with Division 1, Section 01 25 00 - Substitutions. If the alternate software is accepted, the Contractor will be required to supply the Engineer with an authorized copy of the software with all user support manuals.

C. If the Contractor should desire or intend to complete the Work earlier than any required Critical or Completion date, the Port will not be liable to the Contractor for any costs or other damages should the Contractor be unable to complete the Work according to this earlier date. The duties and obligations of the Port to the Contractor shall be consistent with and applicable only to the completion of the Work on the Milestone and Completion dates specified in the Contract, unless the Port and the Contractor otherwise agree and a change order is issued.

D. At anytime throughout the course of the work, the Engineer reserves the right to require additional activities to be added to the Schedule to further define the contractor’s plan and intentions regarding the execution of the Work. In each instance, such activities or changes shall be made by the Contractor at no cost or delay to the Port.

1.02 SCHEDULE - BAR CHART

A. Pursuant to the General Conditions of this Contract, the following additional scheduling requirements are a part of this Contract.

B. Work under this Section shall consist of furnishing a Schedule showing in detail how the Contractor plans to execute and coordinate the Work. The Contractor shall use the Critical Path Method (CPM) and precedence Diagram Method (PDM) to generate the Schedule. The Schedule shall be based on, and incorporate the Contract Milestone and Completion Dates included in the Contract, and shall show the order in which the Contractor shall perform the Work, projected dates for the start and completion of separable portions of the Work, and other information concerning Contractor's scheduling as Port may request.

C. Schedule Requirements: The Schedule shall be in the form of a bar chart and shall consist of horizontal lines, or bars, plotted along a time scale. The horizontal bar(s) shall indicate the start and finish dates as well as the total time period of performance for each activity. The Contractor shall arrange the chart so as to show the activities which are necessary to fulfill each and every Milestone and Completion Date requirement. The schedule shall be sorted by phase, area and early start date.

D. The Schedule Content: The Contractor's Schedule shall include, but not be limited to:

1. Critical procurement activities including mobilization, shop drawings and other submittals, Engineer review of submittals, fabrication, and delivery of key and long-lead equipment and materials;
2. Contract Execution; Preconstruction Submittals, Notice To Proceed; Construction/erection activities; Pre Final Inspection, Final Inspection and Substantial Completion.
3. Offsite activities including interfaces with the work of outside contractors, e.g. utilities, power, or any separate contractor.
4. Port activities including delivery of materials and equipment, programming, abatement, and services provided.
5. Testing activities; Hold and witness points in construction; Commissioning, and Training.
6. Phased Completion, Milestones and associated Substantial Completion Dates if specified.
7. Activities for project Contract activities and requirements which include, but are not limited to, O&M manuals and record documents.
8. Activities that are impacted by Change Order or Event.

E. The identity, and logic of activities comprising the Schedule shall meet the following criteria:

1. The description of work by activity. Activity descriptions and coding shall contain the area of the work as well as the specific type of work.
2. Activity boundaries shall be easily measurable and descriptions shall be clear and concise. The beginning and end of each activity shall be readily verifiable, and progress shall be quantifiable.
3. Responsibility for each activity shall be identified with a single performing organization.
4. Activity duration shall be in work days. Unless agreed otherwise with the Engineer, activity durations over fifteen (15) working days shall be kept to a minimum and be used only for non-construction activities, such as shop

drawing and sample submittals, fabrication and delivery of materials and equipment, concrete curing, and General Conditions activities.

5. The Baseline Schedule must indicate which activities are to be performed on day shift versus night shift, and which activities will be performed utilizing two work shifts, or weekend work. The contractor is fully responsible for planning and performing the work in order to meet all of the required project delivery dates, including additional second or third shift work.

6. Potential problems or constraints related to the implementation of the construction plan shall be identified in writing.

7. Foreseeable delays to activities such as normal seasonal weather shall be considered and included in the planning and scheduling of all work.

8. Imposed completion dates for events other than the Completion Dates are not permitted. Artificial Constraints are also not permitted.

9. The format for the Schedule shall include an activity information table shown on the left side of the page and a bar graph on the right side of the page. The columns in the activity information table on the left side of the page shall include, but are not limited to; Activity ID, Activity Description, Calendar ID, Original Duration, Remaining Duration, Early Start, Early Finish, Total Float, and Predecessors. The bar chart format shall include the Start Date to the left of the bar and the Activity Description to the right of the bar. The logic ties shall be visible on the bar chart. Critical Activities bars shall be identified by a different color than the non-critical activities.

F. Other Schedules

1. Three-week “Look Ahead” schedule: The three-week "Look Ahead" Schedule shall include the current week’s activities from the monthly Schedule, the next two weeks of planned work activities and other schedule information deemed necessary by the Contractor.

    a. These schedules shall identify critical work, utility shutdowns and activities impacting operations.

2. As-Built project schedule: The As-built shall be submitted at the end of the Project. The as-built schedule shall show actual start and finish dates for all activities in the schedule. This is the final schedule update for the project.

G. Submittals

1. The submittal of the schedule documents shall include:

    a. The Baseline Schedule shall be submitted and accepted or accepted as noted prior to issuance of NTP, per Section 01 32 19 - Preconstruction Submittals.

        (1) The Baseline Schedule shall include a narrative that explains the basis for the Contractor’s schedule of construction and any constraints.

    b. The monthly schedule shall be submitted with the monthly request for payment.

c. Three-week “Look Ahead” schedule: Contractor shall provide to the Engineer one electronic copy (PDF format) for the project meetings, 24-hours before the scheduled meeting.

d. As-Built project schedule shall be submitted at the end of the Project.

2. All schedules and schedule documents shall be electronic, submitted to the Engineer via CMS. Submit one (1) color pdf of each schedule report, (except the Look-ahead schedules) together with an electronic data file of the CPM schedule. The bar chart schedules shall be sized for 11” X 17” printouts.

H. Acceptance Process

1. The Engineer will review the Contractor’s Schedule. If required, a meeting will be held between the Engineer and the Contractor to resolve any conflicts between the Contractor’s schedule and the overall Project Construction. The Contractor shall revise the schedule as required by the Engineer to support the Project Construction and shall submit its revised schedule to the Engineer within five (5) days for review and acceptance.

2. Acceptance by the Engineer of the Contractor’s Schedule is advisory only and shall not release the Contractor of the responsibility for accomplishing the Work within each and every Contract-required Milestone and Completion Date. Omissions and errors in the Schedule shall not excuse performance that is not in compliance with the Contract. Acceptance by the Engineer in no way makes the Port an insurer of the Schedule’s success or liable for time or cost overruns from its shortcomings. The Port disclaims any obligation or liability by reason of its acceptance of the Schedule.

1.03 COORDINATION

A. The Contractor shall coordinate the Work with that of other contractors working on or near the project site and shall cooperate fully with the Engineer in maintaining orderly progress toward completion of the Work as scheduled.

B. The Contractor shall involve all applicable subcontractors in the schedule development, updating and revisions.

C. The Contractor shall keep subcontractors informed of the Work underway by utilizing all project schedules.

D. The Contractor shall coordinate all Work activities with Port departments providing services and support to the project.

1.04 SCHEDULE UPDATES

A. Update Procedures

1. The Contractor understands and agrees that its Schedule is intended to accurately reflect at all times the status of the Project Construction and projected activities. The Contractor also understands and agrees that updating is a key requirement to accomplish this intent and shall comply with the requirement to update.

2. The graphic format of the Schedule shall include actual start and actual finish dates for activities that have started or finished. For activities in

progress, activity progress shall be shown on the activity bar and the forecasted completion shall indicate the earliest the activity can be completed based upon current project status.

3. The Contractor understands and agrees that updating the Schedule is independent from updating the cost for progress payment purposes.

4. Contractor shall submit the accepted updated schedule with the pay application and include a written narrative describing the overall progress of the Work. The narrative shall include the following key aspects:

    a. Progress in the last period.

    b. Critical Path progress and schedule concerns.

    c. Changes to schedule logic or sequencing of the work.

    d. Potential Delays and Time Impact Analyses.

    e. Submittal Status (focus on critical submittals and concerns).

    f. Equipment and Material Delivery Status.

5. The Engineer will not be obligated to review or to process any Application for Progress Payment until the Contractor has submitted all schedules update information and the information accepted.

6. Throughout the progress of the Work, the Contractor shall prepare and maintain a three-week Look-ahead bar chart field schedule reflecting the schedule of work activities accomplished for the previous week and the work scheduled for the forthcoming two weeks. This schedule shall be presented at the weekly project meetings Activities on the three-week Look-ahead schedules shall be readily identifiable with activities on the Baseline schedule. Submit a pdf of the three-week look-ahead to the Engineer, 24 hours prior to the Project Meeting.

7. Updates shall be submitted on a monthly basis.

1.05 FLOAT

A. Schedule float is not for the exclusive use or benefit of either the Contractor or the Port. Neither the Port nor the Contractor “owns” the float. The project or Work “owns” the float. Liability for delay to Contract or milestone dates rests with the party whose action (or inaction) caused the delay beyond the float that was available at the time of the delaying action (or inaction).

B. Extensions of time will be granted only to the extent that the activity or activities affected exceed the total float or slack along the critical path of activities affected at the time of Notice to Proceed of a Change Order or the commencement of any delay or condition for which an adjustment is warranted under the Contract Documents. The Contractor shall submit documentation supporting its request for a time extension in a form acceptable to the Engineer and consistent with the requirements of the General Conditions.

1.06 TIME IMPACT ANALYSIS FOR CHANGED CONDITIONS

A. If the Contractor experiences activity delays that the Contractor believes are caused by the Port, and the Contractor seeks to obtain a Contract time extension, the Contractor shall submit a formal written Time Impact Analysis (TIA). The TIA shall define the impact of each change or delay to the current accepted Schedule. The TIA shall include a written narrative of the impact of such delays, and a schedule that depicts how the changed or delayed work affects other activities in the current accepted Schedule.

B. The Contractor shall continue to track update and submit monthly schedules during the development review and response period for the TIA. The Engineer may withhold monthly payment if the Contractor fails to maintain and submit updated schedules.

C. In addition to the Contractor's presentation of the impact in the TIA, the Contractor shall include in the TIA, a mitigation plan that reduces or eliminates the claimed delay. The mitigation plan shall include specific Port and Contractor actions as well as the cost to the Contractor to proceed with the mitigation.

D. In the event that the Contractor requests a Contract time extension, the time impacts to critical path activities in the current accepted Schedule shall be clearly shown. Extensions of time will be granted only to the extent that such changes or delays cause the time for the changed activity and related activities to exceed the total float along the affected path of activities at the time of the Port directive to proceed with the change or the actual commencement of the delay included in the TIA.

E. Each formal TIA shall be submitted in accordance with the General Conditions

F. A copy of the Port accepted TIA will be incorporated in the change order signed by the Contractor and the Port for such change. Any changes to the Schedule will be incorporated into the next update of the Schedule following the Port's acceptance of the TIA.

G. The Contractor shall be responsible for all costs associated with the preparation of the TIA and the incorporation of accepted TIAs, or portion of TIAs, in the Schedule.

H. If agreement is not reached on a TIA, or a portion of a TIA, the Schedule, including any time extensions, shall be revised only to the extent accepted by the Port. For any TIA, or portion of a TIA, that is not accepted by the Port, the Contractor may submit a claim in accordance with the Conditions of the Contract.

1.07 RECOVERY SCHEDULE

A. Should any conditions exist, such that certain activities shown on the Contractor's Schedule fall behind schedule to the extent that any of the mandatory Critical dates or Completion dates are in jeopardy, the Contractor shall be required to, at no cost to the Port, prepare and submit to the Engineer a supplementary recovery schedule, in a form and detail appropriate to the need, to explain and display how it intends to reschedule those activities to regain compliance with the Schedule.

B. After determination of the requirement for a Recovery Schedule, the Contractor shall, within five (5) work days, present to Engineer the Recovery Schedule. The Recovery Schedule shall represent the Contractor's best judgment as to how work should be reorganized for return to the accepted Schedule. The Recovery Schedule shall be prepared to a similar level of detail as the Schedule.

1. Recovery Schedule: The Recovery Schedule shall represent the Contractor's best judgment as to how the Contractor's work shall be reorganized such that the work may return to the accepted Schedule within

a maximum one-month period. The Recovery Schedule shall be prepared at a similar level of detail as the Schedule and shall be based on the accepted Schedule. The following requirements apply to Recovery Schedules:

a. Conditions Requiring a Recovery Schedule: Should any conditions exist, such that certain activities shown on the Schedule fall behind schedule to the extent that any of the mandatory critical dates or milestone completion dates are at risk of being delayed, the Contractor shall, at no cost to the Port, submit to the Engineer a Recovery Schedule.

b. Allow five (5) work days for review by the Engineer. Any revisions that result from the Engineer’s review shall be resubmitted within three (3) work days by the Contractor for acceptance by the Engineer.

c. Narrative: Provide narrative describing the recovery schedule logic.

d. Schedule:

    (1) Complete Schedule organized by Major Area, sorted by sub area and early start date. Provide in bar chart format.

    (2) Critical Path Schedule: This schedule shall show only the critical path. Provide in bar chart format.

e. Manpower Loading and Progress Curve updated to reflect the Recovery Schedule.

f. The accepted Recovery Schedule shall then be the Schedule that the Contractor shall use in planning, organizing, directing, coordinating, performing and executing the Work (including all activities of subcontractors, equipment vendors and suppliers) that is included on the Recovery Schedule. All other Work shall proceed per the accepted Schedule.

g. No later than five (5) calendar days prior to the expiration of the Recovery Schedule, the Engineer and Contractor will meet to determine whether the Contractor has regained compliance with the accepted Schedule. At the direction of the Engineer, one of the following will occur:

    (1) If, in the opinion of the Engineer, the Contractor is still behind schedule, the Contractor shall prepare another Recovery Schedule, at no cost to the Port, to take effect for a maximum of one additional month from the start of the new Recovery Schedule.

(2) If, in the opinion of the Engineer, the Contractor has sufficiently regained compliance with the Schedule, the use of the Schedule shall be resumed.

1.08 AS-BUILT SCHEDULE

A. Provide for the As-Built Record Document an As-Built Schedule prior to request for Final Payment.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION

A. This section addresses the submittals that must be made by the Contractor and accepted by the Engineer prior to issuance of a Notice to Proceed (NTP). The Port has based the Contract time on issuing an NTP forty-five (45) days after Execution and has allowed time in the Contract duration for the Contractor to prepare, submit, and gain acceptance of the required submittals detailed herein.

B. The Port will not issue a NTP, or accept requests for partial payments, or allow for onsite mobilization (less field office setup) until the Preconstruction submittals have been received and accepted by the Engineer. At the sole discretion of the Engineer, a partial NTP may be granted for portions of the Work.

C. No time extension shall be granted for any delays in issuance of the NTP by the Engineer due to the Contractor's failure to provide acceptable submittals required herein. The Engineer shall be the sole authority on determining the acceptability of the Contractor's submittals.

D. Early submission is encouraged. A submittal package that has “Accepted” or “Accepted As Noted” before the Preconstruction Conference can result in a Preconstruction Conference and NTP earlier than that originally contemplated. Poorly prepared, incomplete, or inaccurate submittals as well as non-receipt by the Engineer of required submittals will cause the Preconstruction Conference and the issuance of the NTP to be delayed. The Contract completion date remains "as bid." The Contractor is expressly notified that delay in issuance of NTP, due to incomplete or unacceptable submittals, will reduce the "actual" amount of time the Contractor has to complete the Work of the Contract.

1.02 SUBMITTALS

A. All submittals shall be made in accordance with Section 01 33 00- Submittals.

B. Required Submittals:

1. A Technical Execution Plan (TEP) shall outline the implementation of the work. The TEP shall include at a minimum, the following elements:
    a. Demolition Plan, installation of cleanup action and construction activities including means and methods (Section 02 41 13 Site Demolition).
    b. Survey Approach
    c. Electrical Approach
    d. Transportation Disposal Plan that include how the Contractor will sequence and manage the import and export of all materials on site without any truck queuing on the project site. Plan shall include the selected disposal facilities for all materials.

    e. Contractor’s Permit Statement (National Pollutant Discharge Elimination System (NPDES) Permit) per Document 00 80 00, Supplementary Conditions.

    f. Site Specific Safety Plan per Section 01 35 29 – Safety Management.

g. Quality Control Plan per Section 01 45 16.13a – Contractor's Quality Control Program.

h. Temporary Erosion and Sediment Control Plan per Section 01 57 13 -Temporary Erosion and Sediment Control Planning and Execution.

i. Pollution Prevention Plan per Section 01 57 23 – Pollution Prevention Planning and Execution.

j. Waste Management Plan and Final Report per Section 01 74 19 – Construction Waste Management

k. Piping plan. Include a pipe supporting plan for subsurface piping and piping running along the ground surface and include how pipes will daylight and connect into the AS/SVE System, per Section 33 90 90 – Piping and Wellheads.

2. Copies of any permits or other regulatory or public agency approvals required per Document 00 80 00, Supplementary Conditions.

3. List of subcontractors in accordance with General Conditions.

4. Contractor's Project Organization and personnel qualifications per Section 01 31 00 – Contractor's Project Organization.

5. A Baseline Schedule, per Section 01 32 16 – Bar Chart Schedules.

6. Schedule of Values per Section 01 20 00 - Measurement and Payment Procedures.

7. Submittal Log per Section 01 33 00 - Submittals.

8. Long lead procurement items as defined in technical specifications.

9. Preconstruction submittals for regulated materials per Fugitive and silica dust (see Section 02 87 00)

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION

A. Individual Submittals are required in accordance with the pertinent sections of these specifications.

B. Submittal Log: After Contract Execution, the Engineer will provide an electronic draft Submittal Log to the Contractor indicating those Submittals generally required by the specifications. The Contractor shall check the required Submittals for completeness and accuracy against the bid documents and return the completed Submittal Log to the Engineer within 15 calendar days. The Port will complete the first six (6) columns. The Contractor shall complete the "Contractor Priority" and "Date Due from Contractor" columns. The Contractor may also make comments in the "Remarks" column. This date shall correspond with that shown on the Project Schedule for each Submittal. A copy of the Submittal Log is attached to this Specification Section, for reference purposes only. The Contractor is expected to provide all listed Submittals unless specifically requested to be removed from the Submittal Log and accepted by the Engineer.

C. All Submittal coversheets shall bear the Contract name and number, the date of submission, reference to the specification section and drawing number to which the Submittal applies, the nature of the Submittal, and the Contractor's signature.

D. Submit all shop drawings, catalog cuts, and brochures in the quantity specified herein, electronically, using the Contract Management System (CMS) Submittal Workflow process or other format as accepted by the Engineer.

   1. Submittal drawings shall include the official Port project name and work project number in the title blocks of all drawings that are created or modified for specific use on the project.

E. Prepare a separate Submittal form for each product or procedure and identify by referencing the specification section and paragraph number.

F. The Port will return the Submittal electronically via the CMS Submittal Workflow process, within 21 days of receipt by the Engineer. Submittal status is reviewed in weekly Progress Meetings. See Deferred Submittals section for additional information on submittal process and timelines.

G. The Port will allow one (1) review of the original Submittal and one (1) submittal reiteration, which is included in the cost of the project. The Port has the right to recover any additional cost that may result from the review of any subsequent re-submittals.

H. Engineer shall receive submittals, including shop drawings, product data and samples from Contractor and shall review and take other appropriate action on them, but only for conformity with the design concept of the Project and with the provisions and intent of the Contract Documents. Shop drawings, samples, and other submission reviews by Engineer shall not include checking of dimensions or openings for potential conflict. Engineer's acceptance of a specific item shall not indicate acceptance of an assembly of which the item is a component. Submittals will be returned, "Receipt Acknowledged", "Accepted", "Accepted as Noted", "Revise and Resubmit" or "Not Accepted".

I. Section 01 32 19 - Preconstruction Submittals contains required submittals that must state “Accepted” or “Accepted as Noted” by the Port prior to issuance of Notice to Proceed.

J. See Section 01 25 00 - Substitutions for procedures regarding requests for substitutions.

1.02 COMPLIANCE

A. The Port may not pay for materials delivered or incorporated into the Work without an accepted submittal.

B. Failure to comply with these requirements shall be deemed as the Contractor’s agreement to furnish the exact materials specified or materials selected by the Engineer based on these specifications.

1.03 SHOP DRAWINGS

A. Quality: Prepare shop drawings accurately to scale sufficiently large to indicate all pertinent features of the products and the method of fabrication, connection, erection, or assembly with respect to the work. Calculations associated with shop drawing design shall also be submitted.

B. Structural Fabrication and Erection Drawings: All shop drawings which indicate structural fabrication or erection details and associated calculations shall bear the seal of a licensed structural engineer in the State of Washington.

C. Thoroughly review all shop and detail drawings prior to submittal, including all those provided by subcontractors and suppliers at any tier, to assure coordination with other parts of the Work. Failure to comply will be cause for rejection. Submittals shall bear the Contractor's **approval** stamp and initials of the reviewer.

D. Components or materials which require shop drawings and which arrive at the job site prior to acceptance of shop drawings shall be considered as not being made for this project and shall be subject to rejection and removal from the premises.

E. All drawings submitted to the Engineer shall be drawn on sheets each 24 inches wide by 36 inches long in overall dimensions or on small sheets that are multiples of 8-1/2 inches by 11 inches.

F. Type of Prints Required: Submit one (1) electronic copy of all shop drawings or supplemental working drawings in accordance with Document 00 70 00 – General Conditions.

G. Submit shop and detail drawings in related packages. All equipment or material details that are interdependent or are related in any way must be submitted together as a complete package indicating the complete system. Submittals shall not be altered once accepted for construction. Clearly mark and date revisions. Major revisions must be resubmitted for acceptance

H. All documents submitted to the Port and not returned to the Contractor, shall be retained by the Port, including software and source codes, etc., that is developed or used for the project. See Document 00 70 00 – General Conditions.

1.04 MANUFACTURERS' LITERATURE

A. Submit one (1) electronic copy of manufacturers’ literature. The electronic data shall have software search features and interactive capabilities.

1. Product data, catalog cuts, or brochures shall show the type, size ratings, style, color, manufacturer and catalog number of each item and be complete enough to provide for positive and rapid identification in the field. Submit catalog data in electronic form. The electronic data shall have software search features and interactive capabilities. Specific items shall be clearly marked or highlighted. General catalogs or partial lists will not be accepted.

1.05 SAMPLES

A. The sample submitted shall be the exact or precise article proposed to be furnished.

B. Submit three (3) samples of each article proposed.

1.06 MOCKUPS

A. Provide any mockups required in the technical specifications for evaluation by the Engineer, allowing a reasonable amount of time for review.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION - Not used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 CONTRACTOR FULLY RESPONSIBLE FOR SAFETY

A. The Contractor assumes full and sole responsibility for and shall comply with all laws, regulations, ordinances, and governmental orders pertaining to safety in the performance of this Contract. The Contractor shall conduct all operations under this Contract to offer the least possible obstruction and inconvenience to the Port, its tenants, the public and abutting property owners. The Contractor shall be responsible for employing adequate safety measures and taking all other actions reasonably necessary to protect the life, health, and safety of employees, the public, and to protect adjacent and Port-owned property in connection with the performance of the Work.

B. The Contractor shall have the sole responsibility for the safety, efficiency, and adequacy of the Contractor’s plan, appliances, and methods, and for any damage or injury resulting from their failure, or improper maintenance, use, or operation. The Contractor shall be solely and completely responsible for the conditions of the Project Site, including safety of all persons and property in performance of the Work. This requirement shall apply continuously, and is not limited to normal working hours. Nothing the Port may do, or fail to do, with respect to safety in the performance of the Work shall relieve Contractor of this responsibility.

1.02 REFERENCES

A. The Contractor shall comply with the provisions found in the Port of Seattle Construction Safety & Health Manual, the Federal Occupational Safety and Health Act of 1970 (OSHA), including all revisions and amendments thereto; the provisions of the Department of Safety & Health (DOSH) Washington Industrial Safety Act of 1973 (WISHA); and the requirements of the following chapters of the Washington Administrative Code:

1. Chapter 296-24 WAC General Safety and Health Standards.
2. Chapter 296-62 WAC General Occupational Health Standards.
3. Chapter 296-155 WAC Safety Standards for Construction Work.
4. Chapter 296-800 WAC Safety & Health Core Rules
5. ANSI/ASSE Standards

B. In addition, the Contractor shall comply with the following requirements when they are applicable:

1. Local Building and Construction Codes.
2. United States Coast Guard
3. Seattle Fire Department Codes
4. NFPA 70E
5. National Electrical Code

NOTE: In cases of conflict between different safety regulations, the more stringent regulation shall apply.

1.03 DEFINITIONS

A. Manager, Construction Safety Services

An employee of the Port or designated consultant who is responsible for the day-to-day management of the Port of Seattle's Construction Safety Program, and such agents, including the Field Safety Manager, as authorized to act in his/her behalf.

B. Field Safety Manager

An employee of the Port or designated consultant who conducts and monitors jobsite inspections and verifies Contractor compliance with identified corrective actions.

1.04 SUBMITTALS

A. The Contractor shall submit the following information as found in paragraph 1.05 A

B. The Contractor shall submit a site specific Chemical Exposure Plan prepared by a Certified Industrial Hygienist for any products containing isocyanates, methylene chloride, Hydrofluoric Acid, lead, silica, and processes involving floor sealers, traffic coatings, terrazzo sealers, or specialty paints. The plan shall include employee exposure control methods, isolation methods to prevent spread of chemicals outside the work area and safeguarding of the public.

1.05 CONTRACTOR RESPONSIBILITIES

A. SITE SPECIFIC SAFETY PLAN

1. The Contractor shall submit, for the Port’s review and comment, a Site-Specific Safety Plan in connection with the Work. The submittal shall be made in accordance with Section 01 32 19, Pre-Construction Submittals. An outline of the matters to be address in the Safety Plan is set forth in Appendix A to this Division. The Port’s review of, or comment on, the Safety Plan shall not, in any way, relieve the Contractor of any responsibility or liability for the Safety Plan. Delay in submitting a written safety plan will not constitute grounds for a contract schedule extension or delay claim.
2. The Port will not issue a Notice to Proceed (NTP), until the Safety Plan has been received and accepted by the Engineer and Manager of Construction Safety Services.

B. GENERAL OBLIGATIONS

The Contractor is responsible for accident prevention and job site safety. This responsibility cannot be delegated to Subcontractors, suppliers, the Port, or other persons. To this end, the Contractor shall:

1. Promote a safe and healthy work environment.
2. Provide an accident prevention program.
3. Promote training programs to improve the skill and competency of all employees in the field of occupational safety and health.
4. Instruct all employees of safe work methods and practices when assigning work.
5. Ensure that employees have and use the proper protective equipment and tools for the job.

6. Ensure that all heavy equipment operators (i.e. cranes, loaders and forklifts) are properly qualified and trained on the specific piece of equipment in use.
7. Plan and execute all work to comply with the stated objectives and safety requirements contained in the contract provisions, Federal, State, local laws and regulations, and industry standards.
8. Cooperate fully with the Port and its Consultants and insurers (if applicable) in connection with all matters pertaining to safety.
9. Maintain an orientation program for new employees, including subcontractor employees, that includes at a minimum, a review of:
    a) Potential hazards in the work areas
    b) Required personal protective equipment and apparel
    c) The following prohibited conduct shall result in the immediate removal from the project: gambling, fighting or horseplay, possession of firearms, alcohol or illegal use, possession or sale of a controlled substance or being under their influence.
    d) Emergency procedures
10. Perform documented daily inspections of the project in the Contractor Daily Report. Review and direct immediate action to correct any substandard safety conditions or practices, including those of any Subcontractor, regardless of classification.
11. Hold a minimum of one weekly scheduled safety meetings with its employees. Such meetings shall include a discussion of all observed unsafe work practices or conditions, a review of the accident experience and all corrective actions. The Contractor shall encourage safety suggestions from employees.
12. Hold a minimum of one monthly all-hands safety meeting with its employees, and subcontractor employees - subcontractors at any tier. An agenda shall be prepared and distributed for this meeting. The meeting shall include a safety update, and pertinent safety information for upcoming work. The Contractor shall encourage input and involvement from the subcontractors.
13. Ensure prompt medical treatment is administered to any injured employee.
14. Undertake a complete investigation of all accidents and implement corrective action to prevent a recurrence.
15. Prepare and implement a site safety plan as set forth in Paragraph 1.05. A hereof.
16. Comply with the Administrative Procedures set forth in Paragraph 1.08 hereof.
17. Provide the Engineer and Manager of Construction Safety Services with copies of all DOSH citations immediately upon receipt.

18. Ensure that all of its subcontractors, suppliers, etc., are provided with a copy of this specification and are informed of their obligations regarding safety.

19. Ensure that all Contractor and subcontractor personnel at any tier have completed a one and one-half (1 ½) hour Port of Seattle safety orientation to be held by the Port of Seattle at a time and location to be to be specified by the Port, prior to commencing work. The time expended and any associated costs such as travel time, parking, and other expenses are to be borne by the Contractor.

C. CONTRACTOR SAFETY REPRESENTATIVE

1. It is recognized that the responsibility for safety lies with the Contractor. Each Contractor shall appoint an individual(s) responsible for safety on each contract. This individual(s) must be employed in a supervisory position, empowered by their employer to take corrective action; be present on the project while work is being performed; and spend the amount of time necessary to ensure the Contractor’s compliance with safety requirements.

2. A safety inspection shall be performed and documented for each shift worked, by the Contractor’s safety representative.

3. The Contractor shall submit a resume of the experience and qualifications for the proposed Safety Representative(s) as part of the Safety Plan submittal. Please refer to part D. Definitions, subparagraphs 1 and 2 below. The Port will review the resumes and a personal interview may be required. The Port may reject anyone it deems “Not Qualified.”

D. FOREMAN SAFETY RESPONSIBILITIES:

1. Foremen are key individuals in an effective safety program. Their pro-active efforts toward accident prevention on their daily assignments help determine the degree of safety that exists on the job. A foreman’s safety responsibilities include the following as a minimum:

   a) Inspect his/her assigned job areas to ensure that unsafe acts or conditions are identified and corrected

   b) Ensure that safety requirements are adhered to and enforced

   c) Provide and require the use of proper personnel protective equipment and suitable tools for the job

   d) Set a good example for his/her crew in the matter of safety

   e) Ensure that orderliness and good housekeeping are maintained

   f) See that his/her assigned crew is properly instructed in the safe work practices when assigned to job tasks

   g) Investigate all accidents that occur in areas under their direction to determine facts necessary for corrective actions

   h) Promptly assist in the completion of accident reports per contract requirements

   i) Conduct weekly toolbox safety meetings with personnel to discuss unsafe work practices and conditions identified

- j) Review accident investigations and corrective actions implemented
- k) Encourage personnel to make suggestions regarding safety and to pass these on to supervision
- l) Ensure that prompt first aid is administered

E. DEFINITIONS

1. Fulltime Safety Professional qualifications include:
    - a) Shall have no other duties.
    - b) An individual possessing a minimum of five years progressive experience managing safety programs on large construction projects comparable to this contract in scope and complexity.
    - c) Be knowledgeable concerning all federal, state, and Port of Seattle regulations applicable to construction safety.
    - d) Possess “Competent Person” certification in construction safety disciplines related to the work performed and possess verifiable training. This individual shall also be responsible for identifying “Competent Persons” required by State and Federal safety standards for which they are not certified.
    - e) Have successfully completed the OSHA 500 Safety and Health Course. This requirement may be waived in lieu of a safety and health degree or professional safety certification.
    - f) Training and current certification for CPR and First Aid is preferred.
    - g) Be capable of performing accident investigations and developing a concise report.
    - h) Is proficient in the development and presentation of “tool box” meetings and safety training.
2. Site Safety Officer qualifications include:
    - a) An individual assigned to perform safety functions on any contract not requiring a Fulltime Safety Professional. This can be a collateral duty position held by a supervisor. Safety duties shall take priority over other collateral duties.
    - b) Possess a minimum 5 years progressive experience in their trade.
    - c) Be knowledgeable concerning all federal, state, and Port of Seattle regulations applicable to safety.
    - d) Have successfully completed the OSHA 30-hour Safety & Health Course.
    - e) Possess “Competent Person” certification in construction safety disciplines related to the work performed and possess verifiable training. This individual shall also be responsible for identifying “Competent Persons” required by State and Federal safety standards for which they are not certified.

f) Be trained in, and possess current certification for CPR and First Aid.

g) Possess verifiable training and be capable of performing accident investigations and developing a concise report.

h) Possess verifiable training in the development and presentation of “tool box” meetings and safety training.

F. DETERMINATION

1. When the number of personnel on any shift is under 40 (including Subcontractor employees), the Contractor’s safety representative will meet the definition of “Site Safety Officer” as defined above for each shift.
2. For Contractors with a total of 40 or more personnel (including Subcontractor employees) on any shift, a Fulltime Safety Professional as defined above shall be required for each shift.
3. For each additional 75 employees (including Subcontractors employees) on any shift, a second Fulltime Safety Professional shall be required.
4. At the Port’s discretion the requirements for Contractor safety personnel can be reviewed and action taken to decrease or increase the number of individuals.
5. The Contractor Safety Officer/Professional (s) shall be primarily responsible for ensuring Contractor’s compliance with the safety requirements provided in this Division. Without limiting the generality of the foregoing, the Contractor Safety Officer/Professional (s) shall:

   a) Review all subcontractor and sub-tier contractor’s Site Specific Safety Programs and Job Hazard Analysis (JHA) for compliance with applicable POS Construction Safety, State and Federal Standards and ensure that they receive a copy and are briefed on Document 01 35 29 Safety Management.

   b) Perform a site-specific safety orientation for all employees, subcontractors and sub tier contractors prior to beginning work. This is in addition to the Port’s safety orientation.

   c) Perform daily safety inspections of the Contractor and Subcontractor’s project to evaluate the project for unsafe conditions and/or practices, and take the appropriate corrective action when required.

   d) Immediately report all injuries of personnel, vehicles, “Near Miss” incidents and property damage to POS Manager, Construction Safety Services and insure immediate corrective action is taken. Assist in the preparation of all accident investigations and ensure reports are submitted within 24-hours.

   e) Ensure meaningful, weekly safety meetings are held for all on-site employees. Provide the job foremen with appropriate training materials to conduct weekly “tool box” safety meetings and attend safety meetings to evaluate their effectiveness. Maintain documentation of topics discussed and attendees, with copies submitted to the Engineer or included with Contractors Daily Construction Report.

f) Be responsible for the control, availability, and use of necessary safety equipment, including personal protective equipment and apparel for the employees.

g) Shall attend a monthly safety committee meeting scheduled by the Manager of Construction Safety Services to discuss and resolve relevant issues related to safety and health on Port of Seattle projects.

6. Contractor Safety Officer/Professional (s) not performing their duties in accordance with this document, shall be replaced at the Port’s discretion by an individual meeting the requirements of this section. In addition, the Contractor Safety Officer/Professional (s) may not be removed from this contract or replaced without the Port’s advanced written approval. The Contractor shall notify the Engineer and Manager of Construction Safety Services when this person cannot be on duty while work is being performed and shall submit the name(s) and qualifications of the individual assigned to perform said duties.

G. ACCIDENT PREVENTION

1. The Contractor has the responsibility to correct hazardous conditions and practices. When more than one Contractor is working within a given job site, any project management personnel shall have the authority to take action to prevent physical harm or significant property damage. If it is determined there is “Imminent Danger” the Contractor shall:

a) Take immediate action to remove workers from the hazard and stabilize or stop work until corrective actions can be implemented to eliminate the hazard.

b) Immediately identify and implement corrective action to eliminate the hazard.

c) Immediately notify the Engineer, and Manager of Construction Safety Services or others as necessary. The Engineer will notify the proper authorities if the damage cannot be promptly corrected and could develop into an emergency.

d) Each worker shall immediately report any condition suspected to be unsafe or unhealthy to their job foreman or safety representative. If there is no resolution of the concern at that level, the employee shall report the concern to the Engineer and Manager of Construction Safety Services.

H. ON SITE FIRST AID

1. This section is designed to assure that all employees in this state are afforded quick and effective first-aid attention in the event of an on the job injury. To achieve this purpose the presence of personnel trained in first-aid procedures at or near those places where employees are working is required. Compliance with the provisions of this section may require the presence of more than one first-aid trained person.

a) Each employer must have available at all worksites, where a crew is present, a person or persons holding a valid first-aid certificate.

b) All crew leaders, supervisors or persons in direct charge of one or more employees must have a valid first-aid certificate.

c) For the purposes of this section, a crew means a group of two or more employees working at any worksite.

Additionally, the Contractor shall:

d) Post emergency procedures which shall include telephone numbers and locations of facilities including, but not limited to, hospitals, physicians, police, fire and emergency medical services, in conspicuous locations at the job site and at all telephone locations.

e) Provide in a readily accessible location, first-aid supplies of sufficient size and number to handle common first-aid incidents.

f) Identify personnel qualified to render first aid with suitable emblems affixed to the rear of their hard hats for identification.

g) Regularly discuss actions to be taken during emergencies with the Contractor’s supervisory personnel and at “tool box” safety meetings.

1.06 PORT OF SEATTLE’S RIGHTS

A. INSPECTIONS/INVESTIGATIONS

1. The Port may, in any reasonable manner, observe and inspect the Contractor’s safety and accident prevention procedures for all activities and personnel working at the construction sites, including the Contractor, subcontractors, visitors, and materials or equipment suppliers. This specifically includes, but is not limited to, the right to attend all safety meetings.
2. The Port shall receive written copies of accident or incident reports completed by the Contractor within 24-hours of occurrence, using the accident investigation reports found in the Port of Seattle Construction Safety & Health Manual or contractor equivalent. This reporting shall include but not be limited to those reports prepared pursuant to OSHA and/or DOSH regulations.
3. The Port may, in any reasonable manner, observe or participate in any accident investigation conducted by the Contractor or anyone performing work for, on behalf of or under the Contractor. The Port may also, at its sole discretion and in any reasonable manner, undertake its own accident investigation.

B. CORRECTIVE ACTIONS/STOP-WORK

1. The Port shall have the right to require the Contractor to address unsafe working conditions, including taking corrective action when unsafe working conditions are observed (i.e., lack of good housekeeping practices, use of equipment in obviously poor condition, failure to adhere to statutory construction regulations, etc.).

2. The Port shall have the right to require the removal from the work site of any person, property or equipment that, in the Port's opinion, is deemed unsafe.

3. The Port shall have the right to require the Contractor to immediately cease any action and/or stop the Work (or any portion thereof) in the event that any condition exists that, in the Port's opinion, constitutes an imminent danger or serious harm.

4. The Port shall have the right to suspend the Work (or any portion thereof) pending the completion of any accident/incident investigation, whether undertaken by Contractor, the Port or others.

C. PORT'S ACTION/INACTION DOES NOT RELIEVE CONTRACTOR

1. Nothing the Port may do, or fail to do, with respect to safety in the performance of the Work shall relieve the Contractor of its responsibility to comply strictly with this Division and all standards referenced in Section 1.02 of this document.

D. PORT'S ACTION/INACTION NO BASIS FOR ADJUSTMENT

1. The Port's exercise of any rights under this Paragraph 1.06 shall not be a basis for any adjustment in the Contract Price or Time.

E. PORT OF SEATTLE INCLUDES CONSULTANTS

1. As used in Document 01 35 29 the terms "Port of Seattle" and "Port" specifically includes the Port's designated consultants.

1.07 PORT MANDATED SAFETY REQUIREMENTS

A. Prior to Notice to Proceed (NTP), the Contractor's Project Manager and Safety Representative shall meet with the Engineer and Manager of Construction Safety Services to review and discuss the safety requirements of this contract.

B. SPECIFIC SAFETY PROVISIONS

1. In addition to Federal, State, and Local regulations pertaining to operations and safety, the Contractor shall adhere to the following Port mandated safety requirements:

a) Asbestos and Contractor Personnel Asbestos Training: Ensure that all Certified Asbestos workers have current certifications, and ensure that all other site workers, including subcontractors, have received the initial and annual Asbestos Awareness training prior to the start of work.

b) Entry into Confined Spaces: Work on this project may require entry into confined spaces as defined by WAC 296-809. The Contractor shall read and follow the requirements of the Port of Seattle's Confined Space Entry Program, as found in the Port of Seattle

Construction Safety and Health Manual. The Contractor’s Confined Space Entry Program must meet or exceed these requirements.

1) The Contractor shall provide the Engineer a copy of its Confined Space Entry Program as part of the Contractor’s Safety Plan Submittal. As part of this submittal, the Contractor shall complete the “Confined Space Entry Program Certificate” (Appendix B).

2) Should the Contractor employ subcontractors to work in confined spaces it shall be the Contractor’s responsibility to submit the required documentation for each subcontractor.

3) No work shall be allowed to start in a confined space until the required submittals have been made. In the event the Contractor does not comply with these regulations, ACCESS WILL BE DENIED and the Engineer notified. Delays caused by failure to submit the required documentation shall not be considered a reason for extension of contract time.

c) Electrical - Safe Clearance Procedures

1) Entry into High Voltage Areas: Work on this project may require entry into manholes, vaults, electrical rooms or other High Voltage areas.

2) In the event entry is required, the Contractor is obligated to identify any High Voltage areas that may be involved in the project and immediately notify the Engineer if they have not been properly identified. Before entry into a High Voltage work area the Contractor shall notify the Engineer and contact STIA Electrical Shop at (206) 787-5311(Airport) or the Seaport Electrical Shop at (206) 787-3350.

d) Fire Prevention: The Contractor shall ensure that fire prevention measures on-site are in accordance with OSHA, DOSH, NFPA and POS standards. Approved safety cans shall be used for flammable and combustible liquids. Signs and fire extinguishers shall be provided where required.

e) Traffic Control: Ensure compliance with Section 01 55 26 Traffic Control.

f) Hazardous Materials: Ensure compliance with Section 01 57 23 Pollution Prevention Planning and Execution.

g) Open Flame Devices: Prohibit the use of unapproved fuel-burning types of lanterns, torches, flares or other open-flame devices on Port property.

h) Hot Work Permit:

1) Seaport: Open Flame Welding and spark producing equipment and tasks require the Contractor to implement a formal “Hot Work Permit” Program outlined in the Port of Seattle Construction Safety and Health Manual. Cutting and

Welding tasks also require the Contractor to secure a "Hot Work Permit" from the Seattle Fire Department in accordance with Supplementary Conditions 00 80 00 Article SC-04.12 Permits, Licenses, Fees and Notices.

i) Liquid propane storage and use below grade is prohibited.

j) Excavating & Trenching: Coordination with the Engineer shall be required for work performed on the site.

k) Construction activities that pose a potential risk of exposure to contaminated soil (such as excavations) shall be supervised by personnel who have both a current 40-hour Hazardous Waste certification, and an 8-hour Hazardous Waste Supervisor's certification. These individuals shall be able to identify the potential need for upgrading the level of health and safety protection. All personnel working in direct contact with contaminated soil shall have a current 40-hour Hazardous Waste certification and medical monitoring, as required in Hazardous Waste Operations, Chapter 296-843 WAC and in accordance with OSHA regulations. The plan shall also include emergency procedures and medical treatment, fire protection, Job Hazard Analysis (JHA), and PPE requirements.

l) The Contractor is responsible for soil sampling and air monitoring to determine hazards and exposures to their employees.

m) Safety plan shall include guidelines for the protection of construction-related workers against occupational musculoskeletal injury risk factors arising from operations connected with the construction, maintenance and repair, and demolition of structures, using a hierarchy of controls. Manual Material Handling, Body Positioning and Dynamic Stretching shall be addressed. Contractors will need to consult with their Safety Professionals to determine which tasks require an ergonomics prevention program and which selection of controls are needed to minimize injury.

n) As defined in WAC 296-155 – Part L, individuals involved in operating hoisting equipment, including but not limited to cranes, boom trucks, and forklifts so configured, shall possess recognized certification. Additionally, qualified riggers and signal persons shall also possess recognized certifications. Copies of the certification(s) shall be submitted in accordance with Section 01 32 19 Pre-Construction Submittals.

o) Personal Protective Equipment Policy: To reduce the possibility of injuries, the Contractor shall implement a policy that requires 100% use of hardhats, safety glasses, and gloves for all personnel under their control. It is the responsibility of the Contractor to supply the proper personal protective equipment for the task.

p) Protection of the Public: The Contractor shall submit a plan for the protection of the public on or adjacent to construction and demolition operations. This plan shall include, but not be limited to, barricades, fencing, and signage. "Public" is defined as anyone not associated with the project - general public, POS and tenant employees.

q) At the Port's request, provide safety awareness training for Contractor supervisory personnel and Port management in one or more of the following: cranes & rigging, electrical, fall protection, trenching & excavation, steel erection, heavy equipment, public protection.

C. DISCIPLINARY ACTION MATRIX:

1. Defining "The Plan"

a) The object of this matrix is to consistently and effectively control safety hazards such as unsafe acts, and unsafe conditions that lead to injuries of employees, the general public, or that cause property damage.

b) The matrix also provides a basis for the Contractor's program by standardizing how safety infractions committed by those employees will be handled.

c) All employees of the Contractor, subcontractor, sub tier contractor, vendor, or tenant are covered under this matrix regardless of classification.

d) Damage to equipment or property due to unsafe act or using damaged equipment.

e) Listed are the minimum requirements for discipline. The Contractor has the right to incorporate more stringent procedures from their corporate policy into this matrix. The Contractor shall not submit two Disciplinary Action Programs.

f) Individuals observed by the Contractor's management shall be disciplined under this matrix.

g) Individuals observed by the Port of Seattle management shall also be subject to disciplinary action. POS management shall immediately contact the Contractor's management or provide written information to the Contractor's management as to violation, time, date, employer, and employee.

h) The Contractor's Safety Manager shall perform the act of documenting and distributing the "Written Violation Notice."

2. Defining "Violation"

a) Violations are defined as:

b) "General Violations" are considered to be those infractions that may not cause serious injury or illness to an individual but are still violations of written safety policies and procedures. Examples include housekeeping, unregulated ACM incidents, property damage, mushroomed tools, etc. "General Violations" do not necessarily require a written warning unless they become classified as "Repeat Violations."

c) "Serious Violations" are those violations that if left uncorrected could cause serious injury or illness to an individual. Examples include employees exposed to fall or impalement hazards or serious bodily harm.

d) "Imminent Danger" are violations/situations that will most likely cause permanent disability or death to an individual. Examples can include falls, electrical, or trenching hazards and unsafe equipment.

e) "Repeat Violations" are situations that arise as a result of a previously identified infraction not being abated in the time frame required or numerous violations of the same classification. "Repeat Violations" can also be defined as a situation where one supervisor has multiple employees working under their direction who are in violation of a written Federal, State, project, or company policy.

f) Violations are not limited to the examples listed above.

NOTE: An "employee" may be removed from the project at any time for a safety violation that endangers his life or the life of a fellow employee.

3. Defining "Employee"

   a) As mentioned earlier, all employees of the Contractor, subcontractor, vendor, or tenant are included in this program.

   b) Job title classifications can include but are not limited to trades person, foreman, supervisor, superintendent, etc.

   c) Any person (s) directly reprimanded for their own actions or inactions, regardless of their position, shall be reprimanded as a "Worker."

4. Defining the "Procedure"

   a) Individuals observed committing infractions of written Federal, State, site, or company safety policies shall be brought to the attention of the Contractor's management.

   b) The contractor shall in a timely manner, notify the identified employee(s) that they are in violation of written safety rules or procedures and shall abate the hazard.

   c) In the event of "Imminent Danger or" a "Serious Violation", the Contractor or POS shall immediately notify and remove the employee(s) from the hazardous situation.

   d) The Contractor shall provide timely written warning to the identified individual(s), as well as the direct supervisor and superintendent of that individual(s). The supervisor's names shall be recorded on the "Written Violation Notice."

   e) To discourage "Repeat Violations" or supervisor apathy, the supervision is subject to disciplinary action as stated in the matrix.

   f) The Contractor shall utilize the "Written Violation Notice" provided in this section.

5. Defining the "Results"
   a) Personnel (including supervisors) receiving a Written Violation Notice shall be retrained in the appropriate standard or procedures. Said training shall be documented in writing and submitted to the Engineer.
   b) Written Violation Notices received will remain in force for the duration of the project.
   c) Removal from the project of an "employee" for a minimum of 3 working days.
   d) Removal of an "employee" from any Port of Seattle project for one year.
   e) Written notice sent to the appropriate corporate president.
   f) Copies of all "written violation notices" are to be submitted to the Engineer with a copy forwarded to the Manager of Construction Safety Services within 24-hours of issuance of notice.

DISCIPLINARY ACTION MATRIX

FOCUS POINT /INCIDENT	1ST VIOLATION	2ND VIOLATION	3RD VIOLATION	NOTES
Worker	Verbal & Written Notice	3 Days Off	Removed From POS Projects For One Year	
Worker's Direct Foremen	Written Notice	Written Notice	3 Days Off	3 Worker Lay-offs = Removal From POS Projects For One Year
Worker's Direct Superintendent	Written Notice	Written Notice	Written Notice to Sub/Prime Superintendent and President of Sub/Company	3 Worker Lay-offs = 3 Days Off For Superintendent
Prime Contractor's Superintendent	Written Notice	Written Notice	Written Notice to President of Prime Company	3 Worker Lay-offs = 3 Days Off For Superintendent*

*Document 01 35 19 - Safety Management, this individual may also be removed from the project.

DISCIPLINARY ACTION MATRIX

WRITTEN VIOLATION NOTICE

PROJECT NAME: ______________________ PROJECT #: ______________________

CONTRACTOR: ____

EMPLOYEE BEING REPRIMANDED ____

DATE: _____________________________________ TIME: ____________________

VIOLATION:

____
____
____
____
____

TASK BEING PERFORMED:

____
____
____
____
____

CORRECTIVE ACTION/TRAINING REQUIRED:

____
____
____
____
____

WITNESS: ____

FOREMAN: ____

SUPERINTENDANT: ____

GC SUPERINTENDANT: ____

FIRST NOTICE: ________ SECOND NOTICE: __________ THIRD NOTICE: ___________

EMPLOYEE LAY-OFF OR REMOVAL REQUIRED (YES/NO): ______________

WRITTEN NOTICE TO COMPANY PRESIDENT REQUIRED (YES/NO): _______________

ISSUED BY: ________________________________ COMPANY: _________________

D. SAFETY PERFORMANCE

If the Contractor experiences ongoing safety concerns such as a Lost Work Day Case or Recordable Incident Rate greater than the Bureau of Labor Statistics National Average for Construction, experiences repeated violations of safety & health rules and regulations or “Imminent Danger” situations, or fails to abate violations in a timely manner, the Contractor shall be subject to the following action at the Ports discretion:

1. Removal and replacement of management personnel.
2. Submit a written Safety Recovery plan to the Engineer and Manager of Construction Safety Services detailing what changes will be made to their safety program and a timeline as to when the changes will be implemented.
3. Hiring an independent safety consultant who shall audit the Contractor’s procedures and operations. The consultant shall compile a plan detailing what changes the Contractor shall implement. This report shall be submitted to the Engineer, Construction Manager, and Manager of Construction Safety Services.
4. Notwithstanding 01 35 29 paragraph 1.05 (B)(9)(c), Disciplinary Action Matrix, above in 1.07 (C)(2), shall be used for determining the appropriate corrective action.
5. Conduct a “Safety Stand Down” (suspend all work or any portion thereof) in accordance with the provisions of the General Conditions 00 70 00, Article G-10-04 Port’s Right to Stop the Work for Contractor Non-Performance. Suspended work shall not be allowed to resume until the Contractor has completed the following actions for review and acceptance by the Engineer:
    a) Hazardous conditions leading up to the Safety Stand Down shall be abated.
    b) Training of such type and duration shall be conducted to educate personnel on the awareness of, identification of, and correction of hazards leading up to the stand down.
    c) Document the completion of items a. and b. above.

E. TOUR GUIDELINES

1. It is imperative that the highest degree of protection is afforded to all individuals touring any Port construction site. The following guidelines have been prepared as general instructions for the organization, direction and safe conduct of such tours:
    a) Escorted Visitors: While on the job site, non-construction personnel or groups shall be accompanied at all times by an authorized representative, the Engineer, the Contractor or other designee familiar with the job site.
    b) Notification and Tours: Personnel tours including technical inspections need to be cleared through the Engineer, allowing maximum advance notice. The Engineer shall be consulted to coordinate the tour plan, identify specific rules, and to ensure necessary safety precautions are taken.

c) Safety Enforcement: Before entering a job site, all visitors must be informed regarding the need for careful, orderly conduct and notified of any special hazards that may be encountered.

d) Personal Protective Equipment: All visitors and tour groups must comply with proper dress, footwear, personal protective equipment or other safety requirements deemed appropriate.

1.08 CONTRACTOR ADMINISTRATIVE PROCEDURES

A. PROJECT SAFETY INSPECTIONS

1. Unsafe conditions or acts having the potential to cause bodily injury or property damage are classified as either “Imminent Danger” or “Serious.” In either case, action shall be taken immediately to correct the situation. Any item(s) that cannot be corrected immediately are required to be abated within 24-hours of notification. In the interim, other steps shall be taken to insure the safety of employees or the public.

2. The Construction Safety Inspection Report (CSIR) will be used by the Port Construction Safety Management as the field report for recording the Safety Manager’s observations in Section One(see Appendix D).

   The following instructions apply to the use of this form:

   a) Contractor’s Corrective Action (Section Two): The Contractor shall note the action taken to abate the observation. If an item is abated immediately, it will be so noted in Section One by the Port Safety Manager.

   b) Date Corrected: The Contractor, upon completion, shall enter the date in the appropriate column.

   c) Submittal Procedure:

      1) Projects utilizing CMS will use this system to transmit the CSIR Form between the Port and the Contractor until the observation is satisfactorily resolved.

      2) When corrective action has been completed, the Contractor’s Project Manager or Designee will electronically sign and date the form and return it to the Engineer.

      3) The Engineer will review the form and follow-up to ensure the “Contractor’s Corrective Action” has been addressed, verifying each item corrected.

      4) The Engineer will discuss the noted observations at the Weekly Contractor Progress Meeting.

      5) The completed CSIR form shall be returned to the Manager of Construction Safety Services within five working days.

B. ACCIDENT INVESTIGATION AND REPORTING PROCEDURES

1. All accidents and incidents occurring from operations or work performed under the contract shall be reported, verified, investigated, and analyzed as prescribed by the Port of Seattle Construction Safety & Health Manual. Contractors and other individuals involved in the work shall instruct

employees and other personnel to follow these procedures if someone is injured.

a) Seek medical assistance for anyone injured. The injured person's supervisor will see that first-aid is administered.

b) When a serious accident or emergency occurs/exists, secure the incident area tightly and quickly except for rescue and emergency personnel.

c) Send individuals as required, to assist or direct any emergency personnel arriving on the site.

d) The accident scene shall not be disturbed until released by the Incident Command or Manager of Construction Safety Services, except for circumstances where "Imminent Danger" exists to those performing any emergency services.

e) Immediately notify the Engineer and Manager of Construction Safety Services (or designee) regarding any accident or injury requiring more than First Aid treatment, any third-party incident, or any equipment or property damage estimate in excess of $1,000. Notify the Manager of Construction Safety Services of all other incidents including near miss incidents as soon as possible following the event.

f) Washington State Department of Labor and Industries must be notified immediately by the Contractor in the event of an accident involving the death or hospital admission of any employee.

g) Employees must report all injuries or occupational-related illnesses as soon as possible to their employer or immediate supervisor.

h) A detailed written report, identifying causes and recommending corrective action, must be submitted to the Engineer and Manager, Construction Safety Services within 24 hours. No supervisor may decline to accept a report of an injury from a subordinate.

i) Within 48-hours of a Recordable or Lost Work Day Case Injury, incident involving 3rd party, or property damage incident, the Contractor shall meet with the Engineer and Manager of Construction Safety Services. The meeting shall discuss the status of the injured employee, the root cause of the incident, corrective action implemented, the Job Hazard Analysis, and retraining of the employee and supervisor.

j) Report all accident exposures and near miss incidents that occur on the job site. These records are to be maintained and submitted to the Engineer or other designated authority upon request and shall include but not be limited to:

    1) First-aid injuries not reported on the OSHA No. 300 Form.

    2) The Contractor's OSHA 300 Form.

k) The above information shall be provided only to authorized personnel including the Engineer and Manager of Construction Safety Services.

l) All questions from the media regarding any incident occurring on site shall be referred to the Port’s Public Affairs Manager via the Engineer.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Document

APPENDIX A

SAMPLE CONTRACTOR’S SAFETY PLAN

The Contractor is responsible for reviewing the requirements found and referenced in this Document, the Contract, the Port of Seattle Construction Safety & Health Manual as a minimum, and incorporating any additional specific or unique safety requirements into their written plan. The Contractor’s Safety Plan shall include but not be limited to the following guidelines:

A. GENERAL PROVISIONS

1. **Compliance**: Provisions for accident investigations and reporting, formal incident review, reporting, corrective action and disciplinary action procedures meeting the minimum Port of Seattle requirements.
2. **Job Hazard Analysis (JHA)**: The Contractor shall complete detailed, written Job Hazard Analysis for the work to be performed, identifying hazards that may exist or be created, outline the equipment to be used, and what procedures and/or safety equipment will be used to eliminate or reduce those hazards. The Contractor shall use the form provided in the Port of Seattle’s Construction Safety & Health Manual or contractor equivalent. Supplemental Daily Pre-Task Plans are strongly encouraged.
3. **Medical Treatment**: Provide medical treatment in compliance with Federal, State and local requirements. Names of individuals CPR and First Aid trained.
4. **Site Specific Emergency Procedures**: As related to injuries, weather or emergencies at an active POS facility including pre-determined sites for assembly and measures for accounting of employees shall be included. Emergency numbers shall be posted at the given work area(s):

Fire or Ambulance from a non-Port hard-line phone	911
Fire or Police from a Port hard-line phone	9911
Fire (Seaport)	911
Police (Seaport)	(206) 787-5380

5. **DOSH/OSHA Requirements and Personal Protection**: Safety and health provisions for providing adequate lighting, ventilation, hearing conservation, CO monitoring, and housekeeping. A written Personal Protective Equipment Assessment for head, face, eye, hand and torso protection shall be included.
6. **Personnel Instruction**: The Contractor must identify the greatest number of employees to be working at any one time during peak construction periods, the company policies for initial safety indoctrination of all employees, and company plans for continued safety education for all employees, including: weekly safety meetings, POS Safety Orientation, Ergonomics, Asbestos Awareness training, and English as a second language.

7. **Responsibilities**: Acknowledgment that the Contractor is totally responsible for compliance with OSHA, DOSH, Port or other applicable rules and orders. Additionally, the plan will require a place of employment that is free of unsanitary or hazardous conditions that would harm an employee's health or safety.
8. **Safety Inspections**: Detailed information concerning how safety inspections will be conducted, their frequency, and their documentation.
9. **Safety Personnel**: State the name of the Contractor's Safety Representative(s), their experience and qualifications (i.e. Training in the OSHA 500 (or equivalent), 30-hour or 10-hour) Indicate their authority to take the appropriate measures to eliminate hazards or stop work until hazardous conditions are corrected.
10. **Safety Requirements, Electrical**: Testing, inspection and repair of electrical equipment, GFCI Program, lockout/tagout procedures, how existing circuits will be located and the installation of electrical circuits in accordance with the National Electric Code or Port Mandated Requirements.
11. **Safety Requirements, Equipment**: Operation, documented daily inspection, and maintenance for trucks and heavy equipment such as backhoes, dozers, motor graders, elevated work platforms, powered industrial trucks, and all hand and power tools.
12. **Safety Requirements, Ladders**: Types of ladders for specific uses and their training requirements.
13. **Site Layout**: A layout drawing of the site indicating access roads, fire and ambulance lanes, location of first aid stations, location of required alarm systems, location of offices, parking for private vehicles and equipment, and storage of all flammable and/or combustible liquids, gases, or other hazardous materials.
14. **Storage**: Requirements for storage of flammable and combustible liquids or gases.
15. **Field Sanitation**: Provisions for toilet and hand washing facilities, including the frequency at which they will be cleaned and maintained.

B. SPECIAL PROVISIONS

Depending on the type of construction, additional items must be incorporated into the Contractor's Safety Plan.

1. **Confined Space Entry**: Procedures for confined space entry and work operations in and around confined spaces (including elevator shafts) as well as emergency measures. These procedures must meet or exceed the Port of Seattle requirements found in the Port of Seattle Construction Safety & Health Manual. Prior to daily entry, prime/general contractor shall be notified.
2. **Respiratory Protection Plan**
    a) Submit a letter signed by the Contractor stating that all employees or agents required to wear a negative pressure or supplied air

respirator have been medically evaluated in accordance with WAC 296-842.

b) Submit National Institute for Occupational Safety and Health (NIOSH) certification for all respiratory protective devices utilized on site, including a list of approved components (parts) for each type of respirator that may potentially be used on the project.

c) Submit a letter signed by the Contractor stating that respirator fit testing is current for all Contractor employees and agents who wear negative pressure or supplied air respirators. This fit testing shall be in accordance with quantitative procedures as detailed in WAC 296-842 and 296-62-07715.

d) Respiratory protection requirements for work impacting the following regulated materials:

1) PCBs and PCB-containing materials (see Section 02 84 33)
2) Fugitive and silica dust (see Section 02 87 00)

3. **Steel Erection**: These requirements shall meet or exceed the guidelines of Chapter 296-155 WAC Part P, and shall include: pre-planning, hoisting operations, fall protection procedures, overhead protection and Site-Specific Erection Plan.

4. **Cranes**: Use of cranes or derricks and the testing and inspection thereof, including hooks, latches, wire rope, operator certification, boom stops, load charts, wind speed, warning devices, fire extinguishers, crane operation signals, suspended work platform pre-lift planning, and critical lift plans.

5. **Excavations**: Excavation plans must indicate sloping, documented daily inspections, shoring, barricading, excavation access, *fall protection*, and excavated material storage.

6. **Fall Protection**: How 100% protection will be maintained, identify the use of personal fall arrest equipment, fall protection systems, and fall protection work plans for heights 4-feet. NOTE: The *Monitor System is prohibited*.

7. **Formwork**: Submittal of formwork and false work drawings for review and approval to the Engineer.

8. **Hazard Communication Program**: Including SDS, their location, Master List of Chemicals, Personal Protective Equipment, Training, Labeling, and SDS review and special procedures for sealers, coatings or specialty paints.

9. **Interruption of Fire/Security Systems**: Plans shall include measures and/or procedures to provide interim fire and security protection to facilities or areas affected by interruptions. These include automatic detection devices and alarms, automatic sprinkler systems, fire pumps, fire hydrants, applicable water supplies and reservoirs.

10. **Lock-out/Tag-out**: Procedures for lock-out/tag-out of energy sources during work operations. The Contractor shall include as part of the Lock-out/Tag-out program protocol for *Clearance Orders and Switching Orders* on electrical and mechanical systems.

11. **Scaffolding**: Red/Yellow/Green "Use" tag system, planking, guardrails, toe boards, anchor points, fall protection, access points, and inspections of.
12. **Fire Protection**: Including Hot Work Permits, Welding, shields, fire extinguishers, ventilation, PPE, fire watch and cylinder storage.
13. **Work Adjacent To Occupied Spaces**: Procedures for ensuring occupants of spaces adjoining, above and below construction areas will be protected from hazards created by construction, including but not limited to, falling debris, equipment noise, and penetration of partitions, ceilings, and floors.
14. **Competent Persons**: Where regulatory requirements (DOSH) specify the use of Competent Persons, the Contractor shall submit in writing the names of those persons. Their area of competency and applicable experience/training documentation.
15. **Energized Electrical Work Plan**: Submit detailed procedures for working on and guarding of energized equipment or conducting system outages.
16. **Seaport Safety**: Contractors shall submit a safety plan complying with all Federal, State, Corp of Engineers, Port of Seattle, and Coast Guard rules applicable to this type of construction.
17. **Health Considerations**: The Contractor shall submit a plan that addresses safety & health procedures for working in contact with contaminated soils. This plan shall be revised and resubmitted in the event that conditions encountered during the work are different than those initially planned for. It shall also include:
    a) Identification and evaluation of the hazards and risks associated with each work task.
    b) The names and qualifications of each contractor's representative(s) in charge of the work and present at the project when pipeline removal is performed.
    c) Identification of supervisory personnel and alternative responsibilities for site safety/response operations.
    d) Determine levels of personnel protection to be worn for various site operations.
    e) List equipment with adequate nomenclature by item that will be used at the job site and the date and location where the Engineer can inspect this equipment.
    f) Establishment of emergency procedures, such as: escape routes, fire protection, signals for withdrawing work parties from the site, emergency communications, wind indicators, including facility notification.
    g) Identification and arrangements with the nearest medical facility for emergency medical care of both routine-type injuries and toxicological problems. Submit the name, location, and telephone number of this facility.
18. **Demolition**: The Contractor shall submit a plan to include how they will safely demolish existing structures, ensure security, safe guard employees

and the public from falling material, electrical hazards and air quality issues. An Engineering Survey performed and signed by a Qualified Person shall be included.

19. **Public Protection Plan**: The actions the Contractor will take to protect the public while performing construction or demolition on the project. The plan shall include, but not be limited to, barricades, fencing, and signage. "Public" is defined as anyone not associated with the project - general public, POS and tenant employees.

C. SITE SPECIFIC SAFETY PLAN WORKSHEET

1. The following worksheet is to be used for Port Construction Services On Call Contracts for each work authorization. Once a safety submittal has been made and accepted for the On Call contract, Contractor will submit for each work authorization the following worksheet including support documentation referenced within the worksheet prior to beginning work.

Port of Seattle

JOB HAZARD ANALYSIS WORKSHEET

Site Specific Plan Addendum

Location/address:		**Person in Charge* for Reporting Hazards and Injuries:**	
		Phone Number:	
		* requires OSHA 10 & complete documented daily inspections	
Title of Job/Operation:	**Date:**	**Day of Safety Meetings:**	
	Work Order #:	**Emergency action plan**	**Call Fire Dept 787-5380 on airport grounds. 911 everywhere else. For large scale emergency meet at:**
Analysis Made By:	**Contact person:**		____________________________
Analysis Reviewed By:	**Phone Number:**		
Location of Master Prevention Program:			

Sequence of Basic Job Steps	Potential Hazards/Ergonomics	Recommended Safe Job Procedures and Required PPE

Supervisor Signature: ____________________ **Received by RE/CM:** ____________________

Will the Scope of Work consist of the following tasks? (check all that apply)

	Traffic control*		Confined Space Entry*
	Welding, Cutting, Grinding*		Heavy Equipment
	Trenching or Excavation*		Flammable or Combustible materials(a)
	Carpentry		Steel Erection*
	Painting, Staining, Sealant*(a)		Ladder or Scaffold work
	Demolition (Structural)*		Roofing
	Energized Electrical*		Regulated Materials
	Use of a Crane/Boom/Hoisting device*		Hazardous Materials
	Work from heights of 6′ or greater*		Conveyors*

* **Requires additional paperwork – checklists, plans, permits, shut-down notice, etc.**

(a)List Chemicals to be used on the project.
Material Safety Data Sheets attached ☐ Yes ☐ No *Physical MSDS must be on-site.

(*) A ***Chemical Exposure Plan*** will be required for products containing isocyanates, methylene chloride, Hydroflouric Acid, lead, silica and processes involving floor sealers, traffic coatings, terrazzo sealers or specialty paints.

Description of public protection measures ("Public" is defined as anyone not associated with the project - general public, POS, Tenant, and Airline Employees):

Employee Disciplinary for non-compliance with set forth safety policies and procedures will be consistent Port of Seattle's disciplinary action matrix as described within your site-specific safety plan and site-specific orientation.

Sign Up

Print Name	Signature	Print Name	Signature

APPENDIX B

CONTRACTOR CONFINED SPACE ENTRY PROGRAM CERTIFICATE

I hereby certify that the attached Confined Space Entry Program meets or exceeds the requirements of DOSH standards WAC 296-809 and the Port Of Seattle's Confined Space Entry Program.

My employees will utilize the Port of Seattle (POS) confined space entry permit(s). They will complete all other sections of the permit that are appropriate for the confined space being entered.

My employees will be informed that they must coordinate their confined space entry procedures with other Contractors and POS employees working in or around the confined space. On Airport projects, if entering into a Permit Required Confined Space, we will first contact the Port of Seattle Fire Department, notifying them of the specific location and activity to be performed.

My employees, who will be acting as authorized entrants, attendants, entry supervisors, and air testers, have been trained in accordance with the DOSH procedures and will be made aware of all of the POS procedures for entering confined spaces.

After the confined space entry project is complete my employees will make the Engineer and Construction Safety aware of any new hazards confronted or created during entry operations. On Airport projects, my employees will contact the Port of Seattle Fire Department and advise them that operations have ceased.

A copy of finalized permit with all attachments will be provided to the Engineer at the end of each project.

Contractor's Name: ____

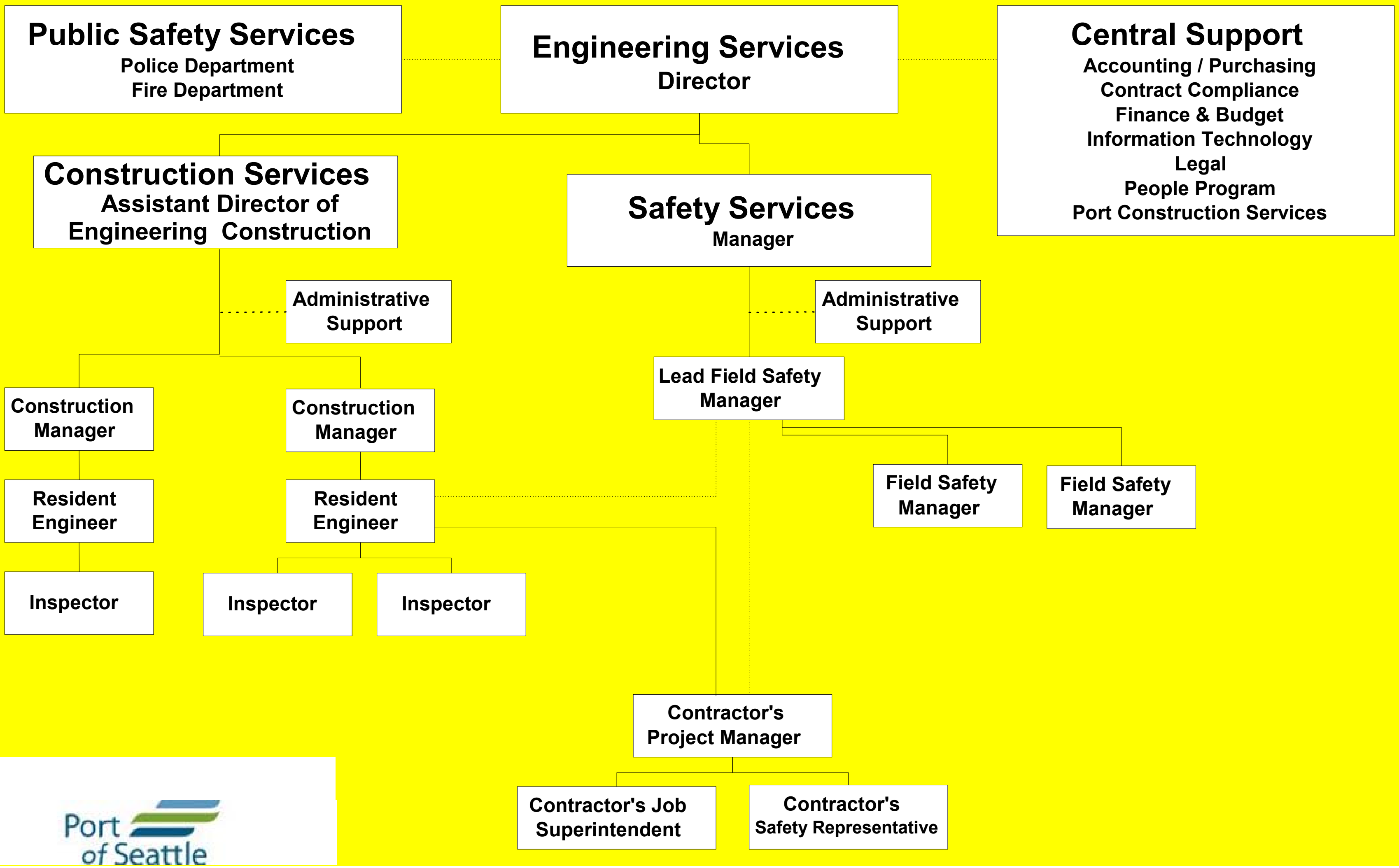
Contractor's Signature: ____

Company Name: _____________________________________ Date: ______________

Port of Seattle Resident Engineer: ____

Date: ______________

Appendix C
Construction Safety Program Organization Chart



Public Safety Services
Police Department
Fire Department

Engineering Services
Director

Central Support
Accounting / Purchasing
Contract Compliance
Finance & Budget
Information Technology
Legal
People Program
Port Construction Services

Construction Services
Assistant Director of
Engineering Construction

Safety Services
Manager

Administrative Support

Administrative Support

Lead Field Safety Manager

Construction Manager

Construction Manager

Resident Engineer

Resident Engineer

Field Safety Manager

Field Safety Manager

Inspector

Inspector

Inspector

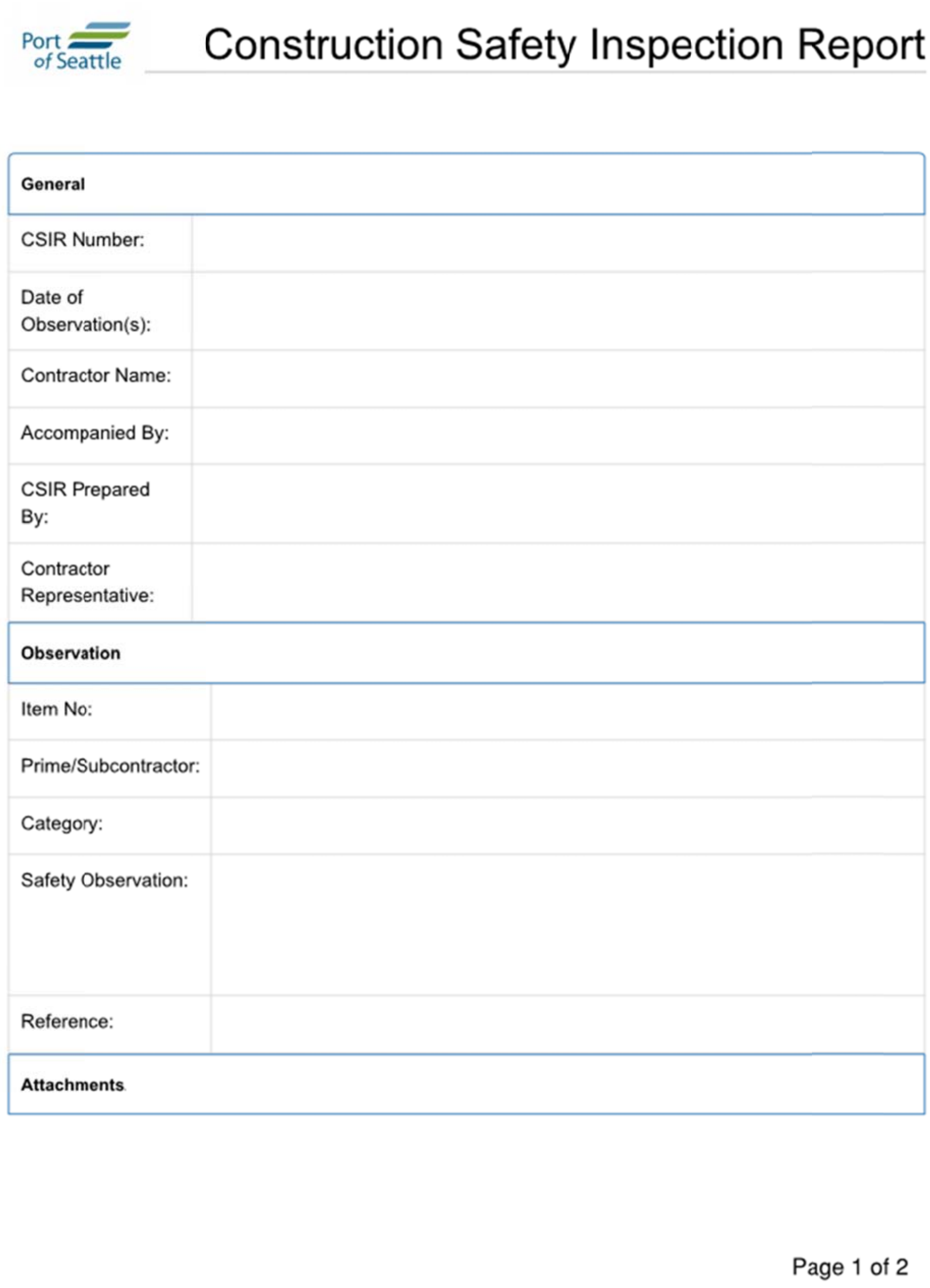
Contractor's Project Manager

Contractor's Job Superintendent

Contractor's Safety Representative

Port of Seattle

APPENDIX D



Construction Safety Inspection Report

General	
CSIR Number:	
Date of Observation(s):	
Contractor Name:	
Accompanied By:	
CSIR Prepared By:	
Contractor Representative:	
Observation	
Item No:	
Prime/Subcontractor:	
Category:	
Safety Observation:	
Reference:	
Attachments	

Contractors Corrective Action Taken:	
Date Item Corrected:	
Inspector Comments:	
Inspector Date:	
Safety Comments:	
Safety Date:	

PART 1 GENERAL

1.01 SUMMARY

A. General: The list of environmental laws set forth in this section is provided pursuant to Section 39.04.120 of the Revised Code of Washington. The Contractor shall fully comply with the provisions of such laws as they may apply to the work.

1.02 LIST OF ENVIRONMENTAL STATUTES, ORDINANCES AND REGULATIONS

A. General: The following is a list of federal, State and local environmental statutes, ordinances and regulations which deal with the prevention of environmental pollution and the preservation of public natural resources that affect or may affect this Project. This list is not to be considered as all-inclusive, nor shall the absence of a law from this list be construed to relieve the Contractor from complying with such law, to the extent it is applicable to the Contractor.

B. Federal

1. Statutes:
   a. National Environmental Policy Act: Establishes a Federal policy on the environment and requires the appropriate Federal agency, in any federally assisted or authorized project, to prepare an environmental impact statement for any "major action significantly affecting the quality of the human environment.

   b. Clean Air Act: Establishes a Federal policy on air quality and directs each state to promulgate air quality laws and regulations to achieve the goals set forth in the Act.

   c. Clean Water Act: Establishes a Federal policy on water quality and directs each state to promulgate water quality laws and regulations to achieve the goals set forth in the Act. In addition, the Act requires a permit for discharge of pollutants and sets forth oil spill prevention provisions and penalties.

   d. Rivers and Harbors Act of 1899: Provides that discharge of refuse without a permit into navigable waters is prohibited.

   e. Port and Waterways Safety Act of 1972: Provides vessel design and construction standards to protect the marine environment.

   f. Resource Conservation and Recovery Act: Provides standards and requirements for the generation, transportation, treatment, storage and disposal of hazardous wastes.

   g. Comprehensive Environmental Response Compensation and Liability Act: Provides standards and procedures for the investigation and remedial activities to clean up hazardous substances which substances that have been discharged into the environment.

   h. Toxic Substances Control Act: Provides standards for the manufacture and distribution of chemicals and for the handling of PCBs.

   i. Endangered Species Act: Establishes protection for species which are listed as threatened or endangered.

2. Regulations and Guidelines:
    a. Environmental Protection Agency Regulations on National Primary and Secondary Ambient Air Quality Standards: Establishes national primary and secondary air quality standards for certain compounds pursuant to Section 109 of the Clean Air Act.
    b. Environmental Protection Agency Regulations Establishing Effluent Guidelines: Establishes national effluent limitations for discharges into navigable waters.
    c. Environmental Protection Agency Regulations on Discharge of Oil: Regulations promulgated pursuant to the Clean Water Act.
    d. Coast Guard Regulations on Oil Spills: Regulations promulgated pursuant to the Clean Water Act.
    e. Army Corps of Engineers Regulations on Navigable Waters: Establishes procedures for obtaining permits required by the Rivers and Harbors Act of 1899 and the Clean Water Act.
    f. Environmental Protection Agency Regulations on Discharge of Dredged or Fill Material Into Navigable Waters: Establishes guidelines for placing dredge or fill material into navigable waters pursuant to the Clean Water Act.
    g. Environmental Protection Agency Regulations for Hazardous Waste Management: Regulations promulgated pursuant to the Resource Conservation and Recovery Act.

C. State:

1. Statutes:
    a. State Environmental Policy Act: Establishes a State policy on the environment and requires the appropriate State or local agency to prepare an environmental impact statement for any "major action significantly affecting the quality of the environment" which the agency either undertakes directly or authorizes.
    b. Shoreline Management Act: Requires a permit for development on State shorelines.
    c. Clean Air Act: Provides that it is the policy of the State to secure and maintain such levels of air quality to protect health and comply with the Federal Clean Air Act.
    d. Water Pollution Control Act: Establishes a State policy to maintain the highest possible standards for all water of the State, requires permits for the discharge of pollutants into the waters of the State of Washington and complies with the Federal Clean Water Act.
    e. Washington Solid Waste Management Law: Establishes uniform State-wide program for handling solid wastes, which will prevent land, air and water pollution.
    f. Washington Hazardous Waste Disposal Law: Establishes a statewide program for the regulation of the disposal of hazardous waste.

g. State Noise Control Act: Authorizes the Department of Ecology to establish maximum noise levels in order to protect against adverse effect of noise in the health, safety and welfare.

h. Model Toxics Control Act: State "Superfund" Law which Law that establishes how cleanups of hazardous waste will be managed and sets standards for performing cleanups.

i. Washington State Hydraulic Code: (Seaport Only) Establishes standards for development activities located at or below the Ordinary High Water Mark.

2. Regulations and Guidelines:

a. Department of Ecology Guidelines for the Implementation of the State Environmental Protection Agency. State guidelines for the implementation of the State Environmental Policy Act.

b. Department of Ecology Shoreline Development Permit Regulations: State guidelines for the issuance of shoreline permits.

c. Air Pollution Regulations on Record keeping: Requires operators of stationary sources of air contaminants to maintain records of emissions and submit periodic reports.

d. Department of Ecology Regulations Relating to Minimum Functional Standards for Solid Waste Handling: Regulations promulgated pursuant to the State Solid Waste Act.

e. Department of Ecology Regulations for Waste Discharge Permits: Establishes standards and procedures for obtaining permits to discharge pollutants in navigable waters pursuant to the federal and state Clean Water Acts.

f. Department of Ecology Regulations on Dangerous Waste: Regulations promulgates pursuant to the state hazardous waste disposal statute.

g. Department of Ecology Regulations Relating to Noise: Regulations establishing noise levels and noise performance standards for certain activities.

h. Department of Ecology Model Toxics Control Act Cleanup Regulation: Establishing rules for reporting, listing, investigation and cleanup of hazardous waste sites.

D. Local:

1. Ordinances, Regulations and Orders

a. King County Environmental Policy Ordinances: Provisions for carrying out the County's responsibilities pursuant to the State Environmental Policy Act.

b. King County Shoreline Management Ordinance: Establishes procedures for obtaining a permit under the Shoreline Management Master Program.

c. King County Solid Waste Code: Establishes provisions for the disposal of solid waste.

d. King County Grading Ordinance: Requires permit for grading, landfills, gravel pits, dumping, quarrying and mining operations.

e. King County Zoning Code: Establishes zoning designations and uses within those designations.

f. Seattle Shoreline Development Ordinance: Establishes procedures for obtaining a permit under the Shoreline Management Act.

g. Seattle-King County Noise Ordinances: Establishes noise levels for various activities in different areas of the city and county.

h. Seattle Environmental Policy Executive Order: Provisions for carrying out the City's responsibilities pursuant to the State Environmental Policy Act.

E. Port of Seattle:

a. Port of Seattle - King County Waste Discharge Permit 7810-02.

1.03 REQUIRED SUBMITTALS

A. Specific submittal requirements are called out in the applicable specification section.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION - Not used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION

A. Contractor Quality Control (QC) shall consist of plans, procedures, and organization necessary to provide materials, equipment, workmanship, fabrication, construction, and operations that comply with the requirements of the Contract Documents.

1.02 COORDINATION

A. As part of the Preconstruction Meeting the Contractor shall discuss the Contractor's Quality Control program. Items for discussion shall include:

1. Identification of the Contractor's QC Representative
2. Persons responsible for shop drawing review
3. Contractor's QC Program and Reporting

1.03 SUBMITTALS

A. Quality Control Plan

B. Quality Control Reports

C. Pre-Installation Meeting List

1.04 CONTRACTOR QUALITY CONTROL REQUIREMENTS

A. The Contractor shall staff its QC program at a satisfactory level as required to perform the activities outlined in this Section with the QC Representative having complete authority to take action necessary to ensure conformance with the Contract Documents.

B. Quality Control Plan: Submit a job specific quality control plan for approval by the Engineer prior to Notice-to-Proceed. The QC plan must be accepted or accepted as noted before NTP will be issued. This pre-construction submittal shall include, as a minimum:

1. Company organization and designation of responsibility of QC activity at both corporate and job site level.
2. Qualifications of QC personnel.
3. Employee QC awareness and protocols.
4. Procedure for incorporating all subcontractors' QC plans into Contractor QC plan.
5. Description of routine daily and periodic QC activities.
6. Description of examination, testing or inspection activities, including certifications and reports.
7. Procedure for communicating and controlling design changes and revisions in the field.
8. Submittal and shop drawing control procedures.
9. Procedure for nonconformance reporting and disposition.

10. Procedure for control at off-site fabrication or production shops.
11. List of publications or references governing work on this job site.
12. Exhibits of any QC forms or checklists routinely used.
13. A line and grade survey controls plan.

C. The Contractor's QC Representative must have prior experience as a Project Engineer, QC Representative, Superintendent, Architect, on site representative or inspector on a project of comparable complexity to this project.

D. Reporting: Contractor's QC Representative shall maintain daily Quality Control (QC) Reports for each workday. QC Reports shall be factual records reporting test results and quality control activities. Submit QC Reports on accepted forms. The Contractor's QC Representative shall verify and sign all reports. Verification shall contain the statement that all supplies and materials incorporated in the Work are in compliance with the terms of the Contract Documents with noted variances.

E. QC Control of On-Site Construction: Contractor's Quality Control program shall include the following phases of control and management for definable features of work:

1. Pre-installation and Preparation Phase: A Pre-installation Meeting will be held prior to beginning work on each definable feature.
2. In-Process Inspection Phase: The follow-up phase shall be performed continuously verify that quality standards are maintained throughout the project. Adjustment to control procedures may be required based upon the results of this phase and control testing. Report the results of the inspection in the daily Contractor QC report.
3. Punchlist Inspections: Punchlist Inspections will be scheduled by the Engineer after the QC Representative notifies the Port that the facility and its systems are complete and satisfactory.

F. Offsite or Factory Inspections

1. In addition to inspections or Special Inspection required by other Sections, Offsite or Factory Inspections by the Engineer (and/or other Owner's Representatives) are required to ensure that the products meet the Contract Documents prior to shipment to the project site.
2. The Contractor shall notify the Engineer, in writing, 21 days prior to the product's availability for inspection.

G. Pre-installation Meetings

1. Pre-installation meetings will be required for every specification section unless agreed otherwise with the Engineer. The Contractor should submit a list of pre-installation meetings which will be held during the project and an anticipated schedule for these meetings. This list shall be submitted for acceptance by the Engineer prior to Notice-to-Proceed.
2. The Contractor shall conduct these meeting with the subcontractor, Port personnel, Contractor quality control and safety personnel, and any appropriate material suppliers at the beginning of each definable feature of the work. The purpose of the meetings is to review accepted submittals, sequence of field activities, contract details, and potential safety hazards to

prevent problems in the field. Field work shall not commence prior to these meeting.

3. Meeting agenda shall cover:
    a. Introduction of responsible parties.
    b. Discussion of submitted and accepted materials.
    c. Status of material and equipment delivery.
    d. Preview of areas where work will begin.
    e. Brief outline of the construction procedures and interface with existing work.
    f. Job hazard analysis.
    g. Quality control tests scheduled for definable feature of work.
    h. Checklist for quality control activities during the work.

H. Control of Off-Site Fabrication/Construction: The Contractor’s Quality Control program shall identify all off-site fabrication processes and its plan for monitoring the quality of fabricated materials prior to delivery to the project site. Coordinate inspections by Port representatives as requested.

I. The Engineer will monitor the performance of the QC Representative. If the QC Representative fails to perform in accordance with the requirements of this specification, the QC Representative will be replaced at the Engineer’s request.

1. The QC Representative’s performance will be judged principally on the timeliness, accuracy and completeness of the QC's assessment of the condition of the elements of the work.
2. Contract work will not be permitted to be performed without an acceptable QC Representative unless specifically authorized by the Engineer.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION

A. The Owner will employ an Independent Testing Agency or provide personnel to conduct tests of materials placed in their final locations in the project as specified by the permit. The Contractor shall assist the Owner's Testing Agency or personnel by providing access to the Work or storage of the materials.

1. Testing and inspection performed as a condition of the permit does not relieve the Contractor of responsibility for compliance with the Contract Documents.

B. The Contractor shall provide and pay for the off-site testing required to confirm the quality of materials delivered to the project. Tests and inspections associated with permits obtained by the Contractor shall be provided and paid for by the Contractor.

1.02 COORDINATION

A. As part of the Preconstruction Meeting the Contractor shall discuss the Contractor's Quality Control program. Items for discussion shall include:

1. Testing and administration processes for on-site and off-site fabrication processes
2. Interrelationship of the Contractor and Port's special testing contract administration

B. The Contractor shall upon request of the Engineer provide the Port storage space for testing equipment and materials.

1.03 SUBMITTALS

A. Schedule of Special Inspections

1.04 CONTRACTOR SPECIAL TESTING AND INSPECTION REQUIREMENTS

A. The Contractor's Quality Control Representative shall be responsible for coordinating the required special inspections. The QC Representative shall:

1. Prepare a schedule of the special inspections required.
2. Notify the Port's special inspector a minimum 24 hours in advance of the requirement for special inspections. Testing that requires special equipment may require additional time for scheduling.
3. Coordinate the work to assure obstructions, such as form work, are not put in place until the required special inspections have been performed.
4. Monitor the correction of all discrepancies noted by the Special Inspector.
5. Describe all special inspections and correction of discrepancies noted by the special inspector in the Daily Report.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY

A. Install, maintain, and operate all temporary facilities and controls as long as needed for the safe and proper completion of the Work.

1.02 TEMPORARY ELECTRICITY UTILIZING PORT POWER

A. Port power will not be available for Contractor use.

1.03 TEMPORARY ELECTRICITY UTILIZING GENERATORS

A. The Contractor shall provide their own power via generator.

1.04 TEMPORARY LIGHTING

A. Provide and maintain fluorescent/LED lighting for construction operations to achieve minimum lighting levels required by the Safety and Health Core Rules (WAC 296-155-165).

1.05 COMMUNICATIONS

A. Contractor is responsible for their own jobsite communication.

1.06 TEMPORARY WATER

A. Cost: Unless otherwise indicated by the Engineer, the Contractor shall provide and pay for all temporary water service required for construction operations.

1.07 TEMPORARY SANITARY FACILITIES

A. Contractor shall provide and maintain their own temporary sanitary facilities. Terminal restrooms will not be available for Contractor use.

1.08 BARRIERS AND ENCLOSURES

A. General Requirements Need to include any barrier requirements.

1.09 FENCES

A. Provide a 6-foot-high chain link fence with gates around the perimeter of the laydown area. Any additional fencing required?

1.10 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Prohibit traffic across landscaped areas.

1.11 SECURITY

A. Provide security and facilities to protect the Work and Port’s operations from unauthorized entry, vandalism, or theft.

B. The construction site shall be closed to the public at all times. Construction site is defined as the temporary facilities and work areas inside partitions, enclosures, and cones and tape.

C. Ensure the security of tenant facilities in the event construction activities endanger those facilities or commodities.

D. Abide by special requests of security personnel, Port of Seattle Police, and City of Seattle Fire Departments.

1.12 PROGRESS CLEANING AND WASTE REMOVAL

A. In addition to the requirements of Section 01 74 00 - Cleaning:

1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

2. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

3. Collect and remove waste materials, debris, and rubbish from site and dispose off-site in a legal manner.

1.13 STREET CLEANING AND DUST CONTROL

A. See Specification Section 01 57 13 - Temporary Erosion and Sediment Control Planning and Execution

1.14 REMOVAL OF CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion or as directed by the Engineer.

B. Clean and repair damage caused by installation or use of temporary work.

C. Removal of temporary facilities and controls, including but not limited to restoration of site and laydown area utilities to preconstruction conditions (capping, safing and incorporation of lockout/tag-out protocols), shall be an element of the final inspection and punchlist.

1.15 USE AND OCCUPANCY

A. The Terminal is an operating facility that must remain in full operation throughout the term of this Contract. Where facility operations conflict with those of the Contractor, the operations of the facility will take precedence over those of the Contractor. It shall be the sole responsibility of the Contractor to schedule and coordinate its activities with those of the facility to assure minimum disruption of facility operations.

B. Contractor will be allowed space for the storage of materials and the pursuance of Work under this Contract in the areas as directed by the Engineer. The Contractor shall limit storage of materials, tools, and other items necessary to the Work, to areas within the construction barriers. Items stored outside the designated areas shall be prohibited without prior acceptance of the Engineer.

1.16 NOISE CONTROLS

A. Contractor shall comply with City of Seattle noise ordinance.

1.17 MAINTENANCE OF OPERATIONS

A. Public Safety Convenience: The Contractor shall conduct all operations with the least possible obstruction and inconvenience to the Port, its tenants and the public.

B. Responsible Representative: The Contractor shall appoint one employee as the Contractor's responsible representative and point of contact. The appointed representative shall have authority to act on behalf of the Contractor and shall be available, on call, twenty-four hours a day, throughout the period of construction for the Contract. A twenty-four hour telephone number shall be provided to the Engineer for use in case of an off-hour emergency. The Contractor shall provide immediate response to correct all deficiencies upon notification.

C. Temporary Facilities: The Contractor shall provide temporary barriers, temporary enclosures or partitions sufficient to physically separate Terminal operations.

PART 2 MEASUREMENT AND PAYMENT

2.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. This item shall consist of planning, installing, inspecting, maintaining, upgrading and removing temporary erosion and sediment control Best Management Practices (BMPs) as shown on the drawings, in the Contractor's Erosion and Sediment Control Plan (CESCP), or as ordered by the Engineer to prevent pollution of air and water, and control, respond to, and manage eroded sediment and turbid water during the life of the contract.

B. This work shall apply to all areas associated with contract work including, but not limited to the following:

1. Work areas
2. Equipment and material storage areas
3. Staging areas
4. Access Roads

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. The following rules, requirements and regulations specified may apply to this work:

1. Surface Water Design Manual, King County, Department of Natural Resources, (Current Edition).
2. Washington State Department of Ecology Stormwater Management Manual for Western Washington, Vol. 2 http://www.ecy.wa.gov/programs/wq/stormwater/manual.html.
3. Washington State Stormwater Quality Standards (WAC 173-201A).
4. WAC 173 201 A, Water Quality Standards of the State of Washington.

1.03 SUBMITTALS

A. As part of the required Preconstruction Submittals, Section 01 32 19 - Preconstruction Submittals and before NOTICE TO PROCEED is given, the Contractor shall submit the following:

1. Contractor Erosion and Sediment Control Plan (CESCP)

B. The following shall be submitted in accordance with Section 01 33 00 – Submittals:

1. Oil Absorbent Pad
2. 6 Mil Plastic Sheeting
3. Catch Basin Protection
4. Bitminuous Asphalt/Cold Patch
5. CESCL Certification Cards
6. CESCL Qualifications

PART 2 MATERIALS

2.01 MATERIAL REQUIREMENTS

A. GENERAL:

1. All products used to construct the Contractor selected BMPs shall be suitable for such use and submitted to the Engineer for approval.

B. OIL ABSORBENT PADS:

1. Oil absorbent pads shall be made of white, 100 % polypropylene fabric that absorbs oil-based fluids and repels water-based fluids. Each pad shall be a minimum of 15x19 inches in size and absorb no less than 50 ounces of oil-based fluids.

C. TESC – ASPHALT CURB & ASPHALT BERM:

1. Asphalt curb and asphalt berm shall be constructed as directed by the Engineer. The asphalt concrete shall meet the requirements of [Section - 32 12 16.13 - Bituminous Concrete Pavement.

D. WATER FILLED DIVERSION BERM

1. Berm shall be a minimum 6 inches high and 10 feet long and made of 10 mil polyurethane or 22 oz. PVC.

E. GEOTEXTILE FABRIC DAMS

1. Geotextile Fabric dam shall be a urethane foam core encased on Geotextile material. The minimum length of the unit shall be 7 feet. The foam core shall be a minimum of 8 inches in height, and have a minimum base width of 16 inches. The geotextile material shall overhang the foam by at least 6 inches at each end, and shall have apron type flaps that extend a minimum of 24 inches on each side of the foam core. The geotextile material shall meet the requirements for silt fence.

F. CATCH BASIN PROTECTION:

1. Catch basin protection shall be designed and installed for the purpose of preventing sediment from entering the storm system. Protection shall:
2. Be constructed of non-woven geotextile fabric with sewn seams;
3. Contain a built-in lifting strap;
4. Have a built-in, high flow bypass;
5. Be sized such that all water draining to the catch basin flows into the insert and does not flow directly into the storm.

G. CATCH BASIN COVERS

a. Catch basin covers shall be constructed using 30 mil PVC liner material.

H. PLASTIC SHEETING

1. Plastic sheeting shall be clear, reinforced, and a minimum of 6 mil thick. Sandbags or other Engineer-approved material shall be used to secure the plastic sheeting in place. Black plastic may be used to cover stockpiles.

PART 3 EXECUTION

3.01 PROJECT INFORMATION

A. GENERAL

1. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.
2. No discharge of water shall be allowed that increases volume, velocity, or peak flow rate of receiving water background conditions, or that does not meet state of Washington water quality standards.
3. The Contractor's Erosion and Sediment Control Plan (CESCP) required by this section shall be based upon the Temporary Erosion and Sediment Control (TESC) requirements of the contract but shall specifically phase, adjust, improve and incorporate the TESC requirements into the Contractor's specific schedule and plan for accomplishing the work. The CESCP shall be modified as changes are made to improve, upgrade and repair best management practices used by the Contractor and as the work progresses and TESC needs change.
4. The Contractor shall be wholly responsible for control of water onto and exiting the construction site and/or staging areas, including groundwater, stormwater, and process water. Stormwater from offsite shall be intercepted and conveyed around or through the project and shall not be combined with onsite construction stormwater.
5. Modifications to project hydraulic conveyances, detention facilities, and TESC plan sheets shall be stamped by a Professional Engineer (P.E.) licensed by the State of Washington. All other changes to the CESCP shall be signed by the CESCL.

B. PROJECT REQUIREMENTS

1. DESCRIPTION OF WORK
    a. In order to comply with the requirements of this section, the Contractor shall:
        (1) Develop and submit a Contractor's Erosion and Sediment Control Plan (CESCP). The CESCP shall, at a minimum, include and address the following:
            (a) Site Description and Drawings
            (b) Contractor Erosion and Sediment Control Personnel
            (c) Schedule and Sequencing
            (d) BMP Installation
            (e) BMP Maintenance
            (f) BMP Inspection
            (g) Record keeping
            (h) BMP Removal
            (i) Emergency Response
            (j) Construction Dewatering

(k) Fugitive Dust Planning

(l) Utilities Planning

(2) Revise and modify the CESCP during the life of the contract and maintain records.

(3) Install, maintain, and upgrade all erosion prevention, containment, and countermeasures BMPs during the life of the contract, and removal at the end of the project.

(4) Contain, cleanup and dispose of all sediment and convey turbid water to existing or proposed detention/treatment facilities.

(5) Perform other work shown on the project drawings, in the Contractor Erosion and Sediment Control Plan, or as directed by the Engineer.

(6) Inspect to verify compliance with the CESCP requirements including BMPs; facilitate, participate in, and implement directed corrective actions resulting from inspections conducted by others including outside Agencies and Port employees/consultants.

(7) Educate all Contractor and sub-contractor staff in environmental compliance issues at weekly meetings and document attendance and content.

2. DEFINITION

a. SWPPP: Stormwater Pollution Prevention Plan consisting of the following documents:

(1) Temporary Erosion and Sediment Control Plan sheets in the contract documents;

(2) Section 01 57 13 - Temporary Erosion and Sediment Control Planning and Execution;

(3) Section 01 57 23 - Pollution Prevention, Planning and Execution;

(4) Contractor’s Erosion and Sediment Control Plan (CESCP), both submitted by the Contractor.

3. ADMINISTRATIVE REQUIREMENTS

a. The provisions of this section shall apply to the Contractor, subcontractors at all tiers, suppliers and all others who may have access to the work site by way of the contractor’s activities.

b. Failure to install, maintain, and/or remove BMPs shown on the drawings, in the approved Contractor Erosion and Sediment Control Plan and specified herein, or by order of the Engineer; or failure to conduct project operations in accordance with Section 01 57 13 - Temporary Erosion and Sediment Control Planning and Execution will result in the suspension of the Contractor's operations by the Engineer in accordance with Section 00 70 00 - General Conditions.

c. The Contractor shall be solely responsible for any damages, fines, levies, or judgments incurred as a result of Contractor, subcontractor, or supplier negligence in complying with the requirements of this section.

d. Any damages, fines, levies, or judgments incurred as a result of Contractor, subcontractor, or supplier negligence in complying with the requirements of this section will be deducted from payment due by Modification.

e. Any time and material costs incurred by the Port due to damages, fines, levies, or judgments incurred as a result of Contractor, subcontractor, or supplier negligence in complying with the requirements of this section will be deducted from payment due by Modification.

f. The Contractor shall be solely responsible for any schedule impacts from damages, fines, levies, judgments, or stop work orders incurred as a result of Contractor, subcontractor, or supplier negligence in complying with the requirements of this section. The project schedule will not be changed to accommodate the time lost.

g. Contractor shall not grade, demolish, or perform any earthwork after NOTICE TO PROCEED until the following has been installed per the project drawings, the approved Contractor Erosion and Sediment Control Plan, or as directed by the Engineer:

   (1) Perimeter controls are in place.

   (2) Areas not to be disturbed are delineated with safety fence or construction fence.

   (3) Permanent sumps used for sediment control during construction have been installed.

   (4) Water flows from off site are tight lined and directed away from work area.

   (5) All construction entrances are stabilized. Catch basin inserts are installed in all catch basins that receive drainage from the Work area and haul.

   (6) Materials on hand, in quantities sufficient to cover all bare soil, divert all flows, contain all sediments, and prevent turbid discharges from the site during all stages of construction. These materials include, but are not limited to the following:

      (a) Reinforced 6 mil plastic sheeting

      (b) Bitminuous/Cold patch asphalt

      (c) 6” pipe

      (d) 8” pipe

      (e) Sand bags, filled

4. AUTHORITY OF ENGINEER

   a. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing, excavation, and fill operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, wetlands or other areas of water impoundment.

   b. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Engineer, such work shall be performed by the Contractor at his/her own expense.

   c. The Engineer may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.

   d. In the event that areas adjacent to the work area are suffering degradation due to erosion, sediment deposit, water flows, or other causes, the Engineer may stop construction activities until the situation is rectified.

   e. In the event that the Washington State Department of Ecology issues an Inspection Report, a Notice of Non-Compliance, Notice of Violation or Enforcement Action, the Engineer may stop all construction activities until it has been determined that the project is in compliance. The Engineer may require the Contractor to send additional staff to successfully complete Contractor Erosion and Sediment Control Lead (CESCL) training before construction activities may begin. The number of working days will not be changed to accommodate the work stoppage. All costs associated with work stoppages, mitigation of the event, and/or training shall be paid by the Contractor.

   f. In the event that the Contractor discharges storm water, ground water, or process water to storm drains, ditches, gutters or any conveyance that discharges to a receiving water as defined by the Department of Ecology without prior approval of the Engineer, the Engineer may stop all construction activities and require additional Contractor staff training and may require that all parties involved in the unapproved discharge be removed from the project for a time determined by the Engineer. The project schedule will not be changed to accommodate the time lost. All costs associated with mitigation of the unauthorized discharge, work stoppages, training and/or removal of personnel from the project shall be paid by the Contractor.

5. COORDINATION MEETINGS

   a. The Contractor shall be available, at a minimum, for a weekly coordination meeting with the Engineer, other Port Staff and outside agency representatives to review the ongoing contract work for compliance with the provision of this specification.

3.02 PREPARATION FOR EXECUTION OF WORK

A. CONTRACTOR'S EROSION AND SEDIMENT CONTROL PLAN (CESCP)

In order to comply with these requirements, the Contractor shall include and address the following in the CESCP:

1. Site Description and Drawings
    a. Included in the CESCP shall be a written description of the construction site, including location of staging areas, material storage areas, natural and constructed drainage systems within the work area and staging areas.
    b. Drawings shall be included in the CESCP which show the location of the construction site, including location of staging areas, material storage areas, natural and constructed drainage systems within the work area and staging areas. .
    c. The drawings shall show locations of BMPs during each phase of construction as identified by the Contractor in the Project Schedule.
    d. The drawings and written description shall detail temporary stormwater conveyance facilities and other measures proposed by the Contractor to limit the contributing drainage areas.
2. Contractor Erosion and Sediment Control Personnel
    a. The Contractor shall designate sufficient employees as the responsible representatives in charge of erosion and sedimentation control. These employees' responsibility will be the oversight of all water and air quality issues. One of these designees shall be onsite at all times when any work activity is taking place.
    b. One of the designated employees responsible for erosion and sedimentation control as discussed above shall be the Contractor Erosion and Sediment Control Lead (CESCL) who is responsible for developing, maintaining and modifying the CESCP for the life of the Contract and ensuring compliance with all requirements of this section.

        The CESCL shall be qualified in the preparation of erosion and sediment control plans, in the installation, inspection, monitoring, maintenance of BMP's, and documentation required for NPDES permits as well as sensitive resource identification, water treatment, and restoration and stabilization. The CESCL shall have authority to direct all Contractor and sub-contractor personnel.
    c. The CESCL shall have no other duties aside from developing, maintaining, modifying, inspecting, implementing the CESCP and ensuring compliance with all requirements of this section, and, all other environmental regulations, or as directed by the Engineer.
    d. Qualifications of the CESCL shall be as follows:
        (1) Have successfully completed Contractor Erosion and Sediment Control Lead (CESCL) training given by a Washington State Department of Ecology-approved

provider, ,and have five years' experience in construction site erosion and sediment control regulatory requirements and BMPs, erosion and sediment control plan development, and stormwater/water quality monitoring, or

(2) Currently certified as a Certified Professional in Erosion and sediment Control (CPESC) offered by CPESC, Inc. (www.cpesc.org) and have one year experience in state of Washington construction site erosion and sediment control regulatory requirements and BMPs, erosion and sediment control plan development and stormwater monitoring.

e. The CESCL shall also have done the following:

(1) Coordinated, developed, and implemented erosion and sediment control plans for NPDES permit compliance in the State of Washington.

(2) Completed at least two erosion and sediment control plans for earthwork projects.

(3) Developed phased construction work schedules addressing all ground disturbing activities.

(4) Designed proper temporary and permanent erosion and sediment control measures (BMPs) during demolition, existing road improvement, and for emergency situations.

(5) Designed excavation dewatering plans.

(6) Designed plans for dust abatement.

(7) The Contractor shall submit for approval all documentation listed above necessary to prove CESCL qualifications including but not limited to resumes, certificates, degrees, recommendation letters, and plan examples.

3. Duties and responsibilities of the CESCL shall include:

a. Maintaining permit file on site at all times which includes the CESCP, the SWPPP, and any associated permits and plans;

b. Directing BMP installation, inspection, maintenance, modification, and removal;

c. Availability 24 hours per day, 7 days per week by telephone;

d. Updating all drawings with changes made to the plan;

e. Keeping daily logs;

f. Prepare and submit for approval a Contractor Erosion and Sediment Control Plan (CESCP);

g. Immediately notify the Engineer should any point be identified where storm water runoff potentially leaves the site, is collected in a surface water conveyance system (i.e., road ditch, storm sewer), and enters receiving waters of the State;

h. If water sheet flows from the site, identify the point at which it becomes concentrated in a collection system.

i. Inspect CESCP requirements including BMPs as required to ensure adequacy; facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies, Port employees, and Port consultants.

j. Set up and maintain a construction stormwater monitoring plan that includes monitoring locations and procedures. At a minimum, the plan will include monitoring points everywhere construction stormwater discharges from the project.

k. The CESCL shall have authority to act on behalf of the Contractor and shall be available, on call, 24 hours per day throughout the period of construction.

l. The CESCP shall include the name, office and mobile telephone numbers, fax number, and address of the designated CESCL and all Contractor personnel responsible for erosion and sediment control.

m. In addition to the CESCL, the Contractor shall designate sufficient employees as Erosion and Sediment Control Inspectors who will be responsible for all erosion and sediment control, water quality, fugitive dust and other environmental compliance as directed by the CESCL. At a minimum, the Contractor’s superintendent foremen, and lead persons shall be designated as Erosion and Sediment Control Inspectors. On matters concerning erosion control, the Erosion and Sediment Control Inspectors shall report to the CESCL.

n. The Erosion and Sediment Control Inspectors shall have successfully completed “Contractor Erosion and Sediment Control Lead” (CESCL) training given by a Washington State Department of Ecology-approved provider.

4. Schedule and Sequencing

   a. The CESCP shall include:

      (1) Schedules for accomplishment of temporary and permanent erosion control work, that include as a minimum all specific work items as are applicable for construction; paving; structures at watercourses, saw cutting, and dewatering, underground utilities and Stormwater conveyances.

      (2) Proposed method of erosion and dust control on haul roads and a plan for disposal of waste materials;

      (3) Estimated removal date of all temporary BMPs;

      (4) Estimated date of final site stabilization.

      (5) Dates of demolition, earthwork and concrete pouring activities.

        (6) Dates when construction activities temporarily or permanently cease on any portion of the site.

        (7) Dates when any stabilization measures are installed.

        (8) Dates when structural BMPs are initiated.

        (9) Dates for all work performed within 200 feet of sensitive environmental areas including wetlands, streams and ponds.

    b. Erosion control work activities consistent with the CECSP shall be included in the Project Schedule for each work area and project activity as shown on the drawings.

5. BMP Installation

    a. The CESCP shall include installation instructions and details for each BMP used during the life of the Project;

    b. To prepare or modify Contractor's Erosion and Sediment Control Plans, use BMPs from the Washington State Department of Ecology, Stormwater Management Manual for Western Washington, Vol. 2, and (Current Version). May be downloaded at: http://www.ecy.wa.gov/programs/wq/stormwater/manual.html

    c. The CESCL shall certify that all BMP installers are trained in proper installation procedures.

6. BMP Maintenance

    a. The CESCP shall include a description of the maintenance and inspection procedures to be used for the life of the project.

    b. BMPs shall be maintained for the life of the project, the completion of a work phase and/or until removed by direction of the Engineer;

    c. BMPs shall be maintained during all suspensions of work and all non-work periods;

    d. BMPs shall be maintained and repaired as needed to assure continued performance of their intended function and in accordance with the approved CESCP;

    e. Sediments removed during BMP maintenance shall be placed away from natural and constructed storm water conveyances and permanently stabilized.

    f. All maintenance shall be completed within 24 hours of inspection

7. BMP Inspection

    a. The Contractor shall inspect all TESC best management practices daily during workdays and anytime 0.5" of rainfall has occurred within 24 hours on weekends, holidays, and after hours. Rainfall amounts can be determined by - contacting the National Weather Service. -

    b. Deficiencies identified during the inspection shall be corrected within 24 hours or as directed by the Engineer.

c. Note repairs or improvements needed, if any, and notify CESCL or site project superintendent to implement improvements;

d. Observe runoff leaving the site during storms, checking for turbid water;

e. Implement additional BMPs, if needed, to address site-specific erosion control;

f. Inspect streets surrounding site for dirt tracking;

g. Inspect for dust.

h. The Contractor shall visually inspect all stormwater runoff that discharges from the project for petroleum or chemical sheen, or “rainbow”. Occurrences of sheen shall be reported immediately to the Engineer and shall follow procedures specified in Section 01 57 23 – Pollution Prevention, Planning & Execution.

i. The Contractor shall collect samples and test all stormwater runoff that discharges from the project for turbidity using a calibrated turbid meter, and for pH using test strips that measure from pH 0 - 14. Turbidity that exceeds 25 NTUs or pH that is below 6.5 or above 8.5 shall be reported immediately to the Engineer.

8. Record keeping

    a. Reports summarizing the scope of inspections, the personnel conducting the inspection, the date(s) of the inspection, major observations relating to the implementation of the CESCP, and actions taken as a result of these inspections shall be prepared and retained as a part of the CESCP;

    b. All inspection reports shall be kept on-site during the life of the project and available for review upon request of the Engineer.

    c. Copies of all inspection records and updated CESCP shall be submitted to the Engineer weekly.

    d. The CESCP shall include the Contractor’s inspection form which includes the following:

        (1) All best management practices to be inspected and monitored for all work areas and work activities identified in the schedule for the life of the contract.

        (2) Inspection time and date.

        (3) Weather information including current conditions, total rainfall since last inspection and rainfall in the 24 hours prior to the current inspection.

        (4) Locations of BMPs inspected.

        (5) Locations of BMPs that need maintenance and reasons why.

        (6) Locations of BMPs that failed to operate as designed or intended.

(7) Locations where additional or different BMPs are needed and reasons why.

e. A description of stormwater discharged from the site. The CESCL shall note the presence of suspended sediment, turbid water, discoloration, and/or petroleum sheen.

f. Any water quality monitoring performed during inspection.

g. General comments and notes, including a description of any BMP repairs, maintenance or installations made as a result of the inspection.

h. A statement that, in the judgment of the person conducting the site inspection, the site is either in compliance or out of compliance CESCP. If the site inspection indicates that the site is out of compliance, the inspection report shall include a summary of the remedial actions required to bring the site back into compliance, as well as a schedule of implementation. If the site inspection indicates that the site is out of compliance, the CESCL shall notify the Engineer immediately.

i. Name, title, and signature of the CESCL conducting site inspection and the following statement: “I certify that this report is true, accurate, and complete, to the best of my knowledge and belief.”

9. BMP Removal

a. After cleaning and removal, the drainage system shall not be used for temporary construction stormwater conveyance or storage.

b. Sediment removed shall be hauled offsite or as directed by the Engineer.

c. Temporary BMPs shall be removed upon permanent stabilization or as directed by the Engineer.

d. Areas disturbed during removal of temporary BMPs shall be permanently stabilized.

e. Permanent stabilization shall occur upon installation of:

(1) Concrete or asphalt pavement.

(2) All stormwater discharges from the project meet the following criteria:

(a) 0-25 NTUs.

(b) 6.5-8.5 pH.

(c) No visible sheen.

(d) No settleable solids.

(e) Washington State Stormwater Quality Standards (WAC 173-201A) at the receiving water, as determined by the Engineer.

10. Emergency Response

a. The CESCP shall contain information on how the Contractor shall control and respond to turbid water discharges, sediment movement, and fugitive dust. At a minimum, the Contractor's employee responsible for, or first noticing, the discharges shall take appropriate immediate action to protect the work area, private property, and the environment (e.g., diking to prevent pollution of state waters). Appropriate action includes but is not limited to the following:

(1) Hazard Assessment - assess the source, extent, and quantity of the discharge.

(2) Securement and Personal Protection - If the discharge cannot be safely and effectively controlled, then immediately notify the CESCL and the Engineer. If the discharge can be safely and effectively controlled, proceed immediately with action to protect the work area, private property, and the environment.

(3) Containment and Elimination of Source - Contain the discharge with pipes, sand bags or asphalt berm down slope from the affected area. Eliminate the source of the discharge by pumping turbid water to a controlled area, building berms, piping clean water away from the area or other means necessary.

(4) Cleanup - when containment is complete, remove sediment, stabilize, dispose of contaminated water and prevent future discharge.

(5) Notification - report all discharges immediately to the Engineer.

11. Construction Dewatering

a. The CESCP shall address how the Contractor plans to manage polluted water during the life of the project. Specific procedures shall be developed and included in the CESCP when work includes excavation within 10 feet of any water, sewer, or storm system.

b. The Engineer shall be notified before any disposal, hauling, pumping, or treatment of water occurs. Notification shall include location of disposal and methods of treatment.

c. Contractor shall supply the Engineer with copies of all disposal manifests.

d. Water shall not be pumped into gutters, drainage conveyance, catch basins, or any area that drains to one of these unless it meets the specifications outlined in this section and with prior approval of the Engineer.

12. Fugitive Dust Planning:

a. The CESCP shall detail the Contractor proposed approach to fugitive dust management. The plan shall include the following:

(1) Identification of all fugitive dust sources for each work activity.

(2) Description of the fugitive dust control measures to be used for each source.

(3) Schedule, rate of application and calculations to identify how often, how much, and when the control method is to be used.

(4) Provisions for monitoring and recordkeeping.

(5) Contingency plan in case the first control plan does not work or is inadequate.

(6) Name and telephone number of the person responsible for fugitive dust control.

(7) Source and availability of fugitive dust control materials.

b. The Contractor shall provide whatever means is necessary to keep fugitive dust on site and at an absolute minimum during working hours, non-working hours and any shut-down periods.

c. The Contractor’s methods for fugitive dust control will be continuously monitored and if the methods are not controlling fugitive dust to the satisfaction of the Port, the Contractor shall improve the methods or utilize new methods at no additional cost.

d. The Contractor shall maintain as many water trucks on a site during working and non-working hours as required to maintain the site free from fugitive dust.

e. During time periods of no construction activity, water trucks must be ready with on-site Contractor’s personnel available to respond immediately to a dust or debris problem as identified by the Engineer.

f. At no time shall there be more than a 10 minute response time to calls concerning fugitive dust/debris problems during work hours and a 90 minute response at all other times on a 24 hour basis.

B. UTILITIES PLANNING:

The CESCP shall identify when and how all underground utility work will be conducted so that water quality compliance is maintained. At a minimum, the Contractor shall:

1. Have all shut off valves located and have procured the means to shut off valves within 10 minutes of a water line break.

2. Before cutting into an existing water line, the Contractor shall verify to the Engineer that the water line is not pressurized.

3. The Contractor shall not cut into an existing storm drain or connect new stormwater conveyance systems into existing systems until it has been verified to the Engineer there will be no discharge of non-compliant water during and after cutting and connection operations.

4. The Contractor shall grout all holes, seams, cracks, joints, cast iron rings and grates within 24 hours of installation of each item.
5. Storm systems to be demolished in place shall be first blocked at the point of connection to existing section to prevent contamination of existing storm system.
6. Chlorinated water shall be discharged to sanitary sewer or removed from the site.
7. Air plugs shall not be utilized for more than 24 hours and shall be in new condition with no leaks and monitored daily for proper air pressure.
8. Mechanical plugs shall not be utilized for more than 5 calendar days and shall be used according to the manufacturer's instructions and engineering parameters. The Contractor shall submit instructions and engineering documentation before use.
9. When a plug needs to remain in place longer than 5 days, the Contractor shall utilize grout. The grout shall be installed so that the length is one and a half times the diameter of the pipe.

3.03 EXECUTION OF WORK

A. CONSTRUCTION REQUIREMENTS

1. Saw cutting
    - a. Saw cut slurry and cuttings shall be vacuumed during cutting operations;
    - b. Saw cut slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight;
    - c. Saw cut slurry and cuttings shall not drain to SDS or any other natural or constructed drainage conveyance;
    - d. Collected slurry and cuttings are the responsibility of the Contractor and shall be disposed of off-site in a manner that does not violate groundwater or surface water quality standards.
2. Soil and Construction Stockpiles
    - a. Soil and Construction Stockpiles, debris or aggregate stockpiles of any kind shall not be allowed on this project unless approved by the Engineer.
3. Construction Roads, Entrances, and Exits
    - a. Before leaving project site, all trucks and equipment shall be inspected for mud and debris. All mud and debris shall be removed as per Section 01 50 00 - Temporary Facilities and Controls.
    - b. At no time shall mud, debris, or visible sediment be allowed outside of the project boundaries and on any Port-owned and public roads.
    - c. Mud and debris shall be removed from pavement by vacuum sweeping and shoveling and transported to a controlled sediment disposal area identified in the CESCP.

d. If the mud and debris are contaminated by fuels, grease, metals or other pollutants, they shall be disposed of in accordance with Section 01 57 23 - Pollution Prevention, Planning and Execution.

e. Use of water to wash concrete or asphalt pavement shall be allowed only after sediment has been removed by vacuum sweeping and shoveling, and a Road Wash Plan has been submitted and accepted by the Engineer.

f. Power brooms shall not be utilized without prior approval by the Engineer.

g. Contractor shall have sufficient working vacuum sweepers on site at all times work is being performed. All sweepers shall have on-board water spray systems that shall be operating at all times.

h. If, in the Engineer’s opinion, the Contractor does not adequately manage the tracking of sediment, the Port may subcontract out the control of sediment tracking at the Contractor’s expense.

4. Asphalt Curb and Asphalt Berm

    a. Asphalt Curb and Asphalt berm shall be constructed on project perimeters to tight line offsite water and contain the footprint of the job site.

5. Water Filled Diversion Berms

    a. Water filled diversion berms shall be installed such that offsite water is prevented from entering the job site and site water is kept within the project boundary.

    b. Berms may be used to prevent contaminants and water from entering the catch basins.

    c. Berms may be used on concrete and asphalt surfaces.

6. Geotextile Fabric Check Dams

    a. Geotextile fabric check dams shall be installed on asphalt or concrete surfaces by using rubberized asphalt emulsion or an industrial glue.

    b. Fabric check dams shall adhere to the surface by applying tacking agent under the full length of the barrier section and the full length of the leading edge of the apron.

7. Catch Basin Protection

    a. All catch basins within the project limits, and outside the project limits but within the project drainage basin, including haul roads, shall be protected

    b. Catch basin protection shall be installed where shown in the project drawings, in all storm drainage structures within the work area, or as otherwise directed by the Engineer.

8. Catch Basin Covers

    a. Catch basin covers shall be 30 Mil pvc Liner material.

9. Concrete Truck and Equipment Washing
   a. Concrete trucks shall not wash out on site without approval of the Engineer.
   b. hand tools, screeds, floats, trowels, rollers and all other tools shall be washed out only into Washington State Department of Ecology (WDOE)-approved covered steel containers -
   c. All contained concrete waste shall be disposed of offsite in a manner that does not violate groundwater or surface water quality standards.
   d. All water used for washing, is defined by the WDOE as “process water” and shall be collected and disposed of in a manner that complies with all locate, state and federal regulations.
10. Construction Stormwater
    a. Contractor shall prevent offsite water from entering work areas.
    b. Contractor shall be responsible for all water within excavations and work areas.
    c. The Contractor is responsible for conveying construction stormwater within each work area.
    d. Temporary piping, structures and pump facilities required for the conveyance are the responsibility of the Contractor.
       (1) The construction stormwater shall be held in the storage weir tanks until all stormwater meets the following criteria:
           (a) 0-25 NTUs.
           (b) 6.5-8.5 pH.
           (c) No visible sheen.
           (d) No settleable solids.
11. Asphalt Curb and Asphalt berm
    a. Asphalt curb and asphalt berm shall be constructed on project perimeters to tight line offsite water and contain stockpiles and the footprint of the job site.
    b. Asphalt curb and berm shall be a minimum height of four inches.
    c. Asphalt material shall meet the requirements as specified in Section 32 12 16.13 – Plant mix bituminous pavement.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for –Temporary Erosion and Sediment Control will be as a -Lump Sum.

B. " Temporary Erosion and Sediment Control – Force Account" will be made on a Force Account Basis in accordance with Document 07 00 00 – General Conditions, Paragraph G-08.06. An estimated amount has been entered in the bid Item schedule.

4.02 PAYMENT

A. Payment for "TESC – Plan and Execution" will be made at the contract lump sum price as stated in the Schedule of Unit Prices and shall be full compensation for furnishing all labor, equipment, materials and tools to develop, implement and maintain the temporary erosion and sedimentation control plan including implementation of temporary stormwater conveyance facilities either as shown on the drawings or as required to complete the work, dust control, - control of sediment tracking, providing and operating vacuum sweepers and water trucks, and other measures as required as detailed on the drawings and specified herein through the duration of the contract, with the exception of those items measured and paid for separately. Payments will be made as follows:

1. Upon acceptance of the Contractor's Erosion and Sediment Control Plan (CESCP) 20%.
2. After NTP and before Substantial Completion, 60% will be prorated and paid monthly for compliance with the CESCP. Non-compliance will result in withholding of payment for the month of the non-compliance.
3. At final payment, 20% for a clean and stabilized site.

-

End of Section

PART 1 GENERAL

1.01 SUMMARY

A. This section consists of planning for and implementing the temporary measures indicated herein, shown on the Contract Documents, or as ordered by the Engineer to prevent pollution of soil and water, and control, respond to, and dispose of potential pollutants or hazardous materials during the life of the Contract.

B. This work shall apply to all areas associated with Work including, but not limited to the following work areas:

1. Jobsite
2. Equipment and material storage areas
3. Staging/Laydown areas

1.02 DESCRIPTION OF WORK

A. In order to comply with this specification the Contractor shall:

1. Develop and submit a site specific Pollution Prevention Plan
2. Revise the Pollution Prevention Plan during the life of the Contract
3. Install, maintain, and remove all spill prevention, containment, countermeasures, and pollution prevention Best Management Practices during the life of the Contract
4. Contain, cleanup and dispose of all hazardous materials or potential pollutants
5. Perform other work shown on the Contract Documents or as directed by the Engineer
6. Maintain any required Contractor pollution liability insurance including insurance liability for the transportation of hazardous materials for the duration of the Contract
7. Maintain a proper Hazardous Material Endorsement for any driver that is transporting hazardous material in a vehicle that requires the driver to maintain a valid and current Commercial Driver’s License in the State of Washington

1.03 POLLUTION PREVENTION PLAN

A. The Contractor shall develop and submit to the Port a site specific Pollution Prevention Plan. The Pollution Prevention Plan must be a site-specific document that outlines the administrative, operational, and structural Best Management Practices that will be implemented on the project. Approved BMPs may be found in the Stormwater Management Manual for Western Washington, Department of Ecology, August 2001, or current edition.

B. The Pollution Prevention Plan must, at a minimum, include the following:

1. Site specific description and drawings
2. Contractor pollution prevention contact personnel
3. Known or potential hazardous materials inventory list

4. Safety Data Sheets (SDSs) for hazardous materials identified on the inventory list
5. Hazardous material containers labeling system
6. Hazardous material container storage and handling procedures
7. Hazardous material spill prevention planning and execution
8. Hazardous material spill control and response planning and execution
9. Hazardous material cleanup and disposal planning and execution
10. Subcontractor’s acknowledgment

1.04 SUBMITTALS

A. As part of the required Preconstruction Submittals, Section 01 32 19 - Preconstruction Submittals, and before Notice to Proceed is issued, the Contractor shall submit the following information:

1. Pollution Prevention Plan and the required contents
2. Insurance Endorsements verifying liability coverage for job-site work and any transportation of hazardous materials to or away from the jobsite.
3. Copy of a completed MCS-90 Certificate if required under the Motor Carrier Act of 1980 for transportation of hazardous material which verifies compliance with the financial responsibility requirements of the Act;
4. A list of all drivers who will be hauling hazardous material in a vehicle that requires the driver to maintain a Commercial Driver’s License in the State of Washington under RCW 46.25.080. These drivers must show evidence of a proper Hazardous Material Endorsement in accordance with Washington RCW 46.25.070 and 46.25.085.

1.05 DEFINITIONS

A. Absorbent: Any material capable of absorbing oils, water-based materials, solvents, acids, and other hazardous materials. Absorbent materials include: pads, kitty litter, floor dry, and other commercially available materials.

B. Best Management Practice (BMP): The variety of administrative, operational, and structural measures that will be implemented to prevent and reduce the amount of contaminants in stormwater and the environment. (Example: Providing secondary containment for liquid storage is a BMP).

C. Container: Any portable device, in which a material is stored, transported, treated, disposed of, or otherwise handled.

D. Daily Report: The report (form CM03) that the Contractor shall submit daily to include Contractor daily activities.

E. Dangerous Waste: Solid wastes designated by the State of Washington Under Chapter 173-303 WAC and regulated as Dangerous Waste, Extremely Hazardous Waste, or Mixed Waste. (The State of Washington is authorized to implement Federal Hazardous Waste Regulations - see also Hazardous Waste Definition)

F. Hazardous Material: A substance or material, including a hazardous substance, hazardous waste, marine pollutant, including but not limited to: diesel, gasoline, petroleum products, solvents, paints, acids, lubricants, curing compounds, form release agents, adhesives, sealants, and epoxies. (See also Hazardous Waste definition)

G. Hazardous Material Storage Area: The area used by the Contractor to store hazardous material.

H. Hazardous Material Container Labeling System: The system used by the Contractor for identifying the secondary containers used to store hazardous materials or wastes. Acceptable methods include: Department of Transportation (DOT), Hazardous Material Information System (HMIS); National Fire Protection Association Fire Diamond (NFPA Hazard Rating).

I. Hazardous Waste: Solid wastes designated by 40 CFR Part 261, and regulated as hazardous or mixed waste by the United States EPA.

J. Safety Data Sheet (SDSs): Written or printed material available for each chemical that includes information on: the physical properties, hazards to personnel, fire and explosion potential, safe handling recommendations, health effects, fire-fighting techniques, and reactivity and disposal.

K. Secondary Container: Any container, other than the original container that is used for transferring, holding, storing or otherwise containing hazardous materials or wastes.

L. Secondary Containment: A device designed, installed, or operated to prevent any migration of wastes or accumulated liquid to the soil, ground water, or surface water. The device must, at minimum, hold 110 percent of the volume of the largest container being stored. The device must have the strength to contain a spill and be made of materials that will not be degraded by the wastes or accumulated liquids it is intended to contain.

M. Sorbent: A material used to soak up free liquids by either adsorption or absorption, or both.

N. Storm Drainage System (SDS): Consists of any drain, inlet, catch basin, slot drain, pipe, gully, fissure, ditch, or other form of conveyance that collects and transports stormwater.

1.06 REFERENCES

A. The following rules, requirements and regulations specified may apply to this work:

1. Washington State Dangerous Waste Regulations: Chapter 173-303 WAC, February 1998 Edition.
2. National Pollution Discharge Elimination System Waste Discharge Permit No. WA-002465-1 (Seattle-Tacoma International Airport)
3. Part C - Hazardous Communication: Chapter 296-62-054 WAC, “Right to Know”
4. Puget Sound Stormwater Management Plan, Puget Sound Water Quality Action Team; 1998.
5. Title 40 Code of Federal Regulation Subchapter I - Solid Wastes 261, 262, 263, 265, 268, 273, 279, 370 (Federal Hazardous Waste Regulations)
6. Stormwater Management Manual for Western Washington, Department of Ecology; August 2001 (or Current Version)

7. Surface Water Design Manual, King County Public Works, September 1998
8. WAC 173-201 A, Water Quality Standards of the State of Washington.
9. Revised Code of Washington - 46.25.085, 46.25.080, 46.25.070, 46.48.170, 4.24.314

1.07 PERMITS

A. Work shall be conducted in accordance with all applicable NPDES permit including but not limited to the Port of Seattle's Phase 1 Municipal Permit (Seaport).

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 SITE DESCRIPTION AND DRAWINGS

A. A written site description shall be included in the Pollution Prevention Plan that addresses the following:

1. Physical description and location of the construction site and staging areas;
2. Construction activities that will involve the use of hazardous materials or generate hazardous waste;
3. Location of material storage areas and project staging areas;
4. Designated fueling areas;
5. Proximity to any natural or manmade drainage conveyance including ditches, catch basins, ponds, wetlands, and pipes;
6. Public areas relating to construction project;
7. Proximity to other construction sites;

B. Drawings shall be included in the Pollution Prevention Plan that show the construction site(s), location of fueling areas, equipment storage areas, catch basins and other man-made and natural drainage conveyances within the work area and storage areas. The drawings may be hand drawn sketches but must include the appropriate spatial information.

3.02 CONTRACTOR POLLUTION PREVENTION CONTACT PERSONNEL

A. The Contractor shall identify in the Pollution Prevention Plan at least one project personnel that will be available 24 hours a day to administer and respond to hazardous materials management requirement of the Contract and provide the following information:

1. Contact Name
2. Contact Phone Number
3. Contact E-mail Address
4. Contact Fax Number
5. Contact Address

B. Duties

1. Maintain permit file on site at all times which includes the Pollution Prevention Plan, Contractor Erosion and Sediment Control Plan and any associated permits and plans;
2. Direct BMP installation, inspection, maintenance, modification and removal;
3. Available 24 hours per day, 7 days per week by telephone;
4. Update all drawings with changes made to the Pollution Prevention Plan;
5. Maintain daily logs;
6. Immediately notify the fire department (911) of any hazardous material spill.
7. Inspect for Pollution Prevention Plan requirements including BMPs as required to ensure adequacy, facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies, Port employees and Port consultants.

C. Qualifications

1. The Pollution Prevention Plan Inspector shall have the following experience:
    a. Prevention, control and clean-up of construction caused pollution from petroleum, hazardous materials and construction wastes.
    b. Knowledge of basic hazard and risk assessment techniques.
    c. An understanding of basic hazardous materials terms.
    d. Ability to perform basic control, containment or confinement operations within the capabilities of the resources and personnel protective equipment available.
    e. Installation, inspection, maintenance and removal of Pollution Prevention BMPs.

3.03 HAZARDOUS MATERIAL INVENTORY LIST

A. A complete list of all known or potential hazardous materials or waste to be used or generated during all phases of the construction project shall be included in the Pollution Prevention Plan.

3.04 SAFETY DATA SHEETS (SDSs)

A. SDSs shall be included in the Pollution Prevention Plan for all materials on the Hazardous Material Inventory List.

B. For all hazardous materials not submitted in the original Hazardous Material Inventory List, the Contractor shall provide to the Engineer a completed Form A-3 and SDS prior to bringing the material on site and submit a revised inventory list (or plan if required) within 7 days.

1. Hazardous materials shall be permitted on the work site only with prior written acknowledgement of receipt of Form A-3 and SDS by the Engineer.

3.05 HAZARDOUS MATERIAL CONTAINERS LABELING SYSTEM

A. The Pollution Prevention Plan shall address and the Contractor shall implement the following:

1. Identification of container with a legible label containing the materials product name, as was written on the material's original container label.
2. Include the name of the material's manufacturer, as was written on the chemicals original container label.
3. Include appropriate hazard warnings, which identify the chemicals associated risks to health, flammability, or reactivity.
4. Contractor shall mark each container with the Contract project number and company owner of the container.
5. The mark shall be permanent, easily identifiable and placed with care to prevent defacing of the marker through abrasion, chemical reaction, or other means that would hinder marker identification.
6. At all times during the Work, the Contractor shall assure that proper and identifiable labels are attached to all hazardous materials and secondary containment

3.06 HAZARDOUS MATERIAL CONTAINER STORAGE AND HANDLING

A. Solid Chemicals, chemical solutions, paints, petroleum products, solvents, acids, caustics solutions, and any waste materials, including used batteries, shall be stored in a manner that will prevent the inadvertent entry of these materials into waters of the state, including groundwater. Storage shall be in a manner that will prevent spills due to overfilling, tipping, or rupture. In addition, the Pollution Prevention Plan shall address and the Contractor shall implement the following specific requirements:

1. All liquid products must be stored on durable, impervious surfaces and within a berm or other means of secondary containment capable of containing 110% of the largest single container volume in the storage area.
2. Waste liquids shall be stored under cover, such as tarps of roofed structures, in addition to secondary containment. Any waste storage areas, whether for waste oil or hazardous waste, shall be clearly designated as such and kept segregated from products to be used on the site.
3. In the event that the Contract Document Drawings designate a hazardous material storage area, the Contractor shall be restricted to storing hazardous materials or waste specific to the Project work to the area designated in the Contract Document Drawings.
4. All hazardous materials and waste containers shall be stored with the container lid secured, to prevent spills or leaking.
5. Upon completion of a specific task for which hazardous material(s) were used, the Contractor shall document in the Daily Report (Form CM03), the amount of hazardous material removed from the site, and the product and manufacturer name(s) of such material(s).

3.07 HAZARDOUS MATERIAL SPILL PREVENTION

A. The Pollution Prevention Plan shall address and the Contractor shall implement the following:

1. Hazardous Material Transfer

    a. All hazardous materials shall be transferred from primary to secondary containers using secondary containment with spill kits in close proximity.

2. Vehicle and Equipment Fueling-
    a. All equipment fueling operations shall utilize pumps and funnels and absorbent pads and / or drip pans;
    b. Fueling shall not take place within 100 feet of any natural or manmade drainage conveyance including ditches, catch basins, ponds, wetlands, and pipes;
    c. Fueling shall be restricted to designated fueling areas as shown on the Contract Documents or as submitted and accepted by the Engineer as a part of the Pollution Prevention Plan;
    d. A spill kit will be located within 100 feet of the fueling operation.
    e. Vehicle and Equipment Maintenance
    f. Engine, transmission, and hydraulic oil may be added, as needed utilizing funnels and drip pans;
    g. Absorbent pads shall be placed to prevent fluid contact with soil;
    h. No fresh or used engine fluids will be stored on the project site;
    i. No vehicle maintenance other than emergency repair shall be performed on the project site.
3. Small Engine Fueling and Maintenance
    a. All small engine fueling operations shall utilize funnels.
    b. Absorbent pads shall be placed to prevent fluid contact with soil.
    c. Fueling shall not take place within 100 feet of any natural or manmade drainage area.
    d. Contractor shall not drain and replace engine fluids on Port property.
    e. These fluids may be added, as needed utilizing funnels.
    f. Fluid addition shall be done over drip pans.
    g. Absorbent pads shall be placed to prevent fluid contact with soil.
4. Equipment Storage
    a. Drip pans and absorbent pads shall be placed under all equipment that is unused for more than 4 hours, overnights, weekends, and holidays.
5. Spill Response Kits
    a. Spill kits shall be stored at designated locations on the project site and at the hazardous material storage areas and in close proximity to any fueling operation.
    b. Spill Kits shall, at a minimum, contain the following:

(1) 1-spill response procedures sheet

(2) 12-oil absorbent pads

(3) 12-water-based absorbent pads

(4) 1-roll of Visqueen

(5) 5-gallons of loose absorbent material i.e. kitty litter or floor sweep

(6) 24-heavy duty garbage bags

(7) 1-shovel

(8) 1-broom

(9) 10-copies spill report form

3.08 HAZARDOUS MATERIAL SPILL CONTROL AND RESPONSE

A. The Plan shall contain information on how the Contractor shall control and respond to hazardous material spills. At a minimum, the Contractor’s employee responsible for the spill must take appropriate immediate action to protect human health and the environment (e.g., diking to prevent contamination of state waters).

1. Hazard Assessment - assess the source, extent, and quantity of the spill.
2. Containment and personal protection - If the spill cannot be safely and effectively controlled, then evacuate the area and immediately notify outside response services (go to Step 5). If the spill can be safely and effectively controlled, secure the area and proceed immediately with spill control (impacts to waters of the state should be given the highest priority after human health and safety)
3. Containment and elimination of Source - Contain the spill with absorbent materials or a soil berm around the affected area. Eliminate the source of the spill by closing valves, sealing leaks, providing containment, or deactivating pumps.
    a. Spill control measures may include damming the spill, covering floor drains, catch basins, or preventing the contaminant from entering water systems. Contaminants include turbidity as well as chemicals.
4. Cleanup - when containment is complete, clean or remove the spill with absorbents or by pumping and containerizing the material for off-site disposal.
5. Notification - Report all spills immediately to the Port of Seattle Fire Department:
    a. Port Phone: 911
    b. External Phone: (206) 787-5380
    c. Provide the Following Information:
        (1) Time spill occurred or was discovered
        (2) Location of the spill and equipment involved
        (3) Estimated amount of spill

(4) Measures taken to contain the spill and secure the area

d. Report all spills immediately to the Engineer.

3.09 HAZARDOUS MATERIAL CLEANUP AND DISPOSAL

A. The Plan shall contain information on how the Contractor shall characterize, cleanup and remove all hazardous material and waste generated from Contractor operations. At a minimum, the Plan shall include or communicate the following:

1. For the purposes of this section, clean shall be defined as the Work site being free of all hazardous material(s), waste(s) container(s), containment device(s), scrap material(s), used spill pads or absorbent pads, or any other hazardous material debris resulting from the Contractor activities.
2. The Port of Seattle will retain title to all hazardous waste presently on site, encountered during demolition, removal, and excavation. This does not include hazardous materials generated by the Contractor, such as used motor oils, paints, lubricants, cleaners, spilled materials, etc. Contractor will be the generator and owner of these wastes and shall clean and dispose of such waste according to the Contract Documents and follow local, State, and Federal regulations. The Port of Seattle will be shown as the hazardous waste generator and will sign all hazardous waste manifests for non-Contractor generated hazardous wastes. Nothing contained within these Contract Documents shall be construed or interpreted as requiring the Contractor to assume the status of owner or generator of hazardous waste substances for non-Contractor generated hazardous wastes.
3. Hazardous material(s) and waste(s) shall be disposed in a fully permitted disposal facility with the approvals necessary to accept the waste materials that are disposed. Use of the Port of Seattle’s EPA Identification Number for disposal purposes must be coordinated with the Engineer and all documentation such as manifests, land disposal restriction forms, and profiles must be delivered to the Engineer if the Port of Seattle’s EPA Identification number is being used for disposal on the project.
4. Contaminated materials, such as absorbent materials, rags, containers, gloves, shall be collected and placed into labeled containers.
5. Any unanticipated hazardous materials, waste, or contaminated soils encountered during construction that are not generated by the Contractor shall be immediately brought to the Engineer’s attention for determination of appropriate action. Contractor shall not disturb such hazardous materials or contaminated soils until directed by the Engineer.

3.10 SUBCONTRACTOR ACKNOWLEDGEMENT

A. The requirements of the Pollution Prevention Plan are the responsibility of the Contractor and compliance must be communicated at all tiers of the Contract. The Contractor must provide a written acknowledgement from all subcontractors that they have read, understand, and will comply with the requirements of the Pollution Prevention Plan. This written acknowledgement must be included in the Pollution Prevention Plan as part of the preconstruction submittal. The subcontractor acknowledgement section of the Pollution Prevention Plan must be updated as needed throughout the life of the Contract.

3.11 EDUCATION

A. The Contractor shall provide narrative in the Pollution Prevention Plan on how they will educate all personnel including subcontractors. At a minimum, the Contractor shall train staff through regularly scheduled meetings to discuss environmental protection subjects as related to this project. This may be added to any existing weekly meetings (such as safety meetings). Training content shall emphasize sensitive areas, emergency response, spill prevention and inspections. Keep minutes of the meetings detailing attendees and subjects discussed. Submit the minutes to the Engineer monthly.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this Section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. This item shall consist of the management of all construction water including collection, conveyance and disposal of onsite stormwater and groundwater, diversion of offsite water away from the project sites, and collection and offsite disposal of process water.

B. The Contractor shall be solely responsible for design, installation, operation and maintenance of all collection and conveyance systems and shall modify as needed to meet the requirements of this Section. The Contractor shall take full responsibility for fines imposed due to exceeding the discharge limits.

C. No onsite water treatment shall be allowed.

1.02 DESCRIPTION OF WORK

A. In order to comply with the requirements of this section, the Contractor shall:

1. Develop and submit a Construction Water Management Plan (CWMP).
2. Install temporary structures, modifications, sumps, piping, by-passes, connections, and pumps to contain and convey stormwater to the disposal collection area.
3. Remove all temporary system components and restore the Port’s stormwater facilities to their original condition.
4. Clean all Port storm conveyances, structures, vaults and facilities to the satisfaction of the Engineer.

1.03 SUBMITTALS

A. As part of the required Preconstruction Submittals, Section 01 32 19-, the Contractor shall submit the following:

1. Construction Water Management Plan.

1.04 PERMITS

A.

B. Work shall be conducted in accordance with Stormwater Pollution Prevention Plan, as required by the STIA NPDES permit number WA-002465-1.

PART 2 PRODUCTS

2.01 STORMWATER STORAGE TANK

A. Storage tanks shall consist of a weir tank with a capacity adequate to contain the volume determined in the Contractor’s analysis. The Port reserves the right to limit the maximum height for tanks and the available location for tank placement. Coordinate with the Engineer for tank placement. Tanks shall only be located in active work areas.

2.02 PUMPING

A. The Contractor is responsible for all pumping and shall identify structures utilized as sumps for pumping locations. These shall be augmented with other on-site pumps utilized for collection of standing water and continuous dewatering of excavations.

2.05 TEMPORARY PIPING

A. Temporary above ground piping shall be PVC/Woven Synthetic Fibers, EPDM, Ductile Iron, or HDPE Pressure Pipe meeting AWWA C901/C906.

B. All above ground piping and fittings shall be sized and pressure rated for their application, water tight, free of leaks or tears, and maintained in working condition.

C. Piping is limited to the active work area; no piping can be located outside of an active work area.

PART 3 EXECUTION

3.01 GENERAL

A. Design and modifications to conveyances, pumps, sumps, detention facilities and any hydraulic calculations necessary for implementation of this Section shall be stamped by a Professional Engineer licensed in the State of Washington.

B. Damage to any portion of the Construction Water Management System caused by Contractor operations, weather or negligence shall be repaired immediately at sole cost to the Contractor.

C. The system shall be designed to handle the specified maximum peak influent flow rates.

D. Contractor shall provide all utilities and power required for water management activities.

3.02 CONSTRUCTION WATER MANAGEMENT PLAN (CWMP)

A. The Contractor shall prepare a CWMP that describes and includes the management of construction stormwater and non-construction stormwater. The plan shall include procedure outlines for start-up, normal operations, process monitoring, freeze protection, normal shutdown, and decommissioning.

B. This plan shall describe the management of construction stormwater and by what means non-construction stormwater is segregated from the project site. This consists of planning/phasing, installing, onsite collection, conveyance, plugs, pumps, and disposal of all construction water collected or related to construction activities or as ordered by the Engineer.

C. In addition, the CWMP shall include and address, at a minimum, the following:

1. Site Description and Site Drawings
    a. Provide a detailed project description including phasing and schedule for major work activities.
2. Construction Water Management Description and Drawings
    a. Contractor shall provide sufficient detail to show that all site water is managed per the requirements of this Section and to the satisfaction of the Engineer.
    b. Installation layout drawing storage systems.
3. Design Calculations

a. Contractor shall provide product information and/or supporting calculations indicating that their selected pumps and hoses will meet the pump conveyance requirements.

b. All Contractor calculations shall be approved and stamped by a Professional Engineer licensed in the State of Washington.

4. CTAPE Documentation

a. CTAPE documentation shall meet Department of Ecology requirements.

3.03 SYSTEM REMOVAL AND CLEANING

A. The Contractor shall clean, flush, jet and vactor out all sediment accumulated in Port conveyances including, but not limited to, storm pipes, manholes, vaults, ponds and ditches. The cleaning operation shall not flush sediment laden water or debris into the active downstream storm system.

3.04 EMERGENCY RESPONSE

A. The Contractor shall be available 24 hours per day, seven days per week to respond to system emergencies.

B. The Contractor shall respond to system emergencies within one hour of notification by the Engineer.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

No separate measurement or payment will be made for the work required by this Section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Lump Sum price bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Mobilization shall consist of preconstruction expenses and costs of preparatory work and operations performed by the Contractor which occur before 10% of the Executed Contract Price is earned from other Bid Items. Items which are not to be included in the item of mobilization are:

1. Any portion of the Work covered by a specific Bid Item or incidental work which is to be included in a Bid Item or Items.
2. Profit, interest on bond money, overhead or management costs.

B. Demobilization shall consist of post-construction expenses and work that occurs after 95% of the Executed Contract Price is earned.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION - Not used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. Based on the Lump Sum Bid Item price for “Mobilization/Demobilization”, partial payments will be made as follows:

1. When the Contractor and Engineer agree 10% of the Executed Contract Price is earned, excluding mobilization and amounts paid for materials on hand, 60% of the amount bid for “Mobilization” will be paid.
2. When the Contractor and Engineer agree 95% of the Executed Contract Price is earned from other Bid Items, excluding mobilization and amounts paid for materials on hand, the remaining amount bid for “Mobilization/Demobilization” will be paid.

End of Section

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surveys provided by the Port

B. Contractor Survey Requirements. All work must be performed by a surveyor registered in the State of Washington.

C. All elevations indicated on drawings refer to National Ocean Survey Mean Lower Low Water (MLLW) Datum unless otherwise noted for Seaport projects.

1.02 SURVEYS PROVIDED BY THE PORT

A. The Port will provide those and only those services listed below:

1. Establish primary survey control points.

B. All other survey work needed for construction is the sole responsibility of the Contractor.

1.03 REQUIRED CONTRACTOR SUPPORT

A. The Contractor shall provide sufficient space and safe facilities to enable the Engineer to set control points and perform other work required by this specification.

B. Requests for setting primary control points shall be made at least 2 weeks prior to the need. Delays due to Contractor failure to give timely notice to the Port for surveying services are at the sole risk and expense of the Contractor.

C. If the Contractor encounters any underground utilities that are not shown on the existing conditions drawings, or known utilities that are not in the location that is shown on the existing conditions drawings, the Contractor must notify the Engineer immediately. The Engineer will work with Port Survey to determine whether and how this variation will be surveyed and recorded by Port Survey.

1.04 PRESERVATION OF STAKES AND MARKS

A. All primary controls shall be set once by the Engineer or others and shall be carefully preserved by the Contractor. The Contractor will be back charged for the replacement costs of stakes and marks set by the Port Survey, and damaged or destroyed by the Contractor’s operation. .

B. Major survey control points will not be removed by the Contractor without the approval of the Port Surveyor. The Contractor will be responsible to remove survey stakes and markings before beneficial occupancy of the area.

1.05 CONTRACTOR SURVEYS

A. The Contractor shall establish such additional lines, grades and controls as are needed for construction.

B. All work performed shall be in conformance with the lines, grades and dimensions indicated on the drawings. If a discrepancy is noted between the drawings, the same shall immediately be brought to the Engineer’s attention. Where tolerances are stated, the work performed shall be within those tolerances. The Engineer will determine if the work conforms to such lines, grades and dimensions and his determination shall be final.

C. The Contractor assumes full responsibility for detailed dimensions and elevations measured from primary control points.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION - Not used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION

A. Definition

1. Cutting and patching refers to the modification, removal or repair of nominally completed or previously existing work in order to accommodate construction of the Work in this Contract. Cutting and Patching may include uncovering other work for access, inspection, obtain samples for testing or for similar purposes and is defined to include Cutting and Patching during the fabricating, erecting, and installing process for individual units of work. Drilling to install fasteners and similar operations are not included in this section. The work in this section does not include regulated materials work.

B. General Work

1. The Contractor represents that it has carefully reviewed all demolition, removal, modification, cutting, patching, and re-installation or replacement requirements of the Work and has included in its bid the cost for all such requirements described in this section.
2. Any existing, materials, structures, facility components or finishes that require cutting and or patching to complete the Work shall be repaired or reinstalled to equal or better condition as the adjacent finishes, to ensure a smooth and seamless transition, color matching or similar finish. Remove and replace work judged by the Engineer to be visually unsatisfactory at no additional cost.
3. The extent of the repair or reinstallation of the existing work shall be limited to areas affected by the Work. Costs to repair damage created by the Contractor during inspections, temporary removal or in the course of completing the Work shall be the burden of the Contractor.

C. Coordination with Subcontractors

1. The Contractor represents that the Subcontractors have been advised to review all demolition, removal, modification, cutting, patching, and re-installation or replacement requirements of the Work and that the Subcontractor has included in their bid the cost for all such requirements described in this section. The Contractor shall coordinate any cutting and patching described herein. If the Subcontractor refuses or fails to adhere to this section, the Contractor shall not be relieved of the requirements of this section.
2. The Contractor shall be responsible for cutting, patching, drilling, disconnecting electrical/mechanical services, disconnecting and capping utility lines at present locations, connections to new locations and modification in piping runs and electrical devices, including control access and signal, or such other work as may be required to complete the Work.
3. The Contractor shall remove and replace any and all temporary mechanical, electrical, access control and signal items installed to complete the Work whether shown on the drawings or not and shall restore all original systems or functions to equal or better condition existing prior to the Work.

1.02 ITEMS TO BE CUT AND PATCHED

A. The items anticipated to be patched and repaired, removed and reinstalled as part of this Work may include but is not limited to:

1. Utility components; i.e. water, steam, condensate, waste lines, HVAC supply and return lines, etc.
2. Concrete slabs
3. Asphalt slabs
4. Exterior finishes
5. Fire protection devices; i.e. pull boxes, alarms, sprinkler systems, fire extinguisher cabinets, etc.
6. Electrical components; i.e. distribution panels, junction boxes, lighting, conduit, etc.

1.03 QUALITY CONTROL

A. Requirements for Structural Work:

1. Notify the Engineer immediately if work concerning structural integrity is involved.

B. Operational and Safety Limitations:

1. Do not cut and patch operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in a manner intended or resulting in decreased operational life, increased maintenance, or decreased safety.

PART 2 PRODUCT

2.01 MATERIALS

A. Except as otherwise indicated or approved by the Engineer, provide materials for cutting and patching that will result in equal or better quality than the work being cut and patched in terms of performance characteristics, including visual effect where applicable. Comply with the requirements and use materials identical, including texture and color, with original where feasible and where recognized that satisfactory results can be produced thereby. Re-install undamaged materials temporarily removed in their original locations where feasible or indicated unless noted otherwise.

1. Primary Products: Those required for original installation.
2. Product Substitution: For any proposed change in materials, submit request for substitution.

PART 3 EXECUTION

3.01 GENERAL

A. Execute cutting, fitting, and patching, to complete the Work and to:

1. Gain access in order to install components associated with this work.
2. Fit the several parts together to integrate with other work.
3. Uncover work to install ill-timed work.

4. Remove and replace defective and non-conforming work.
5. Remove samples of installed work for testing.
6. Provide openings in elements of work for penetrations of mechanical, electrical, signal and access control work.

3.02 EXAMINATION

A. Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching.

B. After uncovering existing work, assess conditions affecting performance of work.

C. Beginning of cutting and patching means acceptance of existing conditions.

3.03 PREPARATION

A. Temporary support: Provide adequate temporary support for work to be cut to prevent failure or deleterious movement of materials to remain. Do not endanger other work.

B. Protection from weather: In accordance with Section 01 50 00 - Temporary Facilities and Controls, provide protection from elements for areas that may be exposed by uncovering work.

3.04 CUTTING AND PATCHING/REMOVAL AND RE-INSTALLATION

A. General - Employ skilled tradespeople to perform cutting and patching. If possible, employ original installer or fabricator to perform cutting and patching for visually exposed surfaces.

   1. Cut work by methods least likely to damage work to be retained and work adjoining. Review proposed procedure with the original installer where possible and comply with their recommendations.
   2. Fit Work airtight to pipes, sleeves, ducts, conduits, structural elements and other penetrations through surfaces.
   3. At penetrations of fire-rated material provide proper thickness of the construction element to maintain the required fire rating.

B. Condition removed materials to be reinstalled.

   1. Clean, straighten and refinish materials to match existing surroundings.
   2. Store and protect materials against damage as a result of weather, vandalism or neglect.

C. Patching

   1. Execute patching to complement adjacent work. Inspect and test patched areas to demonstrate integrity of the work.
   2. Fit products together to integrate with other work.
   3. Restore work with new products in accordance with requirements of Contract Documents.
   4. Restore exposed finishes of patched areas and, where necessary extend finish restoration onto retained work adjoining in a manner that will eliminate evidence of patching.

5. If a portion of a painted surface is patched and repaired, repaint entire surface to nearest natural break in wall surface, or as directed by Engineer, or as delineated on drawings for repaint.
6. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
7. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer.
8. Where wall systems (metal studs, gypsum wall boards, insulation, etc.) are removed for Work, reinstall wall system using new material of same size, quality, and quantity to match existing. Paint all exposed surfaces to match existing.
9. Where the fireproofing materials are removed for work, reinstall fireproofing materials to match existing conditions and current code requirements.

3.05 CUTTING AND PATCHING FOR WORK BY SUBCONTRACTORS

A. Cutting and patching for all subcontracted work including but not limited to mechanical, electrical, plumbing and communication Work shall be included in the cost for such Work identified in the technical specification sections.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The costs for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY

Throughout the construction period, maintain the project site where Work is carried out in a standard of cleanliness to include progress and closeout cleaning, dust control throughout construction.

1.02 QUALITY ASSURANCE

A. Inspection: Conduct daily inspections (and more often if necessary) to verify that requirements of cleanliness are being met.

B. Codes and Standards: In addition to the standard described in this section, comply with all pertinent requirements of governmental agencies having jurisdiction.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT

A. Provide all required personnel, equipment, and materials needed to maintain specified standard of cleanliness.

PART 3 EXECUTION

3.01 PROGRESS CLEANING

A. Site:

1. At all times, and as may specifically be requested by the Engineer, the Contractor shall cleanup and remove all refuse resulting from the Work in order that the Project site remains free from an accumulation of construction debris. Upon failure to do so within 24 hours after request by the Engineer, such cleanup work may be done by the Port and the cost thereof shall be charged to the Contractor and deducted from the Contract Sum.
2. Project sites adjacent to public areas shall at all times be maintained in a condition suitable for public viewing and ensure public safety is not compromised in any way. The Engineer’s right to require or perform any necessary cleanup to maintain this condition as stated above applies.
3. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
4. Provide adequate storage for all items, awaiting removal from the job site, observing all requirements for fire prevention and protection of the ecology.

3.02 DUST CONTROL

A. Maintain continuous cleaning and wetting procedures to control dust pollution at project site and haul routes as required by governing authorities and the Contract Documents. Use power sweepers for street cleaning, if necessary.

B. Schedule cleaning so that resultant dust and contaminants will not fall on wet or newly coated surfaces.

C. See additional requirements in related sections.

3.03 CLOSEOUT CLEANING

A. Cleaning: Provide final cleaning of Work prior to Final Inspection. At a minimum complete following cleaning operations:

1. In addition to removal of debris and cleaning specified in other sections, clean interior and exterior exposed-to-view surfaces.
2. Remove grease, mastic, adhesives, dust dirt, stains, fingerprints, labels, and other foreign matter from sight exposed interior and exterior surfaces.
3. Clean transparent and glossy materials to a polished condition; remove foreign substances. Polish reflective surfaces to a clear shine.
4. Remove temporary protection and labels not required to remain.
5. Clean equipment and fixtures to sanitary condition.
6. Clean surfaces of equipment; remove excess lubrication.
7. Clean plumbing fixtures to a sanitary condition.
8. Clean light fixtures and lamps.
9. Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, clean ducts, blowers, and coils when units have been operated without filters during construction.
10. Clean mechanical and electrical equipment and spaces, including tops of pipes, ducts, equipment, etc.
11. Clean all exterior surfaces of structures.
12. Remove waste, foreign matter, and debris from roofs, gutters, area ways, and drainage systems.
13. Hose-clean exterior paved surfaces; rake clean other surfaces of grounds.
14. Remove waste, debris, and surplus materials from site. Clean grounds; remove stains, spills, and foreign substances from paved areas and sweep clean. Rake clean other exterior surfaces.
15. Maintain cleaning until Physical Completion.
16. Re-clean areas or equipment, after final inspection, if dirtied as result of Contractor’s Work in preparing for final inspection or completion of punchlist.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY

A. This section includes construction waste management requirements.

1.02 DEFINITIONS

A. Co-mingled or Off-site Separation: Collecting all material types into a single bin or mixed collection system and separating the waste materials into recyclable material types at an off-site facility.

B. Construction, Demolition and Land-Clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition, and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage. This also includes uncontaminated soils that are designated as geotechnically unsuitable or excess excavation.

C. Hazardous/Dangerous Waste: As defined by Chapter 70.105.010 Revised Code of Washington and 40 Code of Federal Register 261 and by Washington Administrative Code 173-303.

D. Proper Disposal: As defined by the jurisdiction receiving the waste.

E. Recyclable Materials: Products and materials that can be recovered and remanufactured into new products.

F. Recycling: The process of sorting, cleaning, treating and reconstituting materials for the purpose of using the material in the manufacture of a new product. Can be conducted on-site (as in the grinding of concrete).

G. Recycling Facility: An operation that is permitted to accept materials for the purpose of processing the materials into an altered form for the manufacture of a new product.

H. Salvage for Reuse: Existing usable product or material that can be saved and reused in some manner on the project site or other projects off-site.

I. Salvage for Resale: Existing usable product or material that can be saved and removed intact (as is) from the project site to another site for resale to others without remanufacturing.

J. Source-Separated Materials: Materials that are sorted at the site into separate containers for the purpose of reuse or recycling.

K. Sources Separation: Sorting the recovered materials into specific material types with no, or a minimum amount of, contamination on site.

L. Time-Based Separation: Collecting waste during each phase of construction or deconstruction that results in primarily one major type of recovered material. The material is removed before it becomes mixed with the material from the next phase of construction.

M. Garbage: Product or material typically considered to be trash or debris that is unable to be salvaged for resale, salvaged and reused, returned, or recycled.

1.03 SUBMITTALS

A. Waste Management Plan

B. Waste Management Final Report

1.04 PERFORMANCE GOALS

A. General: Divert CDL waste to the maximum extent practicable from the landfill by one or a combination of the following activities:

1. Salvage
2. Reuse
3. Source separated CDL recycling
4. Co-mingled CDL recycling

B. CDL waste materials that can be salvaged, resold, reused or recycled, include, but are not limited to the following:

1. Clean dimensional wood, pallet wood, plywood, OSB, and particleboard
2. Asphalt
3. Concrete and concrete masonry units
4. Ferrous and non-ferrous metals
5. Gypsum products
6. Glass, both window and bottle
7. Plastics, including plastic film
8. Cardboard packaging
9. Insulation
10. Field office waste paper, aluminum cans, glass, plastic, and cardboard

C. Hazardous/Dangerous Wastes, contaminated soils and other hazardous materials such as paints, solvents, adhesives, batteries, and fluorescent light bulbs and ballasts shall be disposed of at applicable permitted facilities.

1.05 WASTE MANAGEMENT PLAN

A. Per the requirements of Section01 32 19, Preconstruction Submittals, submit to the Engineer a Waste Management Plan narrative in accordance with these specifications. Use the Waste Management Plan Form attached at the end of this Section or other format as accepted by the Engineer (Attachment A).

B. The Waste Management Plan shall include the following:

1. Name of designated Recycling Coordinator
2. A list of waste materials that will be salvaged for resale, salvaged for reuse, recycled, and disposed.
3. Identify waste handling methods to be used, including one or more of the following:

a. Method 1 – Contractor or subcontractor(s) hauls recyclable materials to an accepted recycling facility.

b. Method 2 - Contracting with diversion/recycling hauler to haul recyclable material to an accepted recycling or material recovery facility.

c. Method 3 – Recyclable material reuse on-site.

d. Method 4 – Recyclable material salvage for resale.

4. Identification of each recycling or material recovery facility to be utilized, including name, address and types of materials being recycled at each facility

5. Description of the method to be employed in collecting, and handling, waste materials.

6. Description of methods to communicate Waste Management Plan to personnel and subcontractors.

1.06 WASTE MANAGEMENT FINAL REPORT

A. Use the Waste Management Final Report Form attached at the end of this section or other format as accepted by the Engineer (Attachment B).The Waste Management Final Report shall list the following for the project:

1. A record of each waste material type and quantity recycled, reused, salvaged, or disposed from the Project. Include total quantity of waste material removed from the site and hauled to a landfill.

2. Percentage of total waste material generated that was recycled, reused, or salvaged.

B. Quantities shall be reported by weight (tons) unless otherwise accepted by the Engineer.

C. Submit copies of manifests, weight tickets, recycling/disposal receipts or invoices, which validate the calculations or a signed certification of completeness and accuracy of the final quantities reported.

1.07 QUALITY ASSURANCE

A. Regulatory Requirements: The Contractor shall maintain compliance with all applicable Federal, State, or Local laws that apply to Construction Waste Management and material salvage, reuse, recycling and disposal.

B. Disposal Sites, Recyclers and Waste Materials Processors: All facilities utilized for management of any materials covered under this specification must maintain all necessary permits as required by federal, state and local jurisdictions.

C. For a comprehensive list of recycling facilities in King County, and other Contractor resources, contact King County's Construction and Demolition Recycling Program:

http://your.kingcounty.gov/solidwaste/greenbuilding/construction-demolition.asp

PART 2 NOT USED

PART 3 EXECUTION

3.01 SOURCE-SEPARATED CDL RECYCLING

A. Provide individual containers for separate types of CDL waste to be recycled, clearly labeled with a list of acceptable and unacceptable materials.

3.02 CO-MINGLED CDL RECYCLING

A. Provide containers for co-mingled CDL waste to be recycled, clearly labeled with a list of acceptable and unacceptable materials.

3.03 LANDFILL

A. Provide containers for CDL waste that is to be disposed of in a landfill clearly labeled as such.

3.04 REMOVAL OF CDL WASTE FROM PROJECT SITE

A. Transport CDL waste off Owner’s property and legally dispose of them.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

Attachment A
WASTE MANAGEMENT PLAN

Company:
Project:

Designated Recycling Coordinator:

Waste Management Goals:
This project will recycle or salvage for reuse CDL waste generated on-site to the maximum extent practicable.

Communication Plan:

Expected Project Waste, Disposal Facility, Collection Strategy, and Handling:
The following charts identify waste materials expected on this project, disposal facility details, collection strategies (e.g. source-separate, co-mingle), and waste handling methods

Deconstruction/Demolition Phase

Waste Material	Facility (name, address)	Collection Strategy	Waste Handling Method

Construction Phase

Waste Material	Facility (name, address)	Collection Strategy	Waste Handling Method

PART 1 GENERAL

1.01 DESCRIPTION

A. Construction Project Closeout requires completing physical and administrative portions of the Work as identified in General Conditions.

B. The Contractor shall ensure that all procedures and actions identified in this section and elsewhere in the Contract Documents necessary to fully complete the Work are accomplished in a timely and effective manner. Lack of compliance with the closeout requirements may result in Contract time delays. The Contractor is expected to take the lead role in assembly of documents, execution of the Work and coordinating the startup and closeout process.

C. Refer to the attached closeout checklist, which identifies major closeout actions and milestones to be accomplished.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

APPENDIX A: CONSTRUCTION PROJECT CLOSEOUT CHECKLIST

ITEM:	**Specification Reference(s):** (As Applicable)	**COMPLETION DATE:**
Partial/Substantial Completion		
1. Request Punchlist Inspection (provide Contractor's Punchlist)	General Conditions	
2. Submitted draft O & M Documents (Accepted or Accepted as Noted)	Section 01 78 23.13 – Operations and Maintenance Documents	
3. Completed Punchlist Inspection	General Conditions	
4. Completed Training of Port personnel	Section 01 79 00 – Training, Technical Sections	
5. Certificate of Occupancy issued by permit agency	General Conditions	
6. Completed commissioning activities	Section 01 91 00 – Commissioning, Technical Sections	
7. Submitted draft warranties and special warranties and bonds (if required)	Section 01 78 36 – Warranties and Bonds	
8. Perform final cleaning of project site	Section 01 74 00 – Cleaning	
Certificate of Substantial Completion Issued		
Physical Completion		
9. Punchlist Backcheck Accepted	General Conditions	
10. Perform final cleaning of project site	Section 01 74 00 – Cleaning	
11. Demobilization complete	General Conditions	
12. Project As-built (redlines) documents Accepted	Section 01 78 29 – As-Built Redline Documents	
13. O&M Documentation Accepted	Section 01 78 23.13 – Operations and Maintenance Data	
14. Submitted Construction Waste Management Final Report	Section 01 74 19 – Construction Waste Management	
15. Submitted final warranties and special warranties and bonds (if required)	Section 01 78 36 – Warranties and Bonds	
Certificate of Physical Completion Issued		
Closeout Administrative Requirements		
16. All Regulated Materials Project Record Documents Accepted		
19. Notices of Substantial and Physical Completion issued	General Conditions	

ITEM:	**Specification Reference(s):** (As Applicable)	**COMPLETION DATE:**
20. Reconciliation of any Allowances, or Not-to-Exceed Change Orders completed	General Conditions	
21. All open cost items resolved	General Conditions	
22. Final progress payment requested 100%	Section 01 20 00 – Measurement and Payment Procedures	
23. Complete all items on the Contractor’s Public Works Closeout Checklist.	Section 01 77 20 – Public Works Project Closeout	

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. The Contractor shall ensure that all procedures and actions identified in this section and elsewhere in the Contract Documents necessary to fully complete the Public Works Project Closeout are accomplished in a timely and effective manner. Lack of compliance with the closeout requirements will result in delays to release of all responsibilities within the contract and retainage.

B. Refer to the attached Typical Public Works Project Timeline, which identifies the major closeout actions and milestones to be accomplished.

C. All Milestones identified in Section 01 77 00 Construction Project Closeout must be completed before achieving the Public Works Project Closeout Checklist identified herein.

1.02 CLOSEOUT ADMINISTRATIVE REQUIREMENTS

A. To achieve Final Acceptance, the Closeout Administrative Requirements must be achieved, as per the General Conditions.

1.03 RELEASE OF RETAINAGE TO CONTRACTOR

A. The Contractor must request release of retainage from the Port.

B. Refer to General Conditions for release of retainage requirements

1.04 POST-FINAL ACCEPTANCE INSURANCE REQUIREMENTS

A. Refer to General Conditions.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

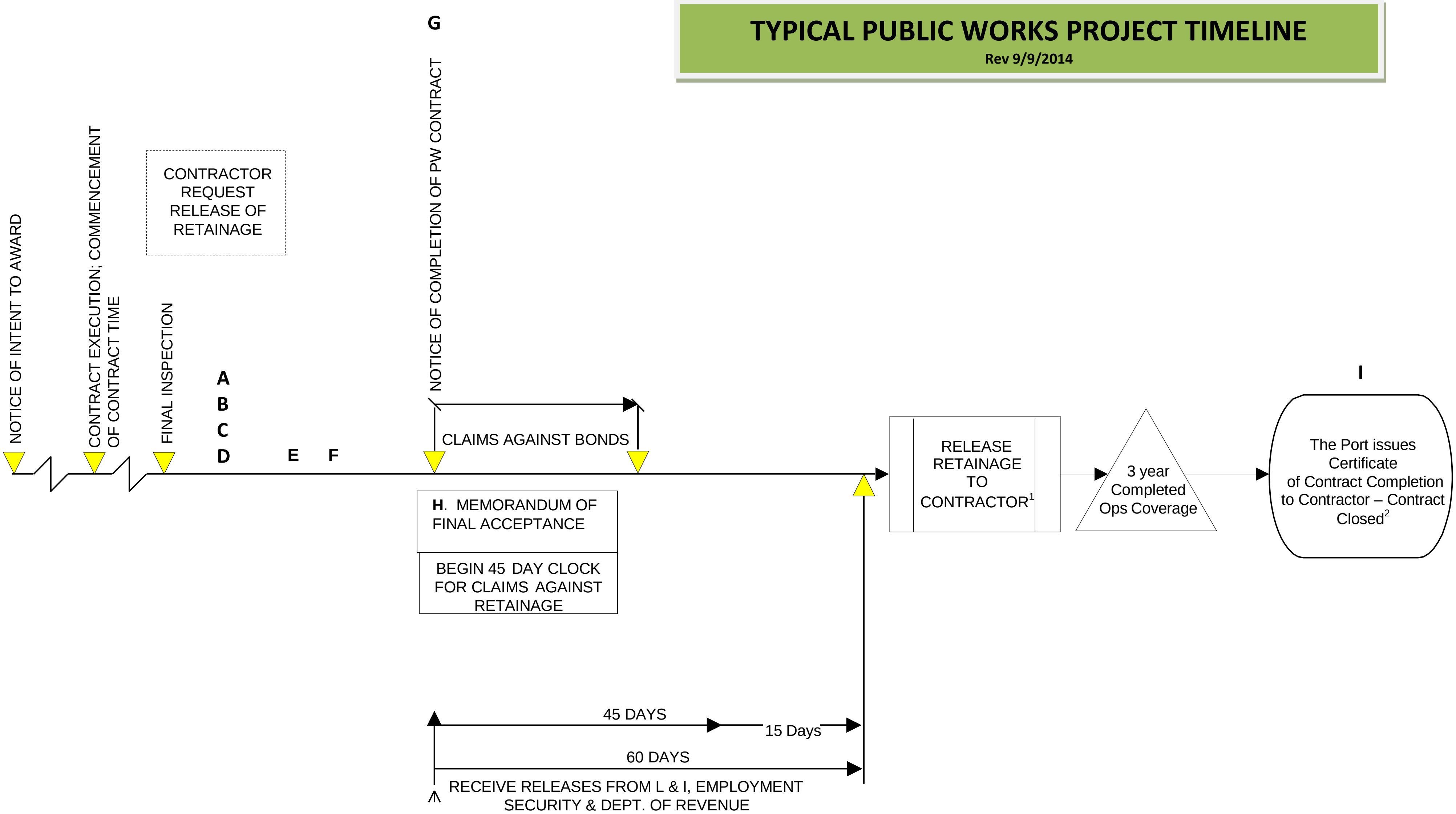
APPENDIX A

PUBLIC WORKS PROJECT CLOSEOUT CHECKLIST

ITEM:	BY:	DATE:
1. Receive Release of Claims from Contractor and verification that all Subcontractors Industrial Insurance is in good standing		
2. Contractor submits Affidavit of Wages Paid for Contractor and all subcontractors		
3. Memorandum of Final Acceptance issued		
4. Notice of Completion of Public Works Contract sent to state agencies and Contractor		
5. Port receives releases from L&I, Employment Security and Department of Revenue		
6. Release retainage or retainage bond		

TYPICAL PUBLIC WORKS PROJECT TIMELINE

Rev 9/9/2014



LEGEND

A EEO/EPI/WMBE/DBE DOCUMENTS
B ALL CLAIMS SETTLED
C FINAL PAYMENT
D RE COMPLETION MEMO
E RECEIVE CONTRACTOR RELEASE OF CLAIMS
F RECEIVE ALL AFFIDAVITS OF WAGES PAID
G NOTICE OF COMPLETION OF PUBLIC WORKS CONTRACT
H MEMORANDUM OF FINAL ACCEPTANCE
I POS CERTIFICATE OF CONTRACT COMPLETION

NOTES:

[1] As long as 60 days have transpired from the date of the “Memorandum of Final Acceptance” ”, any claims previously made in writing and identified by the Contractor, a Subcontractor, or material supplier as unsettled at the time of application for Final Payment are resolved and no valid claims against retainage have been tendered.

[2] Port of Seattle Certificate of Contract Completion will be issued after the 3 year completed operations insurance coverage period. The completed operations period is from substantial completion date plus 3 years.

PART 1 GENERAL

1.01 SUMMARY

A. This section identifies the requirements for Posting of Condensed Operating Instructions and the format and general content requirements for the compilation of all operation and maintenance documentation for this project. Additional special O&M documentation requirements may exist in other divisions and sections of the specification.

1.02 POSTING OF CONDENSED OPERATING INSTRUCTIONS:

A. Instructions shall be clearly laminated and secured adjacent to or inside the equipment where it can be easily read by operating personnel performing the steps listed. The writing shall not fade in sunlight and shall be secured to prevent easy removal, peeling and degradation if exposed to the weather.

1.03 OPERATING AND MAINTENANCE MANUALS

A. Computerized Maintenance Management System (CMMS) Input Form shall be completed by the Contractor and submitted for approval at least sixty (60) days prior to Substantial Completion or with the draft O&M submittal.

B. Quantity: One electronic and two copies of the draft and final manuals addressing all work within this project.

  1. The electronic data shall have software search features and interactive capabilities, format, and index shall be defined by the Contractor and approved by the Engineer.

    a. Provide electronic O&M in Microsoft Office or Adobe PDF format.

    b. PDF versions originating from scanned documentation shall be generated from legible documents, formatted and fully text searchable.

C. Draft manuals: Contractor shall submit draft manuals at least sixty (60) calendar days prior to the scheduled project Final Inspection. The Engineer shall review with Commissioning Agent, Design Team or Owner and return the draft submittals to the Contractor in accordance with Section 01 33 00 - Submittals.

D. Final manuals, incorporating all comments made, Contractor shall submit a final electronic draft to the Engineer seven (7) calendar days prior to the Pre-Final Inspection. Port will respond with approval or revision requests within fifteen (15) days. Upon approval of the final manuals by the t Engineer after review with Commissioning Agent or Port stakeholders, the Contractor shall resubmit two O&M manuals and one electronic copy incorporating all required changes prior to Final Inspection. If changes are required to final manuals, the Contractor shall provide copies of the revision for each hard copy (if sheets within a bound manual or portion thereof are updated replace full bound copy) and one revised full electronic O&M manual. All changes shall be submitted with a transmittal identifying all changes. Contractor is responsible for obtaining written releases dealing with copyright restrictions.

E. Binders shall be 8 1/2” x 11” loose-leaf, clearly labeled on the spine. Maximum 3-inch binders do not overload binders. O&M library shall consist of a series of three-

D-ring binders. Covers shall be hard durable materials with cleanable plastic covers, and metal lockable hinge.

F. Covers: label with project number, name of project, Port of Seattle, Designer, Prime Contractor and the year project completed. The binder spine shall be labeled with the project number, name of project and the specification sections contained within the binder.

1.04 FORMAT OF MANUALS

A. Each document shall contain a title page and table of contents provide a main tab for the Computerized Maintenance Management System (CMMS) Input Form; Material Safety Data Sheets (MSDS); and, each specification section.

1. Computerized Maintenance Management System (CMMS) Section: In addition to a hard copy for the manuals, the CMMS input form shall be a live electronic Excel spreadsheet and provided by the Engineer to the Contractor.
    a. PDF or other format is not acceptable for this document.
    b. Include information in Manual 1 as defined below.
2. Material Safety Data Sheets – Provide a complete set. Information should be presented with summary including a cross reference to specification and equipment identification numbers.
    a. Include information in Manual 1 as defined below.
3. Specification Sections: Behind the section number tab, there shall be the equipment ID tag and sub-tab for each piece of major equipment (or group, if small or numerous) within the specification. These sub-tabs shall be similar to the specification number tabs but a different color. Behind each equipment name tab shall be the following sections, in the given order, divided by a double weight colored sheet labeled with the typed title of the section:
    a. Contact Information: The name, address and telephone number of the manufacturer and installing contractor and the 24-hour number for emergency service for all equipment in this section, identified by equipment. Emergency numbers and System/Equipment identification shall be typed in bold for ease of emergency identification, and the completed Computerized Maintenance Management System (CMMS) input form will be included.
    b. Submittal and Product Data: All approved submittal data, cut sheets and appropriate shop drawings. If submittal was not required for approval, descriptive product data shall be included. A copy of the start-up report will be included. Eliminate advertisement documentation and other data that does not specifically relate to this project system or equipment.
    c. Preventative Maintenance Instructions
        (1) This section shall include condensed typewritten excerpts from the manufacturer’s “best practice” written instructions for regular or periodic maintenance prepared by the equipment manufacturer or supplier for all systems,

equipment, or items listed within the specification, with recommended break-down inspections, replacement parts, and servicing.

(2) This section shall include condensed instructions for start-up, shut-down, emergency operation, safety precautions, unusual features, troubleshooting suggestions and wiring and control diagrams. Where control sequences are clearly covered in controls section of the O&M manuals, it is not to be duplicated here. These instructions shall be provided for each major piece of equipment identified within the technical specifications.

B. Information Compilation

1. Manual Group I - Building Structural, Exterior and Interior Materials and Systems Operations and Maintenance Instructions :

a. Includes all building material and finishes. State specific identifying information, lot numbers, local distributors and suppliers with their company names, addresses, and phones numbers. List installing contractors or vendors with their company names, addresses, and phones numbers. Manual shall contain all information needed to identify, maintain, and replace/duplicate any finish materials, equipment or features installed in this project, presented and arranged in a logical manner, indexed and tabbed in accordance with the respective specification sections, for efficient use by the Port’s personnel. The information provided shall include, but not limited to, the following:

(1) Material, piece of equipment, or finish designation.

(2) Manufacturer’s name, model number, make, size, local vendor and supplier.

(3) Proportions of mixes.

(4) Color formula list for each paint color used.

(5) Finish numbers or designations.

(6) Cleaning, safety, and manufacturer’s “best practice” operational and maintenance instructions including all requirements for personal protective equipment.

(7) Local subcontractor and supplier’s name, address, phone number, and reference order number.

(8) State and local permits associated with the work.

(9) All first time pressure vessel permits

(10) All water backflow-preventer inspection reports and certifications

(11) All procedures and test results on domestic water pipe pressurization and sanitizing

(12) Equipment operating parts list and reorder information.

    (13) Equipment shop repair manual.
    (14) Recommended spare parts inventory.
    (15) All warranties required by the general and technical specifications, placed in appropriate specification section division.
    (16) Electronic copies shall be software acceptable to the Engineer.

2. Manual Group II - Equipment and Mechanical Operation and Maintenance Instructions:
    a. These shall be the written manufacturer's data with the model and features of this installation clearly marked and edited to omit reference to products or data not applicable to this installation. This section shall include manufacture and design data on the following:
        (1) Equipment and/or system photo as installed within this project with description and design intent.
        (2) Cleaning, safety, and manufacturer's "best practice" operational and maintenance instructions
        (3) Completed pre-commissioning and pre-functional checklists with all data and documentation.
        (4) State and local permits associated with the work.
        (5) All first time pressure vessel permits
        (6) All water backflow-preventer inspection reports and certifications
        (7) All procedures and test results on domestic water pipe pressurization and sanitizing
        (8) Completed functional test results.
        (9) Elevator, escalator, conveyance and other equipment documentation and manuals that requires special outside agency permits.
        (10) For HVAC systems, final air & water testing, adjusting, and balancing (TAB) report.
        (11) All starting, normal shutdown, emergency shutdown, manual operation, seasonal changeover and normal operating procedures and data, including any special limitations.
        (12) Copy of posted condensed operating instructions.
        (13) O&M and installation instructions that were shipped with the unit.
        (14) Required operator certifications to safely operate equipment or systems
        (15) Safety issues with operating, maintaining and servicing equipment such as noise, fumes, gases such as Freon or

FS-6, Asbestos Containing Material (ACM) or other regulated material, including all requirements for personal protective equipment.

(16) Annual breakdown service procedures and schedules.

(17) Troubleshooting procedures and guide.

(18) Specific manufacturer's breakdown shop repair manual.

(19) Parts list, edited to omit reference to items that do not apply to this installation, including local sources of supply.

(20) Manufacturer recommended spare parts for servicing and maintaining equipment and local source of supply. Provide warehouse lead-time for delivery.

(21) List of specialty tools required to service or maintain equipment and local source of supply.

(22) Equipment performance data, ratings and curves. If the equipment includes a pump or fan, the appropriate pump or fan curve upon which the equipment was selected as well as the impeller or volute selection installed. If the curve was generated specifically for the project using a computer program selection, include along with the curve a reference to the program and it's revision status.

(23) Warranty that clearly lists conditions to be maintained to keep warranty in effect.

  (a) Contractor/Labor warranty (including phone numbers)

  (b) Part/system/equipment specific warranties (including complete list of components)

  (c) Specifically what is NOT covered by warranty

(24) Single-line system/equipment diagrams/shop drawings

(25) Electronic software and imprinted copy ladder logic. Editing software and documentation shall be executed on maintenance hardware (laptops).

(26) Service contracts issued or/extended warranty

(27) Controls Operations and Maintenance Manual shall contain:

  (a) As-built set of control drawings (refer to Submittal section above for details).

  (b) As-built sequence of operations for each piece of equipment.

  (c) Points list and all their attributes.

  (d) Color print screens of geographic layout of equipment/system software.

  (e) Valve schedule.

(f) Schedules and set points after testing and acceptance of the system.

(g) Two electronic copies on CD of the entire program for the facility.

(h) Maintenance instructions, including calibration requirements and methods by type.

(i) Control equipment component submittals, and parts lists.

(j) Copies of all checkout tests and calibrations performed by the Contractor or manufacturer (not commissioning tests).

(k) Drawings for each piece of equipment and components, including the sequence of operation.

(l) Specifications: The component or system specification section copied and inserted complete with all addenda.

3. Manual Group III – Electrical and Communication Operation and Maintenance Instructions:

a. These shall be the written manufacturer’s data with the model and features of this installation clearly marked and edited to omit reference to products or data not applicable to this installation. This section shall include manufacture and design data on the following:

(1) Equipment and/or system photo as installed within this project with description and design intent.

(2) Cleaning, safety, and manufacturer’s “best practice” operational and maintenance instructions

(3) Completed pre-commissioning and pre-functional checklists with all data and documentation.

(4) Completed functional test and equipment calibration results.

(5) Short circuit study results.

(6) Variable Frequency Drive and non-linear electric load test reports as required in Division 15.

(7) Settings of breakers, relays, timers, electric equipment thermostats, and any other field control devices.

(8) Software and firmware necessary to configure any electrical equipment.

(9) State and local permits associated with the work.

(10) All starting, normal shutdown, emergency shutdown, manual operation, seasonal changeover and normal operating procedures, settings, and data, including any special limitations.

(11) Copy of posted condensed operating instructions.

(12) O&M and installation instructions that were shipped with the unit.

(13) A list of required operator certifications to safely operate equipment or systems

(14) Safety issues with operating, maintaining and servicing equipment such as noise, fumes, gases such as Freon or FS-6, Asbestos Containing Material (ACM) or other regulated material, including all requirements for personal protective equipment.

(15) Annual breakdown service procedures and schedules.

(16) Troubleshooting procedures and guide.

(17) Specific manufacturer's breakdown shop repair manual.

(18) Parts list, edited to omit reference to items that do not apply to this installation, including local sources of supply.

(19) Manufacturer recommended spare parts for servicing and maintaining equipment and local source of supply. Provide warehouse lead-time for delivery.

(20) List of specialty tools required to service or maintain equipment and local source of supply.

(21) Equipment performance data, ratings and curves.

(22) Warranty that clearly lists conditions to be maintained to keep warranty in effect.

  (a) Contractor/Labor warranty (including phone numbers)

  (b) Part/system/equipment specific warranties (including complete list of components)

  (c) Specifically what is NOT covered

(23) Single-line system/equipment diagrams/shop drawings. Two electronic copies on CD of the entire program for the facility.

(24) Equipment, panel, & board schedules

(25) Logic diagrams. If PLC or other special programming required, provide editing software and documentation to be executed on maintenance hardware (laptops).

(26) Material Safety Data Sheets (MSDS)

(27) Service contracts issued or/extended warranty

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Throughout the progress of the Work the Contractor shall maintain accurate set of As-built Redline Drawings (including shop and Contractor bidder-design drawings).

B. As-Built (Redline) Drawings will be used by the Port at a future time as the basis of revision to the CAD drawing files and therefore must clearly communicate the changes in graphics and text to the CAD operator performing the drawing revisions.

1.02 QUALITY ASSURANCE

A. The responsibility for maintenance of changes to the As-Built Redline Drawings shall be assigned to one person on the Contractor's staff.

B. As-Built Redline Drawings:

1. Shall be kept accurate and current per the requirements of paragraph 3.01, Maintenance of As-Built Record Documents.
2. Thoroughly coordinate all changes by making red-line entries on an ongoing basis on a single set of full size Contract and Working Documents maintained at the job site. Accuracy shall be such that future users of information showing the as-built condition of the Work may reasonably rely on the information shown.
3. As-Built Redline Drawings Kick-off Meeting
    a. Convene a meeting with the Engineer prior to making entries in the As-Built Redline Drawings set to clarify level and style of information requirements.
    b. Attendees should include the Contractor's field manager, the Contractor's staff member responsible for making the entries, the Engineer and Inspector(s) responsible for monthly review of the As-built Redline Drawings.
4. Inspection and Quality of As-Built Redline Drawings
    a. A checklist is appended to this Section: (Appendix # 1-- Red-Lines Quality Checklist). This checklist will be used by Port personnel reviewing the Red-Lines for currency and quality prior to the Engineer's acceptance of the Progress Payment requests. The checklist will serve to define Contract requirements for quality and content of entries.

1.03 SUBMITTALS

A. Progress Submittals:

1. The Engineer's acceptance of the current status of changes to the As-Built Redline will be a prerequisite to the Engineer's acceptance of requests for each Progress Payment. Appropriate payment may be withheld if documents are not up to date at the time of the Progress Payment request(s).

B. Substantial Completion :

1. At the time of Substantial Completion, provide a hard-copy and an electronic copy of the As-Built Redline Drawings including shop drawings and bidder-design drawings to the Engineer.

C. Final As-Built Redline Drawings Submittal:

1. After acceptance of the final As-Built Redline Drawings by the Engineer, and within 14 days after Physical Completion of all or a part of the work, and prior to Final Payment request, submit an electronic PDF file and hard copy.

PART 2 PRODUCTS - Not used

PART 3 EXECUTION

3.01 MAINTENANCE OF AS-BUILT PROJECT RECORDS

A. During construction of the Work, the Contractor shall use all means necessary to maintain a record of changes to the Contract documents completely protected from deterioration and from loss and damage.

B. As-Built Redline Drawings

1. All change directives in the Work generated by Change Orders (CO), Design Bulletins (DB), Construction Bulletins (CB), Requests for Information (RFIs) and accepted substitutions shall be recorded on the Contract Documents.

2. The Contractor shall revise (1) set of full size Contract Documents by red-line process to show the as-built conditions during the course of the project. Identify documents with the title RED-LINES.

   a. Define an accepted method for protecting the project As-Built Redline Drawings for the duration of the Contract.

   b. Do not use the As-Built Redline Drawings for any purpose except entry of new data and for review by the Engineer.

   c. Maintain and protect the drawings at the site of Work.

3. Changes shall show the actual Work with the same level of accuracy and completeness as the original Contract Documents. As-built Redline Drawings should include changes in location, identification and sizes of material, equipment, utilities and elements of the project and reflect the correct scale, grade, elevations, dimensions and coordinates of changes.

   a. Use an erasable red-colored pencil (not ink or indelible pencil) to clearly indicate the changed graphics or text. The change directive (CO/RFI/DB/CB) number should be identified on the drawing with the “clouded” changes. It is not necessary to describe the directive, when, why or who authorized the change.

   b. Distinguish between annotations intended to be copied exactly by a future drafter creating As-Built Redline Drawings files and information that is supplemental and not meant to be copied. Examples of supplemental information would include notes to the drafter and information purely for the Contractor’s information in monitoring the change. A suggested approach is to make all markings not to be copied by a CAD operator in a color other than red, reserving red for information to be copied exactly.

c. Do not include markings or reference to documents that do not generate a graphic or text change.

4. Complex or complicated changes can be noted in the As-built Redline Drawings with a cloud and reference to the directive attached to the drawing sheet or the back of the sheet preceding it.

5. Include changes or modifications that result from final inspection.

C. Shop drawings and Contractor bidder-design drawings shall be maintained accurate and current and show, as a minimum, the following information:

1. Changes from approved detail drawings prepared and/or furnished by the Contractor; including but not limited to shop drawings, installation plans and dimensions of equipment.

2. The actual bidder-design work by the Contractor to meet performance specifications, such as HVAC controls, Fire Alarm, Sprinkler systems and Data Management systems, to the same level of detail as the submitted and approved bidder-design drawings.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

Appendix #1: Red-Lines Quality Checklist

CHECK ITEM	EXAMPLE/COMMENT
Check that supplementary information is coded in such a way that it will not be transferred to the final record documents	Example: lines or notes not to be copied might be marked in a different color. An example of supplementary information might be references to dates or meetings or field conversations that the Contractor may want recorded on the Red-Lines for record purposes but that are not relevant to the physical as-built condition.
Check that the changes are marked exactly as they should be indicated in revised drawings	An example of unacceptability would be a relocated light fixture shown by a circle around the item with an arrow leader pointing to the new location. Correctly it should be drawn in the final location in which it was actually installed exactly as a drafter would be intended to draw it with all circuits or connections included and previous circuits and connections shown deleted.
Check that a drafter could access the information from which the change was constructed	The change should be clouded or otherwise identified with a reference to the actual change directive from which it was constructed (CB, FA, FD, RFI, etc.) - this may not necessarily be the official Change Order. The traditional practice of attaching the directive to the back of the preceding sheet is recommended.
Check that the original information superseded by a sketch attachment to the change directive is clearly identified	It is not necessary for the Contractor to redraw what is clearly shown and dimensioned on the sketch. However it should be clear what information the sketch replaces.
Check that the Contractor is keeping some kind of log or checklist of changes pending completion of the installation or construction in the cases where the Contractor does not record the change until the work is completed	This is important when the practice adopted is to not mark the changes until the work is completed to assure accurate “as-built” information. Without the checklist, the Contractor can easily lose track and it will be more difficult for the Port Inspector to check the status.
In the case of Item 5 above, check the Contractor’s method for verifying that the change directive does reflect the in-place (As built) work	If the work is not constructed exactly per the sketch accompanying the change directive, the variation should be noted in a way that would be clear to a drafter.

PART 1 GENERAL

1.01 DESCRIPTION

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by Contract Documents, including manufacturers' standard warranties on products and special warranties.

1. Refer to General Conditions for terms of Contractor's overall warranty of the Work.
2. Specific requirements for Work and products, and installations that are specified to be warranted are included in the technical specifications.
3. Certifications and other commitments and agreements for continuing services to the Port are specified elsewhere in Contract Documents.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on Work that incorporates products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

1.02 WARRANTY REQUIREMENTS

A. Replacement Cost: Upon determination that Work covered by warranty has failed, replace or rebuild Work to an acceptable condition complying with requirements of Contract Documents. Contractor is responsible for cost of replacing or rebuilding defective Work regardless of whether the Port has benefited from use of Work through a portion of its anticipated useful service life.

B. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

C. Reinstatement of Warranty: When Work covered by warranty has failed and corrected by replacement or rebuilding, reinstate warranty by written endorsement. The reinstated warranty shall be equal in all respects to the original warranty duration and coverage.

D. The Port's Recourse: Written warranties made to the Port are in addition to implied warranties, and shall not limit duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Port can enforce such other duties, obligations, rights, or remedies.

1. Port reserves right to reject warranties and to limit product selections to products with warranties not in conflict with requirements of Contract Documents.
2. Port reserves right to refuse to accept Work for project where a special warranty, certification, or similar commitment is required on such Work or part of Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.03 BOND REQUIREMENTS

1.04 SUBMITTALS

A. Submit written warranties to the Engineer 60 days prior to the Pre-Final Inspection with the draft Operation and Maintenance Data. Warranty start dates commence on the date of the Certification of Substantial Completion or Physical Completion, whichever comes first.

B. Forms for special warranties are included at end of this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or the Contractor and subcontractor, supplier, or manufacturer. Submit draft to the Engineer for acceptance prior to final submission.

   1. Refer to technical specification for submittal of special warranties.

C. Include final executed sets of all required warranties in the final Operation and Maintenance data submission.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 MEASUREMENT AND PAYMENT

4.01 No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

SAMPLE

SPECIAL LIMITED PROJECT WARRANTY FOR

WHEREAS, ____

(Contractor),

Address ____

Telephone (___) ___-____ ext. ______ has performed ______________________

____

(Work) on the following project: ______________________________

____

Address ____

For the Port of Seattle

and, WHEREAS, the Contractor has agreed to warrant said Work ______________

____

NOW, THEREFORE, the Contractor hereby warrants said Work in accordance with the terms hereof, complying with the terms of the Contract with the Port dated _____________, that _____

____

WARRANTY PERIOD __________, STARTING __________, TERMINATING __________.

IN WITNESS THEREOF, this instrument has been duly executed this ___ day of _________, 20__, for

Contractor __________________as its ______________________________
(typed name) (position)

Name of Firm ____

Address ____

And has been countersigned in accordance with terms and conditions, for the Manufacturer

______________________________ as its ______________________
(typed name) (position)

Name of Firm ____

Address ____

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Contract Management System (CMS) is a web-based system developed by the Port to manage Contract documents. The CMS will be used to generate and capture electronic Contract Documents, route them to the appropriate individuals, file them, and then allow for easy retrieval. The CMS shall be used for all Contract communications between the Port and the Contractor. CMS shall not be used for Electronic Payroll Information (EPI) or any type of payroll submittals.

PART 2 PRODUCTS

2.01 CONTRACT MANAGEMENT SYSTEM

A. The Port will provide the Contractor with one user login for the Port's CMS located at https://docmgt.portseattle.org at no cost to the Contractor. Access to the CMS web site will be provided by way of a Port provided password and user name. The login will be subject to the terms and conditions of use as described in the Contract Documents and may be revoked by the Port at any time.

B. Additional logins may be provided at the Port's discretion. Each login will be subject to the same terms and conditions of use as the Contractor's initial login and will similarly be subject to revocation by the Port at any time. Coordination of the integration process will be the responsibility of the Contractor.

2.02 MINIMUM REQUIREMENTS

A. In order to utilize the CMS, the Contractor shall use equipment and software that meets the following minimal requirements:

1. Hardware:
    - a. i5 compatible processor or higher IBM-compatible PC
    - b. 16 GB free space on hard drive
    - c. 4 GB of RAM
    - d. Require VGA or higher-resolution monitor at least 1,024x768 pixel resolution
    - e. DSL link to the Internet
2. Software:
    - a. Operating System: Windows 7
    - b. Browser: Internet Explorer 10.0
    - c. PDF Reader for viewing attachments only.
    - d. PDF Editor for markups and/or editing of attachments.
    - e. MS Office 2007 or 2010 Professional
3. Scanner:
    - a. Flatbed scanner + ADF (automatic document feeder)
    - b. TWAIN Compliant drivers
    - c. Minimum 200-page Automatic Document Feeder

d. Scanning speed: Portrait 56 ppm simplex / 92 ipm duplex

e. Scanning resolution: 100 dpi - 400 dpi Optical; up to 600 dpi Interpolated

f. Paper size: Check 2.8” x 6.7” to ledger 11” x 17”

g. Capable of color scanning

4. Printer:

   a. Inkjet or Laser printer

   b. Paper size: Check 2.8” x 6.7” to ledger 11” x 17”

   c. Capable of color printing

PART 3 EXECUTION

3.01 SETUP AND TRAINING

A. Setup

1. Prior to use, the Contractor shall be required to have at least two (2) project personnel attend and complete a training session conducted by the Port as specified below.

2. Following successful completion of the training session the Contractor will be provided with login with accompanying user name and password.

B. Training

1. The Port of Seattle will provide up to eight (8) hours of on the job training. Training shall be coordinated through the Engineer and will provide sufficient indoctrination to the system to allow the Contractor to access the system and use the basic features thereof.

2. Additional training may be requested by the Contractor to cover topics or information not included in the initial training session. These requests will be considered by the Engineer based on availability of training personnel.

3. Additional training may be requested by the Contractor for personnel in excess of the initial training allowed above. Such additional training requests will be considered by the Engineer based on availability of training personnel and the size of previously scheduled sessions.

3.02 SYSTEM USE

A. System Use

1. The Contractor shall use the Port’s Web-based CMS specified herein for all project communications, including but not limited to letters, daily reports, weekly reports, written notice of change, requests for change order, cost proposals, submittals, substitution requests, requests for information, pay applications, etc. CMS shall not be used for Electronic Payroll Information (EPI) or any type of payroll submittals.

2. Any information not transmitted via CMS will not be considered official documentation, unless specifically allowed as an exception by the Engineer based on extenuating circumstances. All information transmitted via CMS shall be in electronic format. The Contractor is required to scan all

documents into a legible electronic form and will initiate workflows in CMS following the Ports standard protocols for format and system use. The scanned documents (such as pdf's) shall be submitted to the Port in a searchable format. The Contractor shall use Optical Character Recognition (OCR) software to convert all pdf documents produced, or received from subcontractors and supplier, to a searchable format prior to submitting to the Port. Workflows not initiated using the proper formatting protocols will not be accepted by the Port. Protocols will be covered in the Contractor training held at the beginning of the project.

3. The Port may, from time to time, require hard paper copies of certain documents, including Pay Estimates and Contracts, to be signed by the Contractor. In these cases, the Port will provide the Contractor with hard copies of the signed documents, and will incorporate signed documents into the system for reference purposes. In the event the Contractor feels a certain document should be maintained in hard-copy form in addition to electronic form, the Contractor may submit such a request to the Engineer through CMS. Documents accepted for hard copy in this fashion shall be prepared by the Port at the sole expense of the Contractor.

4. The Contractor may request specific forms or reports be incorporated into the system for use in fulfilling the Contractor's requirements. Upon acceptance, the Port shall make reasonable efforts to prepare said form(s) or report(s) based on the Contractor's requirements at the sole expense of the Contractor.

3.03 CONTACT PERSONNEL

A. The Contractor shall designate one employee who shall serve as their primary contact in connection with the use of CMS for the Contract. The Contractor may change its primary contact by providing notice to the Engineer.

B. The Contractor shall further designate a back-up contact that shall serve as primary contact in the event the primary contact is unavailable.

C. The Contractor shall provide 24-hour availability telephone numbers for the primary and back-up contacts.

3.04 TERMS OF USE

A. Use And Protection Of Passwords

1. The Contractor shall use each password in furtherance of Contract work and shall use the password for no other purpose. The Contractor assumes all risks associated with the failure to adequately protect such password. The Contractor further agrees:

    a. To prohibit the disclosure of any password to any person not authorized by the Contractor to use the password.

    b. To protect all passwords in a secure manner that will prevent unauthorized use.

    c. That any Contractor access or information developed as a result of utilizing CMS by way of the password(s) shall be attributed to the Contractor, and that the Port and other users may rely upon such attribution.

B. Restrictions On Use

1. The Contractor shall make every reasonable effort to ensure that:

   a. Computer codes, files, and programs which may interrupt, destroy, or cause damage shall not be uploaded into CMS.

   b. Computer codes, files, and programs which interfere with the proper working of CMS or its use by others shall not be allowed access.

3.05 REVOCATION OF LICENSE

A. The Port may, at any time during the Contract, choose to revoke the Contractor’s login or any such additional logins Such revocation may occur based on misuse, misconduct, termination of the Contract, or other such reasons as deemed justified by the Engineer. Such revocation may occur with or without prior notice to the Contractor or affected user(s).

3.06 DOWNTIME AND SYSTEM AVAILABILITY

A. Any interruptions in service based on Internet conditions, connection media, or the unavailability of servers for maintenance, repairs, or replacement shall not warrant additional compensation to the Contractor. The Port will not be liable for the unavailability of the system for any period of time nor will it be responsible for the inability of the Contractor to access the system or any of its components.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the work will be considered incidental to and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY

A. Prior to Substantial Completion, the Port’s operating and maintenance staff shall receive orientation and training on all modes, functions, operations and maintenance of all products, systems or equipment as identified in the technical specifications.

B. Video requirements for operations and maintenance procedures for specific products, systems or equipment are as identified in the technical specifications. The time and place of the instruction period shall be coordinated by the Contractor with the Engineer.

1.02 REQUIREMENTS/QUALIFICATIONS

A. The Training Plan and Syllabus developed by the Contractor shall detail the content of the training and shall be submitted for acceptance by the Engineer prior to the scheduling of any training.

B. The Engineer can require additional training if the instruction is not deemed adequate for safe turnover and operations by Port personnel.

C. For Training Sessions, Contractor shall provide high definition video resolution in mp4 format file. Audio must be of a quality to be easily understood.

1.03 SUBMITTALS

A. This training plan and syllabus shall be submitted to Engineer no less than seven (7) days prior to the proposed training date(s).

B. Training Plan and Syllabus: The Contractor shall submit for review and approval the Training Plan and Syllabus detailing the content as shown below in 3.02.A.

C. Include all training materials and aides as part of the O&M manuals.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 GENERAL

A. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing Contactor or manufacturer’s representative.

B. Trainers shall have practical building operating expertise with an in-depth knowledge of all modes of operation of the specific piece of equipment installed in this project. More than one party may be required to execute the training.

3.02 TRAINING PLAN,PROCESS AND CONTENT

A. Training Plan

1. For each piece of equipment or system, the plan will cover the following elements:

   a. Equipment (included in training)

   b. Intended audience

    c. Location of
    d. Proposed dates and times
    e. Objectives
    f. Detailed outline including system overview
    g. Subjects covered (description, duration of discussion, special methods, etc.)
    h. Duration of training on each subject
    i. Instructor for each subject
    j. Instructor qualifications
    k. Methods (classroom lecture, site walk-through, operational demonstrations, written handouts, etc.)
    l. Questionnaire/Testing and evaluation of Port staff for understanding of systems and equipment, safety features, and functional operation.
    m. Identify required certifications for operating or maintaining equipment.

B. Training Process and Content:

1. The Contractor shall conduct a site walk-through with Port personnel and the completed as-built drawings.
2. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
3. Training content shall:
    a. Utilize the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and recommended spare parts inventory.
    b. Include start-up, operation in all modes possible, including manual, safety, shut-down and any emergency procedures and routine preventative/annual maintenance for all pieces of equipment.
    c. Discuss of relevant health and safety issues and concerns.
    d. Discuss maintenance associated with maintaining warranties and guarantees.
    e. Discuss Common troubleshooting and maintenance issues, problems and solutions.
    f. Discuss of any peculiarities of equipment installation or operation.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required in this section. The cost for this portion of the work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY

A. The intent of Commissioning is to verify systems and equipment are being delivered to the Port fully functioning in accordance with Contract Documents.

B. Commissioning activities will be provided by the Contractor utilizing the attached Port's checklists and as described in Divisions 2 through 48.

C. Where 01 91 00.13 - Commissioning specifications or requirements conflict with Divisions 2 through 48 or other requirements, the Divisions 2 through 48 requirements shall take precedence.

1.02 TERMS AND DEFINITIONS

A. Commissioning: The process certifying that mechanical, electrical, communications, and control and life safety systems, equipment, subsystems or systems, function together properly to meet performance requirements and design intent as shown in a composite manner in the Contract Documents.

B. Systems: Group of components and equipment functioning as a unit or performing a common function.

C. Functional Testing: That full range of checks and tests carried out to determine if all components, sub-systems, systems, and interfaces between systems function in accordance with the contract documents. In this context, "function" includes all modes and sequences of control operation, all interlocks and conditional control responses, and all specified responses to abnormal emergency conditions.

D. Acceptable Performance: A component or system shall meet specified design parameters and criteria under actual load conditions for duration of time as indicated within the functional test criteria as determined by technical specifications and manufacturer's literature.

1.03 COMMISSIONING TEAM

A. The commissioning team shall consist of the Port's representatives, Contractor, Subcontractors, Manufacturers, and the project Designers in accordance with their contractual arrangements with the Port. The Port's operating staff will be included during specific elements of the commissioning process.

1.04 CONTRACTOR

A. Execute the testing procedures in accordance with the commissioning checklists.

B. A Contractor's representative shall be present during all commissioning activities performed by itself or one of its Subcontractors.

C. The Contractor will schedule and execute the commissioning activities.

1.05 DUTIES OF THE CONTRACTOR

A. Contractor solely responsible for the operations, testing, and results during the commissioning process for systems and equipment to perform in accordance with the Contract Documents.

B. Subcontractor installing equipment and systems shall execute the commissioning activities on their respective Work.

C. Include Commissioning activities and durations within the master schedule.

D. Coordinate all phasing and/or sequencing requirements to integrate the commissioning activities and durations within the master schedule.

1.06 ACCEPTANCE PROCEDURES

A. The Contractor shall verify that all checklists have been completed and equipment and systems functional testing successfully met or exceeded the established acceptance criteria.

B. The Contractor shall provide all acceptance test results, checklists and associated documentation to the Engineer for review and acceptance.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall operate equipment and systems, and conduct all tests in presence of the Engineer and/or a designated Port Representative(s) to demonstrate compliance with Divisions 2 through 48.

1. Testing shall be conducted under design operating conditions as defined within the specifications and in the commissioning activities and approved by the Engineer.

B. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of the technical specifications. Testing shall be accomplished on hierarchical basis. Each piece of equipment will be tested for proper operation, followed by each subsystem, followed by entire system, followed by interfaces to other major systems.

C. Contractor or their subcontractor shall provide all special testing materials and test equipment.

3.02 PRE-COMMISSIONING WORK

A. Attend a commissioning scoping meeting and other meetings necessary to facilitate the commissioning process. One representative of the Contractor cognizant of respective aspects of their work shall attend commissioning meetings. Other trades shall attend the commissioning meetings when their portions of the work are being tested. The Owner's personnel will administer the meetings. Meeting location will be determined.

B. Normal start-up services required to bring system into a fully operational state. This includes cleaning, filling, purging, leak testing, motor rotation check, control sequences of operation, full and part load performance, and similar conditions.

C. Completion of controls installation, calibration, programming, and testing is critical for efficient and successful commissioning process.

3.03 EXECUTING CHECKLIST REVIEW, TESTING AND ACCEPTANCE PROCEDURES

A. FUNCTIONAL TESTING AND ACCEPTANCE PROCEDURES
   1. Start up and test of systems shall be by skilled technicians. Make these same technicians available to assist the Owner's personnel in completing the commissioning process as it relates to each system and their technical specialty.
   2. Coordinate work schedules and time required for commissioning activities, with the Port. Ensure that qualified technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and problem resolutions.

B. System Issues and Discrepancies: Additional technician time and Port personnel time may be required to resolve issues and discrepancies. Make additional technician time available for subsequent commissioning periods until required system performance is obtained.
   1. Complete corrective work to permit completion of commissioning activities.
   2. If deadlines pass without resolution of the problems, the Port reserves its right to obtain supplementary services and equipment to resolve problems.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY

A. The intent of Commissioning is to verify systems and equipment are being delivered to the Port fully functioning in accordance with project documents and for which the Port's personnel are fully trained and equipped to operate, maintain and troubleshoot. Additionally, the Port shall have supporting documentation to enable Port staff to maintain systems and equipment in accordance with manufacturer's recommendations and the Port's intent to sustain operations over the life of the system or equipment.

B. Commissioning services will be provided by the owner hired commissioning agent. Contractor shall perform related work as specified to assist Owner's personnel in the commissioning process. TBD

1.02 TERMS AND DEFINITIONS

A. Commissioning: The process certifying that mechanical, electrical, communications, control, and life safety systems equipment, subsystems or systems, function together properly to meet performance requirements and design intent as shown in a composite manner in the Contract Documents.

B. Commissioning Authority: The person or persons contracted by the Port to direct the commissioning process through appropriate contract channels and recommend project completion from the commissioning perspective.

C. Systems: Group of components and equipment functioning as a unit or performing a common function. (IE: Chilled Water System: consisting of piping, valves, fittings, controls, chillers, expansion tanks, air relief, chemical treatment, pumps, etc.)

D. Functional Testing: That full range of checks and tests carried out to determine if all components, sub-systems, systems, and interfaces between systems function in accordance with the contract documents. In this context, "function" includes all modes and sequences of control operation, all interlocks and conditional control responses, and all specified responses to abnormal emergency conditions.

E. Acceptable Performance: A component or system shall meet specified design parameters and criteria under actual load conditions for duration of time as indicated within the functional test criteria as determined by technical specifications and manufacturer's literature.

F. Areas of Conflict: Where 01 91 00 - Commissioning specifications or requirements conflict with Technical Specifications or other requirements, the Technical Specification requirements shall take precedence.

1.03 COMMISSIONING TEAM

A. The commissioning team shall consist of the Port's representatives, Commissioning Agent, Contractor, Adjusting and Balancing Engineer, and other Subcontractors, Manufacturers, and the Project Designers in accordance with their contractual arrangements with the Port. The Port's operating staff will be included during specific elements of the commissioning process. It is the intent that all members work together as a team to fulfill their contractual responsibilities and meet the objectives of the Contract Documents and make the project turnover and commissioning process seamless.

1.04 CONTRACTOR

A. The Contractor shall execute the testing procedures in accordance with the commissioning plan.

B. A Contractor’s representative shall be present during all commissioning activities performed by itself or one of its Subcontractors.

C. The Contractor will schedule and execute the commissioning plan to the satisfaction of the Commissioning Authority.

1.05 DUTIES OF THE CONTRACTOR

A. Execute the commissioning plan through the operation of equipment and systems by their subcontractors.

B. Shall be solely responsible for the operations, testing, and results during the commissioning process for systems and equipment to perform in accordance with the contract documents.

C. Notify the Engineer in writing that equipment and systems are ready for commissioning.

D. Include within the master schedule, commissioning activities and durations.

E. Professionally maintain shop drawings, as-built drawings and system single-line schematics and diagrams for all systems that are installed and are to be included in the O&M manuals and used during the commissioning process and training per Section 01 78 29 - As Built Redline Documents.

1.06 TESTING, ADJUSTING, AND BALANCING ENGINEER (TAB)

A. The accepted TAB Engineer/Firm shall be qualified and perform Work in accordance with Specification Section 23 05 93 Testing, Adjusting and Balancing.

B. TAB Firm shall communicate through the Contractor to the Engineer.

1.07 COMMISSIONING PHASING AND SEQUENCING

A. The Contractor shall coordinate all phasing and/or sequencing requirements to integrate the commissioning plan activities and durations within the master schedule.

1.08 ACCEPTANCE PROCEDURES

A. The Contractor shall execute the commissioning plan and verify that all commissioning activities have been completed and all activities have successfully met or exceeded the established acceptance criteria.

B. The Contractor shall provide all acceptance test results and documentation to the Engineer for review and acceptance.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall operate equipment and systems, and conduct all tests in presence of the Engineer and/or a designated Port Representative(s) to demonstrate compliance with technical specifications.

1. Testing shall be conducted under design operating conditions as defined within the specifications and in the commissioning plan and approved by the Engineer.

B. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of the technical specifications. Testing shall be accomplished on hierarchical basis. Each piece of equipment will be tested for proper operation, followed by each subsystem, followed by entire system, followed by interfaces to other major systems.

C. Contractor or their subcontractor shall provide all special testing materials and test equipment.

3.02 PRE-COMMISSIONING WORK

A. Attend a commissioning scoping meeting and other meetings necessary to facilitate the commissioning process. One representative of the Contractor cognizant of respective aspects of their work shall attend commissioning meetings. Other trades shall attend the commissioning meetings when their portions of the work are being tested. The Owner's personnel will administer the meetings. Meeting location will be determined.

B. Normal start-up services required to bring system into a fully operational state. This includes cleaning, filling, purging, leak testing, motor rotation check, control sequences of operation, full and part load performance, and similar conditions.

C. Completion of controls installation, calibration, programming, and testing is critical for efficient and successful commissioning process.

3.03 PARTICIPATION IN COMMISSIONING

A. DESCRIPTION

1. Start up and test of systems shall be by skilled technicians. Make these same technicians available to assist the Owner's personnel in completing the commissioning process as it relates to each system and their technical specialty.
2. Coordinate work schedules, time required for commissioning, and similar conditions with the Owner's personnel. Ensure that qualified technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and problem resolutions.

B. System Issues and Discrepancies: Additional technician time and Owner's personnel time may be required to resolve issues and discrepancies. Make additional technician time available for subsequent commissioning periods until required system performance is obtained.

1. Complete corrective work to permit completion of commissioning process.
2. If deadlines pass without resolution of the problems, the Owner reserves right to obtain supplementary services and equipment to resolve problems. Costs incurred to solve problems in an expeditious manner will be the Contractor's responsibility.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required in this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the [Schedule of Unit Prices][Lump Sum price] bid for the project.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. This Section consists of planning for and executing decontamination of personnel and equipment used in the completion of the Work shown on the Drawings and outlined in these Specifications.

1.02 JOB CONDITIONS

A. All equipment, materials, and personnel that come in contact with contaminated site soil and water shall undergo decontamination so that contamination is not spread from the site exclusion zone to other areas of the site or to offsite areas.

1.03 DECONTAMINATION PROCEDURES

A. The Contractor shall submit decontamination procedures as part of the Contractor's Site-Specific Construction Health and Safety Plan (HASP) specified in Section 01 35 29 – Safety Management. The decontamination procedures shall address the following:

1. Worker safety, including methods and procedures to minimize worker contact with contaminants during removal of PPE and disposal procedures of PPE.
2. Equipment to be used in performance of decontamination work.
3. Procedures to prevent the cross-contamination of clean areas.
4. Location and details of decontamination work and vehicle wheel wash stations shown clearly in relation to site exclusions zone(s), decontamination zone(s) and support zone(s).
5. Methods and procedures for inspection and decontamination of vehicles leaving the site.
6. Methods and procedures for decontamination of all equipment and materials having direct contact with site soil and groundwater, including, but not limited to, construction equipment, trench boxes, and other equipment and materials.
7. Protection of the public.
8. Protection of workers or other persons in areas surrounding the site.
9. Equipment to be used in performance of the decontamination work.
10. Means and methods to minimize waste.
11. Procedures for the collection and disposal of all decontamination water and residuals.
12. Protection of the environment.
13. Disposal site(s) approved by the Port, and other necessary agencies, including permits and permissions as necessary.

1.04 SUBMITTALS

A. Decontamination Procedures as part of the Site-Specific Construction HASP as required in Section 01 35 29 – Safety Management.

B. Vehicle Inspection Log as part of the Contractor Daily Report.

PART 2 MATERIALS (Not Used)

PART 3 EXECUTION

3.01 DECONTAMINATION FACILITIES

A. Construct and maintain decontamination facilities and wheel wash stations as described in Section 01 50 00 - Temporary Facilities and Controls.

3.02 DECONTAMINATION OF TRUCKS AND OTHER VEHICLES

A. Prior to exiting the Exclusion Zone, the Contractor shall inspect and decontaminate all vehicles and equipment that have entered the Exclusion Zone. All decontamination shall be accomplished in the Decontamination Zone.

B. The Contractor shall thoroughly decontaminate all trucks and equipment before they leave work areas. Of particular importance are tires, undercarriages, tracks and soil and sediment contact surfaces.

C. The Contractor shall take care while decontaminating vehicles to avoid contaminating personnel, other parts of the vehicle or equipment, or the surroundings. Personnel involved in vehicle and equipment decontamination shall be dressed in the appropriate level of PPE and determined by the Site-Specific Construction HASP. All personnel shall follow all applicable safety procedures specified in Section 01 35 29 – Safety Management.

D. Inspect and decontaminate haul trucks after loading and before the haul trucks exit the Exclusion Zone each time.

E. Maintain a Vehicle Inspection Log to document all trucks and equipment leaving the site have been properly inspected and decontaminated prior to operating on public streets and to ensure and document that tailgates are secured and cleaned and the tarp covers are in place. Submit this log on a daily basis in the Contractor’s Daily Construction Report.

3.03 PERSONNEL DECONTAMINATION

A. Ensure that personnel who have entered the Exclusion Zone perform decontamination as required in Section 01 35 29 – Safety Management, prior to leaving the Exclusion Zone.

3.04 DECONTAMINATION OF EQUIPMENT AND METHODS

A. All equipment having contact with site soil or groundwater, including, but not limited to, trench boxes, hand tools, and survey equipment shall be thoroughly decontaminated after each use.

B. Physical decontamination techniques for equipment and vehicles shall include, but are not limited to, brushing for removal of loose materials with a brush or broom or other suitable scraping tool.

C. A pressure washer shall be used to provide application of pressurized water to agitate and remove soil and contaminated residuals from equipment and vehicle surfaces not removed through physical decontamination.

D. Soaps and detergents must be approved by the Engineer prior to use in decontamination operations.

E. All equipment and vehicle decontamination procedures shall be performed in a decontamination facility as specified in Section 01 50 00 – Temporary Facilities and Controls.

F. Overspray barriers shall be provided on each side of the decontamination area to prevent contamination of adjacent areas.

3.05 MANAGEMENT OF DECONTAMINATION WATER AND RESIDUALS

A. Collection of decontamination liquid that is developed as a result of personnel decontamination shall be collected and disposed of at an off-site disposal location..

B. Decontamination water that is developed as a result of decontaminating any over-the-road vehicle shall be shall be collected and disposed of at an off-site disposal location..

C. Dewater and collect all decontamination solids. Dewatered decontamination solids will be combined with soil and debris excavated as part of the upland excavation and managed as outlined in these Specifications.

D. Manage contaminated PPE with contaminated soil for landfill disposal.

3.06 QUALITY ASSURANCE

A. The Contractor shall conform to the Site-Specific Construction HASP, including adherence to all applicable local, state and federal health and safety standards and guidelines as specified in Section 01 35 29 – Safety Management.

B. The Contractor shall conform to the requirements for site controls specified in Section 01 35 29 – Safety Management for odor and dust control, during decontamination operations.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement will be made for “Decontamination”.

4.02 PAYMENT

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in, the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. Project documents available detailing the subsurface conditions include the following:

B. “Engineering Design Report” Prepared by CRETE Consulting, dated xxxx. The report presents the results of an investigation to study the subsurface soil and foundation conditions at Terminal 30. The investigative study includes the following.

1. A discussion of the soil types, their density or consistency, and their classification, as developed from soil and groundwater samples collected from the site.
2. Results of APS Ground Penetrating Radar survey conducted on October 27-28 2017.
3. Boring Logs from the installation of three new monitoring wells within or in close vicinity to the cleanup action footprint.
4. Key Historical Environmental Reports.

C. Accuracy of report information is guaranteed only within the limits of the available information from other projects and site specific boring. The Bidder shall make their own conclusions and interpretations from the data supplied and from information available from other sources.

PART 2 MATERIALS – NOT USED

PART 3 EXECUTION - NOT USED

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement will be made for “Subsurface Exploration”.

4.02 PAYMENT

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in, the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. Extent of Work: The extent and location of the "Demolition" Work is indicated on the drawings. The Work includes the requirements for the removal, wholly or in part and satisfactory disposal of utilities, pavements, curbs, structures, or other features identified within these specifications. The Demolition Work is included on conduits, wires and other obstructions which are designated to be demolished on the drawings. The drawings should be used for guidance only and to indicate typical general construction features of the various types of structures and is not to be construed as definitive or adequate to supplant the actual on-site inspection by the Contractor. The Work includes the requirements for the removal, in whole or in part, and satisfactory disposal of items identified within these Specifications or on the drawings including, but not limited to, the following:

1. Surface monuments around existing monitoring wells marked for abandonment
2. Storm Drain Structures
3. Storm Drain Piping
4. Electrical Junction Box
5. Concrete slabs and Asphalt Pavement

B. Work Not Shown: All existing features and appurtenances that require removal may not explicitly be shown on the drawings.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. U.S. Department of Labor Occupational Safety & Health Administration

1. OSHA Standard 1926.850(a), Preparatory Operations

B. King County burning of debris

C. METRO

D. Puget Sound Energy

E. City of Seattle material transfer tax

F. Seattle City Light

G. Telephone Company

H. Puget Sound Clean Air Agency

1.03 SUBMITTALS

A. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers' technical literature, standard details, product specifications, and installation instructions for all products.

B. Submit to the Port a demolition plan that includes and addresses, but is not limited to, the following:

1. Worker and public safety,
2. Protection of the environment,
3. Protection of workers or other persons in areas surrounding, above, below, or nearby the demolition activities,

4. Means and methods of demolition including specific types of equipment and machinery to be employed both for large regions and in areas of selective demolition,
5. Schedule of demolition,
6. Sequence of demolition including specific means, methods, and equipment to maintain structural stability, prevent damage, preclude yielding of reinforcement, and limit cracking,
7. Means and methods to minimize waste and maximize salvage,
8. Disposal procedures,
9. Disposal sites approved by the Port and applicable environmental agencies, including permits and permissions as necessary.

C. Include in the means and methods of demolition, the equipment proposed to demolish each feature including procedures and methods to provide necessary supports, lateral bracing and shoring when required, and protection of property to remain undisturbed.

D. Submit the proposed landfills and recyclers for approval.

E. Submit copies of trip tickets and receiver tickets for all material transported to approved landfills and recyclers.

F. Revise and resubmit the Demolition Plan with any proposed changes, for approval by the Engineer, prior to performing changes of means, methods, tools, equipment, etc., of demolition.

PART 2 MATERIALS – NOT USED

PART 3 EXECUTION

3.01 PROJECT INFORMATION

A. The Contractor shall perform a survey to locate all existing utilities prior to starting demolition. Notify and coordinate with the Port to turn off affected services before starting demolition. Notify the Port immediately if observed conditions differ from the Plans or reference drawings.

3.02 DEMOLITION OF STRUCTURES

A. The drawings define the approximate limits of demolition. Use saw cuts at the interface of demolished areas and pavement and/or infrastructure to remain.

B. Completely remove and dispose of concrete, pavement, and other obstructions. Break up, load, and dispose of all pavements and concrete. Remove pavements and concrete by making neat vertical saw cuts at the boundaries of areas to be removed. Prevent damage to existing pavements and concrete that are to remain. Replace adjacent materials that are damaged by the Contractor’s operations and perform replacements at no additional cost to the Port.

C. Contractor shall limit disturbance to soils beneath concrete and asphalt pavement being removed to that which is required to perform the work. Due to possible soil contamination, Contractor shall remove all loose material from bottom of demolished concrete and asphalt pavement before they are hauled off site for disposal.

D. Unique or unusual operations necessary for the removal of an existing feature / obstruction shall be subject to the approval of the Engineer. Do not perform activities including, but no limited to, on-site blasting, burning, or jetting as part of the demolition work, unless approved by the Engineer and the applicable local, state, and federal agencies.

E. The amount of dust and debris resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. The use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as flooding or pollution.

F. Steel protrusions out of the concrete slabs greater than 1-inch in height shall be removed by blow-torch or other method approved by the Engineer.

3.03 DEMOLITION OF UTILITIES

A. Piping: Refer to the Civil Plans and specifications for demolition details. Remove or abandon all existing piping in the demolition area, including underground piping or exposed piping as indicated on the Plans or as directed by the Engineer. Excavate utility lines to be demolished and provide a permanent leak-proof closure at the end of all abandoned lines.

B. Electrical, Lighting, Communications, and Other Related Items: Refer to the Electrical Plans and specifications for demolition details.

C. Water Systems: Refer to the Civil Plans and the Specifications for demolition details.

3.04 DISPOSAL

A. General: All materials, except those indicated as Port of Seattle salvage, and except those materials containing substances classified as hazardous or potentially hazardous by local, state or Federal regulating agencies, shall upon their demolition become the property of the Contractor. All such material, including those containing hazardous or potentially hazardous substances shall be removed and promptly disposed of legally away from the site and on property not owned by the Port of Seattle, except as otherwise provided in these specifications. No material shall be disposed of in adjoining waterways or in the fill. Burning of materials in these areas falls under the jurisdiction of the King County regulations and is generally forbidden under all circumstances.

B. Cleanup: After removal of structures clean and grade the area. There shall be no debris, rubble, or litter left at the site from any of the demolition operations and the site shall be clean.

C. The Port of Seattle encourages the salvage and recycling of materials from demolished structures. The Contractor shall salvage or recycle, in an acceptable manner to environmental agencies and the Port of Seattle, at his option any of the materials designated for disposal.

D. Salvage and Recycling: The Port encourages salvage and recycling of materials from demolished structures. Salvage or recycle, in an acceptable manner to environmental agencies and the Port, any of the materials designated for disposal as approved by the Engineer.

E. Haul: Transport non-salvageable materials, non-recyclable materials to a Port-approved lined landfill with a Lechate Collection System. Contaminated soils shall be taken to a facility specified in Section 31 00 00, Earthwork. This shall be subject to the City of Seattle's material transfer tax.

F. The following recyclers and landfill facilities are approved by the Port:

Demolition Debris and Creosote Disposal	Roosevelt Regional Landfill Roosevelt, WA

Demolition Debris and Creosote Disposal	Oregon Waste Systems Arlington, OR
Demolition Debris and Creosote Disposal	Finley Buttes Regional Landfill Boardman, OR
Asphalt & Concrete	Stoneway Rock Renton, WA
Asphalt & Concrete	R. W. Rhine, Inc. Tacoma, WA
Asphalt & Concrete	Renton Concrete Recyclers Renton, WA
Asphalt & Concrete	Woodworth & Company Tacoma, WA

G. The Contractor has the option to secure his own demolition debris, asphalt, concrete disposal or recycle site(s) provided he has acquired all permits and approvals necessary from governing agencies and the Port.

3.05 BACKFILLING

A. Demolished Areas: Backfill and compact to existing ground level as shown on the drawings, or as directed by the Engineer.

B. For backfill material and compaction requirements, conform to Section 31 00 00 - Earthwork. Do not use demolition debris as backfill material.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement will be made for “Site Demolition”.

4.02 PAYMENT

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in, the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent of “Removal and Alteration” Work includes the removal and disposal of all items and materials, as indicated on drawings and in the specifications. The Contractor shall provide shoring and protection as necessary to prevent damage to existing structures.

1.02 SUBMITTALS

A. The Technical Execution Plan (Section 01 32 19 Preconstruction Submittals) shall include a description of demolition activities including means and methods

PART 2 MATERIALS

2.01 MATERIAL REQUIREMENTS

A. Materials For Reuse At The Project Site Area

1. Material indicated on the drawings to be relocated shall be recovered in good condition. Store items in designated locations at the project site in such a manner that the items will not be damaged by the alteration operations.

B. Materials And Equipment To Be Salvaged And Turned Over To The Port

1. All material and equipment not reused in the Project and which has any salvage value or possibly can be used at a future date shall be presented to the Port for disposition. If accepted by the Engineer, hold and protect the equipment for moving and subsequent storage by the Port.
2. Contact the Engineer for the delivery point for each salvage item or group of items. All support staging frames shall be provided by the Contractor.

C. Scrap Material

1. Items not specified for reuse and items not salvage to the Port and items not elsewhere specified for specific disposal are designate as scrap material and become the property of the Contractor.
2. Remove scrap material from the Work area immediately. Transport scrap materials. Storage or sale of removed items on the site will not be permitted.
3. See Section 01 74 19 - Construction Waste Management.

PART 3 EXECUTION

3.01 PROJECT INFORMATION

A. Occupancy

1. The Port facilities will be occupied for normal operations during construction. The construction operations shall be phased as indicated on the drawings and described in Section 01 11 00 - Summary of Work.
2. Conduct operations in such a manner as to cause the least amount of interference with public traffic and the Tenant’s operations.

B. Condition Of Structures

1. The Port assumes no responsibility for the actual condition of the portions of the structures to be removed or altered. The drawings do not show all arrangements and conditions of the structures and appurtenances as they now exist, nor is there any guarantee that fixtures and materials will be in full accord with the drawings. The Contractor shall be responsible for the complete repair of existing construction and equipment affected by the new construction. The Contractor shall inspect the existing construction and the quantity and condition of equipment and materials, and shall assume full responsibility for servicing and repairing of equipment and materials.
2. Repairs to structures necessitated by the construction project shall be made using material similar to that of adjacent surfaces.

C. Alterations Of Existing Construction

1. Dismantling, cutting and removal of a part of the materials or equipment from the existing structures shall be done in such a manner as to prevent unnecessary damage to the remaining structures. Rebuilding necessary to produce a completed job necessitated because of removal of the materials or equipment, shall become the responsibility of the Contractor, notwithstanding that the specific Work may not be shown on the drawings or mentioned in the specifications. The materials and workmanship necessary to accomplish the rebuilding Work shall conform to the drawings and to the applicable sections of these specifications.

3.02 PREPARATION FOR EXECUTION OF WORK

3.03 EXECUTION OF WORK

A. Traffic

1. Conduct removal operations and the removal of debris to ensure minimum interference with traffic and adjacent occupied or used facilities.

B. Protection

1. Conduct operations to prevent damage by falling debris or other cause to finished area, structures and facilities, as well as persons. Provide shoring, bracing or support to prevent movement or settlement or collapse of portions of the structures to remain.

C. Damages

1. Promptly repair damages caused to adjacent facilities by removal operations as directed by the Engineer and at no additional cost to the Port.

D. Utility Services

1. Do not interrupt existing utilities which service occupied or used facilities, except when authorized by the Engineer. Provide temporary services during interruptions to existing utilities, as acceptable to the Engineer. No less then forty-eight (48) hours’ notice shall be given to the Engineer before any intended interruption of services.

E. Barricades

1. Before starting any cutting or removing any part of the existing surfaces, construct barricades where indicated on the drawings and as required for

the protection and routing of public and Tenant personnel through or around the construction area. Construct barricades as stated in Section 01 50 00 - Temporary Facilities and Controls. Protect all finished areas enclosed within barricades which are not included in the demolition Work. Remove the barriers upon completion of the contract.

F. Removal

1. Removal Operations: Use such methods as required to complete the Work within the limitations of governing regulations and other special requirements as specified.
2. Proceed with removal operations in a systematic manner.

G. Disposal Of Materials

1. Legally dispose of all scrap and waste materials off Port property, and protect the Port from all damages that may arise there from.
2. See Section 01 74 19 - Construction Waste Management.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement will be made for “Removal and Alterations”.

4.02 PAYMENT

A. No separate measurement or payment will be made for the work required by this section. The cost for this portion of the Work will be considered incidental to, and included in, the payments made for the applicable bid items in the Schedule of Unit Prices bid for the Project.

End of Section

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Section includes the procedures and requirements for the handling, stockpiling, loading, and disposal or contaminated soil and debris generated by the construction activities.

B. Disposal work (Wastes) shall include furnishing all labor, tools, equipment and incidentals required for transport and recycling or disposal of site demolition and deconstruction materials and debris, upland excavated soils and associated debris and dredged sediments and associated debris to an off-site disposal or recycling facility. Disposal work also includes all transportation and disposal fees.

C. All Wastes generated during the course of the project shall be disposed of in accordance with all applicable local, state, and federal regulations. The waste is classified as Subtitle “D” Waste, including soil, sediment, and debris removed from the site except for demolished surface materials that can be recycled or reused. This was is also defined to be non hazardous waste.

D. Wastes generated during the course of the project shall be disposed of at one of three Port approved sites that include:

1. Waste Management
2. Regional Disposal
3. Other Port-approved site

E. During initial excavation the first 10 cubic yards of subsurface soil (below the asphalt) will be direct loaded into a 10 cubic yard roll of bin. This soil will be sampled for disposal profiling by the Engineer for disposal at Waste Management, Regional Disposal or other vendor as approved by the Port. All other wastes shall be direct-loaded to over-the-road trucks from the trench excavations for disposal so that stockpiling of waste is not required.

F. This Section includes any required chemical sampling and analysis for disposal characterization should the Contractor chooses to profile the waste for disposal at sites other than sites that have been approved by the Port. Existing site characterization information (See Appendices) shall be used, to the extent possible, for this characterization. Additional characterization of waste may be needed for treated timber or other debris encountered.

G. Effective June 1, 1991 and in accordance with SMC 21.36 as amended by Ordinance 115589, no Waste generated within the City of Seattle shall be deposited in a Waste disposal facility owned and operated by King County.

H. Sweep clean the surface of the active pavements outside the current Work continuously and remove all debris, rubble, or litter completely during each working shift.

1.02 HEALTH AND SAFETY

A. The Contractor is required to implement all health and safety provisions as required by Section - 01 35 29, Safety Management. These provisions include any special monitoring, personal protective equipment, or Work plans to accommodate contaminated soil or material handling. Use of environmental characterization data may not be appropriate for health and safety purposes.

1.03 SUBMITTALS

A. The Contractor shall submit a Transportation and Disposal Plan, in the Technical Execution Plan, in accordance with Section 01 33 00 – Submittals. The plan shall address the handling, storage, transportation, and disposal of wastes generated at the Site, and shall include the Port's desire to direct-load waste from the site without stockpiling on the site. The plan shall comply with regulations administered by the EPA, the U.S. Department of Transportation (DOT), and the Washington State Department of Ecology (Ecology) and the County and City. The plan shall include the following:

1. A list of Wastes that will be generated by the Project. A proposed recycling facility or disposal site shall be identified for each waste stream. The list shall identify estimated quantities and the type of material to be wasted or removed from the Site. .
2. On-site management practices for waste, including types and volumes of waste anticipated, inventory controls, and waste minimization methods.
3. Proposed on-site temporary storage methods for all waste streams, and-off-site disposal methods and facilities. Proposed disposal soil and debris shall be permitted RCRA Subtitle D landfill.
4. Procedures for packaging, labeling, and manifesting of waste streams generated and managed by the Contractor. If materials are determined to be a non-hazardous and non-dangerous waste, they shall be shipped using a non-hazardous Waste manifest or standard BOL provided by the transporting company or generator.
5. A list of all subcontractors to employed in transportation, types of trucks, containers and liners to be used, and inspection procedures prior to transport, and best management practices to prevent any leakage or spillage.
6. A description of all haul routes, transfer facilities, estimated hours and days of operation, estimated number of trucks per day, and on-site traffic control measures.
7. A description of and proposed sequencing of, all sampling and analysis of any waste materials that may be required by the landfill for disposal characterization.

B. Should additional or alternate disposal or recycling sites become necessary during the life of the Contract, the locations and information for each site shall be submitted to the Engineer for approval at least 20 Working Days prior to their proposed use.

C. Weekly disposal reports shall be submitted to the Engineer for all dredge/excavated material and debris transferred to approved disposal or recycling facilities. The weekly reports shall include the total number of truckloads, total estimated volume, total tons of material received at the disposal facilities and a copy of the completed waste disposal tracking sheets.

D. All transportation-related shipping documents shall be submitted to the Engineer, including draft manifests for waste; draft bills of lading; lists of proposed labels, packages, markings, and placards to be used for shipment; and any waste profiles and/or supporting waste analysis documents, for a review a minimum of 7 days prior to anticipated shipment. Generator copies of manifests used for initiating shipments of waste, bill of ladings, and supporting waste analysis documents shall be furnished when shipments are originated.

E. Receipt copies of waste shipment records at the designated disposal facility shall be furnished no later than 35 days after acceptance of the shipment. When required by law, waste shipping papers shall be returned to the Owner within the legally specified time.

F. The Contractor shall include in the Two Week Look Ahead Schedule described in Section 01 32 16 – Bar Chart Schedule specific time frames for excavation. Each excavation activity shall be given an individual line item description, time frame and duration.

1.04 DEFINITIONS

A. Environmental Agent (EA): Port environmental management organization representative responsible for oversight and implementation of certain Port environmental policy and procedures at Port construction sites. The EA is responsible for coordinating environmental requirements, monitoring Contractor performance relative to environmental specifications and liaison with the Resident Engineer and Contractor representatives for oversight of and/or conducting environmental monitoring and sampling. EA activities may also include field screening and documentation of excavation, transport and disposal of contaminated materials.

B. Olfactory Indications (methods): Of or relating to the sense of smell. Soils contaminated with petroleum and other volatile constituents typically exhibit characteristic odors that can be detected (and sometimes identified) by smell.

C. Response: To be reviewed by Construction Management.

D. (PID): A field instrument that is used to detect the presence of and give a relative indication of the concentration of vapors emitted from volatile constituents (contamination) in environmental media (soil and water).

E. Soil (waste) Profile: A characterization of the chemical and physical properties of a waste material including the types of contaminants and their concentrations as measured by approved laboratory analytical methods. A profile is required by the receiving permitted disposal or recycling facility.

F. Special Handling: Refers to hauling and disposal of soils that, because they are contaminated, cannot be reused in place as backfill or as general fill at another location. Such soils must be hauled to and managed at a permitted disposal or recycling facility.

G. Visual Indications (methods): A preliminary evaluation of the potential presence of contamination based on visual observation. For example, fuel contaminated soils are frequently discolored or stained relative to non-petroleum impacted native soils or clean fill. Such discoloration often appears dull gray in color.

1.05 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the reference applies.

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 107	Hazardous Materials Program Procedures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packaging
49 CFR 178	Specifications for Packaging
40 CFR 260	Hazardous Waste Management System- General and Characteristics of Hazardous Waste
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 279	Standards for the Management of Used Oil
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 302	Designation, Reportable Quantities, and Notification

WASHINGTON ADMINISTRATIVE CODE (WAC)

WAC 173-303	Washington Dangerous Waste Regulations
WAC 173-304	Minimum Functional Criteria for Solid Waste

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor shall provide all of the materials and labor required for the packaging, labeling, marking, placarding, and transportation of nonhazardous materials in conformance with DOT standards.

PART 3 EXECUTION

A. Use only Engineer approved waste disposal and recycling sites.

B. All wastes shall be transported in accordance with federal, state, and local transportation requirements, including driver training, placarding, and use of shipping papers or waste manifests.

C. Notify the Engineer at least five working days in advance of any proposed changes to the operations outlined in the approved Technical Execution Plan (Section 01 32 19 - Preconstruction Submittals).

D. Any required sampling and analysis for disposal characterization of waste materials beyond what is required to profile the accepted disposal sites shall be the Contractor's responsibility and is considered incidental to the other payment items. Contractor shall sequence any required sampling and analysis to avoid any delays in the Work.

3.02 OFF-SITE WASTE MANAGEMENT

A. The Contractor shall use RCRA Subtitle D or recycling facilities for nonhazardous material being disposed of off Site.

B. Packaging Certification - Prior to shipment of any material off site, the Contractor shall provide written certification to the Engineer that nonhazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation.

C. Transportation - The Contractor shall use manifests for transporting non hazardous wastes as required by Department of Transportation and any applicable state or local law or regulation. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series.

3.03 SHIPPING DOCUMENTS

A. The Contractor, in consultation with the Engineer, shall evaluate prior to shipment of any material off Site; this shall be done for the purpose of determining proper shipping descriptions, marking requirements, etcetera, as described below.

B. Identification of Proper Shipping Names - Proper shipping names shall be submitted to the Engineer in the form of draft shipping documents for review and approval.

C. Packaging, Labeling, and Marking - The Contractor shall package, label, and mark wastes using the specified materials and in accordance with the referenced regulations.

D. Nonhazardous Material Shipment Documents - The Contractor shall prepare a bill of lading (Contractor Solid Waste Tracking Sheet) for each shipment nonhazardous material which fulfills the shipping paper requirements. The bill of lading shall satisfy the requirements of 49 CFR 172, Subpart C, (and 40 CFR 279 if shipping used oil) and any applicable state or local law or regulation, and shall be submitted to the Owner for review and approval. For laboratory samples, the Contractor shall prepare bills of lading and other documentation as necessary to satisfy conditions of the sample exclusions in 40 CFR 261.4(d) and (e), and any applicable state or local law or regulation. Bills of lading requiring shipper's certifications shall be signed by an authorized representative of the Owner.

3.04 SITE MAINTENANCE

A. Keep work area, site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris resulting from Contractor's operations.

B. Provide on-site containers for collection of waste materials, debris, and rubbish. Periodically remove waste from the site.

C. Dispose of trash and debris in compliance with governing codes, ordinances, regulations, and anti-pollution laws.

D. Locate dumpster(s) or other waste containers inside the work areas or at a location designated by the Engineer.

E. Control all operations in accordance with Section 01 57 23 – Pollution Prevention, Planning and Execution.

3.05 STOCKPILING – GENERAL

A. Stockpiling of waste material will not be allowed given the relatively small work area on the site.

3.06 LOADING

A. The Contractor shall provide equipment and labor to load all trucks for transport and disposal of materials excavated from the Project as specified in this document.

B. Coordinate with the waste disposal facility for truck unloading of contaminated materials for the Project site as required. All waste shall be direct-loaded from the trench excavations into waiting over-the-road trucks.

C. The Contractor shall bear full responsibility for coordinating with the waste disposal facility the number of trucks, loading operations, and hours for loading.

D. Load trucks within the remediation site boundary so that spills are contained within the area. If required by the Engineer, spread polyethylene sheeting over an area sufficient for truck loading in order to avoid contaminating the loading site. Spilled material shall be immediately picked up and deposited back in the trench or directly into a truck for off-site disposal.

E. The Contractor shall be fully and completely responsible for proper loading and adhering to load and weight limits of all trucks leaving the Project. All fines, taxes, penalties, or judgments resulting from overweight or improperly loaded vehicles shall be the full and complete responsibility of the Contractor.

F. All equipment shall be decontaminated per Section 02 22 23 – Decontamination prior to leaving the site.

G. The Contractor shall be responsible for ensuring that all material loaded for off-site disposal meets applicable transportation laws and regulations as well as the requirements of the receiving off-site waste disposal facility.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included, in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. Furnish all labor, materials, facilities, equipment, services, employee training and testing, and agreements necessary to perform the work required for potential silica dust control activities in accordance with these specifications and the latest worker protection regulations from the Washington State Department of Labor and Industries Division of Occupational Safety and Health (DOSH), and for fugitive dust control in accordance with these specifications and the latest regulations from the Puget Sound Clean Air Agency (PSCAA) and any other applicable federal, state, and local government regulations. Whenever there is a conflict or overlap of the above references, the most stringent provisions are applicable.

B. In all cases where potential silica dust exposures may reasonably be expected to occur, the Contractor shall use any and all feasible engineering and work practice controls to reduce and maintain employee exposure levels at or below the DOSH Permissible Exposure Limits (PELs) outlined in Table 1 below.

C. The work specified herein shall be performed by competent persons, trained, knowledgeable and qualified in both fugitive and silica dust evaluation and control methods.

D. If visible fugitive dust emissions are observed or respirable crystalline silica concentrations exceed applicable PELs beyond the perimeter of the work area, the Port is authorized to stop work. The Contractor shall perform all necessary corrective actions to eliminate visible dust and reduce respirable crystalline silica concentrations to less than 0.05 mg/m3 before resuming work. The Port may visually monitor for fugitive dust and collect air samples for silica at any time.

1.02 DEFINITIONS

A. Definitions relevant to silica:

1. Permissible Exposure Limit (PEL):

Table 1 - Permissible Exposure Limits for Respirable Crystalline Silica by Type

Crystalline Silica Type (respirable)	**TWA_8**	**STEL**
Cristobalite	0.05 mg/m^3	0.15 mg/m^3
Quartz	0.1 mg/m^3	0.3 mg/m^3
Tripoli	0.1 mg/m^3	0.3 mg/m^3
Tridymite	0.05 mg/m^3	0.15 mg/m^3

1.03 GOVERNING CODES, STANDARDS, AND REFERENCES

A. Washington State Department of Labor and Industries

1. WAC 296-841 – Airborne Contaminants
2. WAC 296-62-136 – Ventilation
3. WAC 296-901 – Global Harmonized System for Hazard Communication

B. Puget Sound Clean Air Agency

1. Regulation I, Article 9, Section 9.15 – Fugitive Dust Control Measures

C. U.S. Occupational Safety and Health Administration

1. 29 CFR 1926.55 (a) - Gases, Vapors, Fumes, Dusts, and Mists

2. 29 CFR 1926.57 – Ventilation

D. Associated General Contractors of Washington Education Foundation

1. Guide to Handling Fugitive Dust from Construction Projects, Seattle, Washington, 1997

1.04 SCOPE OF WORK

A. Fugitive Dust: All Construction work will potentially generate fugitive dust. It is the responsibility of the Contractor to control the release of fugitive dust by using a combination of reasonable precautions and best work practices.

B. Silica: Construction work that requires control of silica shall include but not be limited to general demolition, chipping, sanding, tuck-point grinding, scabbling/scarifying, surface grinding, sawing, jackhammering on concrete building materials, cement mixing, dry sweeping of concrete dust, and significant disturbance of and/or removal of non-asbestos fireproofing associated with this project.

C. Work activities shall include the following, as applicable:

1. Provision of site security to assure that no member of the public is able to gain access to the construction work area at any time. The Contractor shall maintain access and egress routes at all times.

2. In accordance with WAC 296-841-20005, the Contractor is responsible for determining if the activities being performed may reasonably be expected to release respirable silica at or above the exposure limits. The Contractor shall use, but not be limited to, the following criteria to determine if the work being performed may reach or exceed the PELs:

    a. Type of work being performed.

    b. Duration of work.

    c. Work practices and engineering controls being used.

    d. Previous air monitoring data from within the last 12 months on projects that were “essentially identical”.

    e. Standard or site-specific written operating procedures.

    f. Citation history regarding silica

3. In the case of concrete and demolition work that may generate silica dust at or above the exposure limits, the Contractor must conduct exposure evaluations to determine employee exposure to silica and implement feasible exposure controls to reduce employee exposure below the PEL. This may include the revision of work practices and provision of personal protective equipment during the following activities:

    a. Exposure controls are being evaluated or put in place

    b. The airborne silica concentration has not been reduced below the permissible exposure limit

c. Exposure controls are not feasible

4. Provision of best work practices to prevent the release of fugitive and silica dust outside of the work area, as described in the execution portion of this section, Part 3.

5. Provisions for worker and equipment decontamination. Worker decontamination and equipment areas shall be cleaned daily or as required more frequently to prevent dust emissions.

6. Protection of security, life safety, and energy management systems, including associated wiring, which shall remain operational throughout the work activities.

7. Decontamination of work area(s). Concrete dust shall be cleaned from the work area using wet methods and HEPA vacuuming equipment at the completion of demolition activities, before barriers are removed.

8. Water used for dust suppression or decontamination (provided it does not contain additional chemical contaminants) shall be controlled and disposed of as follows:

   a. Slurry and residual dust shall be vacuumed during dust-generating operations.

   b. Slurry and residual dust shall not remain on permanent concrete or asphalt pavement overnight.

   c. Slurry and residual dust shall not drain to Storm Drain System (SDS), Industrial Waste System (IWS), or any other natural or constructed drainage conveyance.

   d. Collected slurry residual dust and debris are the responsibility of the Contractor and shall be disposed of off-site in a manner that does not violate groundwater or surface water quality standards.

1.05 PERSONAL PROTECTION

A. Respiratory Protection

1. Where exposures to respirable crystalline silica may exceed the PEL, workers shall be provided, at a minimum, with personally issued and marked respirators equipped with high efficiency particulate air (HEPA) filters approved by NIOSH (99.97% efficient) to be worn in the designated work area. Sufficient filters shall be provided for replacement as required by the workers or applicable regulations. Disposable respirators shall not be used.

2. The Contractor shall comply with OSHA 29 CFR Part 1926.134, WAC 296-841-200, WAC 296-842 and ANSI Standards Z88.6-2006, Z88.7-2010 and Z88.10-2010.

3. Worker exposure to respirable crystalline silica shall not exceed the permissible exposure limits. Worker exposure shall be determined by the protection factor of the respirator worn and measured area or personal respirable crystalline silica concentrations.

4. A sufficient supply of replacement parts and HEPA filter cartridges shall be provided to the workers.

5. The Contractor shall maintain daily inspection(s) of all respirators to verify cleanliness and to replace damaged, worn or missing parts.

6. Where respirators are used (in most cases a half-face respirator equipped with HEPA type filters), a complete Respirator Program must be put in place in accordance with WAC 296-842. Such a program includes proper selection, fit-testing, cleaning and maintenance, supervision, training, and written procedure.

B. Protective Clothing:

1. Workers shall be provided with sufficient sets of protective full-body clothing to be worn in the designated work area whenever a potential exposure to respirable crystalline silica concentrations above the PEL exists. Such clothing shall include, but not be limited to, coveralls and eye protection.

2. Protective clothing shall not be worn outside the work area. Non-disposable-type protective clothing and footwear shall be left in the work area.

3. Eye protection shall be provided and worn as required by applicable safety regulations. Equipment shall conform to ANSI Z87.1-2003.

4. Head Protection: Hard hats or other head protection shall be provided as required by applicable safety regulations. Hard hats shall conform to ANSI Z89.1-2009, Class A or B.

5. Foot Protection: Nonskid footwear shall be provided to all workers. Footwear shall conform to ANSI F2412-05.

6. Workers shall not eat, drink, smoke, or chew gum or tobacco in or near the respirable silica work areas.

1.06 SUBMITTALS

A. The Contractor shall provide complete submittals in accordance with Section 01 33 00 and as specified below.

B. Preconstruction Submittals: Prior to conducting any work which may result in any exposure to silica-containing dust or to fugitive dust in excess of the permissible exposure limit, provide a site-specific Work Plan which demonstrates the methods by which this work will be perfomed. At a minimum, the Work Plan shall include:

1. Specific work practices and procedures for work that will generate silica-containing dust or fugitive dust

2. Personal protective measures and decontamination requirements

3. Respirator fit testing records for all employees potentially exposed above the permissible exposure limit

4. Description of engineering controls designed to keep fugitive dust and silica exposures below the levels specified herein, for outside and inside each work area

5. Silica Air Monitoring Program

a. The Air Monitoring Program shall include the proposed sampling plan, sampling procedures, and field quality control procedures of the firm conducting the air monitoring.

C. Construction Phase Submittals

1. Air sample data sheets and laboratory analytical results, including chain of custody

2. Supervisor daily inspection report, including scope of work completed, engineering controls used, hours worked, and equipment and materials used.

D. Post-Construction Closeout Submittals

1. Project Overview: Provide a basic project summary identifying the scope and summarizing the work performed by the Contractor. Provide enough information to have a basic understanding of the project and include project and contact names and ID numbers; Contractor's company name; where, when, and what type of work was completed; and a discussion of significant problems encountered during the course of the work. The written summary shall include a description of all changes or modifications to the Contractor's Pre-Construction Work Plan.

2. Certification: Provide written certification from the Contractor's Project Manager or Supervisor that the Contractor has fully inspected the work area and completed work in strict accordance with the Specifications.

3. Air Monitoring: Submit documentation of all Contractor air monitoring results relative to regulatory compliance. Include copies of all air monitoring data sheets, chain-of-custody documentation and analytical reports for sampling conducted at the site.

4. Project Record Documents: Provide project records including documentation of all contract changes, and copies of work site entry log books, safety logs, sign-in sheets, and supervisor daily field reports. Provide copies of project meetings for pre-construction, construction period, and project closeout meetings.

5. Submit copies of inspections or visits by regulatory agencies. Include copies of any citations or notices received by the Contractor from regulatory agencies during the course of the project.

1.07 SILICA AIR SAMPLING EVALUATION BY CONTRACTOR

A. If the Contractor determines that activities being performed may reasonably be expected to release respirable silica at or above exposure limits, the following shall apply:

1. The Contractor shall conduct air sampling of workers and subcontractors for respirable crystalline silica. The Contractor shall submit an Air Monitoring Plan as part of its Work Plan.

2. The Contractor shall conduct personal air sampling for respirable silica in accordance with National Institute for Occupational Safety and Health (NIOSH) Method 7500. Sample volume shall be sufficient to determine if worker exposure to respirable crystalline silica is below the PEL. If analysis of the samples indicates concentrations are above the PEL, the Contractor

shall determine the cause of the overexposure and revise work practices and engineering controls to reduce exposures to below the PEL. The Contractor is required to conduct re-sampling and analysis at no expense to the Port of Seattle.

3. Results of air samples collected by the Contractor shall be submitted to the Engineer within 48 hours following receipt of analytical results.

PART 2 MATERIALS AND EQUIPMENT

2.01 EQUIPMENT

A. Provide suitable tools for dust collection and water-jet dust suppression systems.

B. Provide sufficient number of HEPA-filtered vacuum cleaners to clean-up visible dust residues.

C. Air filtration devices shall utilize high efficiency particulate absolute (HEPA) filtration systems bearing a UL 586 label indicating its ability to perform under specified conditions. Provide filters marked with the name of the manufacturer, serial number, airflow ratting, efficiency and resistance, and the direction of the test airflow. Units shall have two stages of pre-filtering, as follows:

   1. The first stage pre-filter shall be a low efficiency type for particle sizes 100 micrometers and larger.
   2. The second stage pre-filter shall be a medium efficiency type effective for particle sizes down to 5 micrometers.
   3. Pre-filters shall be installed either on or in the intake grid to the exhaust unit and shall be held in place with special housings or clamps provided by the manufacturer.

D. Air filtration devices shall also include:

   1. An elapsed time meter showing the total accumulated hours of operation
   2. An electrical interlock preventing operation of the unit without a HEPA filter
   3. An automatic shutdown system to stop the fan in case of a rupture in the HEPA filter or a blocked air discharge
   4. Warning lights to indicate normal operation (green); moderately high pressure drop across the filters, such as due to filter overloading (yellow); and too high of a pressure drop due to an overloaded or ruptured HEPA filter or obstructed discharge (red).
   5. An audible alarm if the unit shuts down due to operation of the safety systems
   6. Electrical components approved by the National Electrical Manufacturers Association (NEMA) and the Underwriter's Laboratories (UL). Each unit shall be equipped with overload protection sized for the equipment. The motor, fan, fan housing, and cabinet shall be properly grounded.

PART 3 EXECUTION

3.01 CONTROL METHODS

A. Options for the control of fugitive and silica concentrations are given in the following paragraphs. The specific method(s) used shall be detailed in the submittals and approved by the Engineer.

B. Wet Method

1. Use best management practices for the control of fugitive dust. This may include but is not limited to the following:
    a. The use of control equipment, enclosures, and wet (or chemical) suppression techniques, as practical, and curtailment during high winds.
    b. Treating temporary, low-traffic areas (e.g., construction sites) with water or chemical stabilizers, reducing vehicle speeds, constructing pavement or rip rap exit aprons, and cleaning vehicle undercarriages before they exit to prevent the track-out of mud or dirt onto paved public roadways.
    c. Covering or wetting truck loads or allowing adequate freeboard to prevent the escape of dust-bearing materials.
2. For activities that may generate airborne silica or fugitive dust, use “wet” systems that eliminate or reduce dust generated and tools that include dust control features where possible. Clean up sludge and/or waste immediately following its generation.

C. Enclosure Method

1. Use enclosures as listed in Section 01 50 00 Temporary Facilities and Controls in conjunction with air filtration devices, as described in paragraph 2.01.D. Air shall be moved through the filtration unit at a minimum of 1,500 cubic feet per minute (CFM). Provide HEPA filtered vacuum units to control dust at the point of dust generation, and use tools that include dust control features where possible.

D. Negative Air Pressure Systems

1. If visible levels of dust emissions are observed outside the work area, provide differential air pressure systems for each work area.
2. Construct an enclosure that encompasses the work area.
3. Exhaust air shall only be vented to locations approved by the Port. The Contractor shall provide on-site certification of the negative pressure units to document adequate filtration efficiency for all units exhausting internally within the building or as otherwise required by the Port. Testing may need to be repeated if the unit(s) or their filtration systems have been repaired or replaced during the course of the work, following movement between zones, or if damage has occurred since the units were previously tested. Certification shall be by DOP or Portacount testing and signed by an independent tester or the Contractor's trained Health and Safety personnel. DOP testing shall verify an in-situ efficiency of 99.97% or greater. Portacount testing shall verify an in-situ efficiency of 99.3% or better. The tester(s) shall show knowledge of the testing procedures and limitations to the satisfaction of the Port, including but not limited to knowledge of test modes, variability of results, calibration techniques, and equipment

operating procedure. Where knowledge or testing procedures are deemed inadequate, a Professional Engineer or Certified Industrial Hygienist shall sign test results.

3.02 OVERSIGHT

A. An environmental consultant (Consultant) may be retained to advise the Engineer in all matters pertaining to the work performed in accordance with these specifications and requirements. Where an outside consultant is not hired, Port personnel will serve as this Consultant. References to the Consultant herein shall include the outside Consultant or Port personnel.

B. The Consultant will act as the Engineer’s liaison in technical matters involving the fugitive dust and silica-related work.

C. The Consultant is authorized by the Engineer to have free access to work areas where silica and fugitive dust may be generated, to assist in interpretation of procedures, and to advise on all provisions of the contract documents pertaining to the control of dust.

D. The Consultant will advise the Engineer to stop work if in the course of performing their monitoring duties, they observe an instance of substantial nonconformance with the Contract Documents and/or a situation presenting a nuisance to the public or a health hazard to workers, Port employees, or the public. Work shall not resume until corrective measures have been enforced. Instances of substantial non-conformance shall include but not be limited to the following:

   1. Visible dust emissions outside of the work area barriers
   2. Loss of negative pressurization (if required)
   3. Activities or misconduct affecting worker or building occupant safety
   4. Breaches of containment that could substantially damage building life safety systems

E. If poor work practices are observed, the Consultant/Port shall direct the Contractor to make the necessary corrections. If appropriate corrections are not made, or if an immediate threat that silica dust could be released outside the work area exists, work shall be stopped. The decision to stop work shall be made by the Engineer.

F. The Consultant may perform air sampling inside and outside the work area during the Project. The Contractor shall cooperate fully with the Consultant and ensure the cooperation of his workers during collection of air samples and work area inspections.

G. The Consultant's role in advising the port on environmental health matters does not relieve the Contractor's obligation to comply with all applicable health and safety regulations promulgated by the federal, state, or local governments. Air monitoring results generated by the Consultant shall not be used by the Contractor to represent compliance with regulatory agency requirements for monitoring of workers exposure to airborne silica, nor shall any other activity on the part of the Consultant represent the Contractor's compliance with applicable health and safety regulations.

3.03 WORK AREA ISOLATION AND CLEANUP

A. The Contractor shall continuously endeavor to eliminate the release of fugitive dust and silica into adjacent building spaces.

B. Work areas where fugitive dust and silica-containing materials will be disturbed shall be isolated from other parts of the building with 6 mil polyethylene critical barriers on all doors, windows, and work area penetrations. Other methods may be approved upon written requests. Coordinate with Section 01 50 00 Temporary Facilities and Controls for additional information regarding barriers to the public.

C. The work areas will be considered clean when all visible dust and debris has been removed.

3.04 RECORD KEEPING

A. The Contractor shall maintain, for at least 30 years, a record of the Project. Furnish one copy to the Engineer in an electronic format as part of the post-construction closeout submittals. The record shall include the following information:

1. The starting and completion dates of the project;
2. A copy of all analytical results;
3. Copies of negative pressure documentation records (as required);
4. The name and address of the analytical laboratory used for silica analyses; and
5. The name, address, and social security number (last 4 digits only) of all persons who were engaged in activities that may generate airborne silica or fugitive dust.

PART 4 MEASUREMENT AND PAYMENT

4.01 PAYMENT

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Lump Sum bid for the Project.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of "Skid Mounted Air Sparge and Vapor Extraction Blower Packages" Work is shown in the Contract Documents.

1. Contractor to provide designed and shop fabricated steel skids with air sparge blower, vapor extractions blower, moisture separator, insulated noise reduction blower housings, electronic and manual controls, and associated appurtenances.
2. The control system for the vapor extraction and air sparging skids shall be designed to integrate with the control system for the thermal/catalytic oxidation skid.

1.02 DESCRIPTION OF WORK

A. The remedial system includes one turnkey soil vapor extraction (SVE) system and one turnkey air sparging (AS) system and will include associated appurtenances and controls. The SVE and AS systems will be located in the Equipment Enclosure Area as shown on the Contract Drawings. All systems shall be fabricated off-site. All equipment including piping and instruments shall be installed securely and dampened for vibrations, as necessary. The systems should be constructed to provide continuous operation for several years without major repair or parts replacement.

B. Contractor shall rig, unload, place and lag-down the equipment skids, at the locations shown on the Contract Drawings.

C. Contractor shall connect the SVE equipment piping to the thermal oxidizer.

D. Contractor shall connect the electrical supply and control wiring to and between the equipment skids and the thermal/catalytic oxidizer control panel.

1.03 GOVERNING CODES, STANDARDS AND REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. NEC (National Electrical Code)
2. NFPA 54, ANSI Z223.1 (National Fuel Gas Code)
3. UL (Underwriters Laboratories, Inc.)

1.04 SUBMITTALS

A. Submittals shall include the following:

1. Product Data: Product catalog cut sheets on all equipment, clearly marked to indicate the applicable model number, optional features, design duty points, and intended service of each device. Include catalog performance ratings that indicate airflow, static pressure, horsepower, and temperature rise. Include electrical characteristics and connection requirements.
2. Shop Drawings: Fabrication drawings of equipment including fabricated equipment skids and piping, indicating configuration, general assembly, and materials used in fabrication.

3. Electrical Submittals:
    a. Catalog data for conduit, conductors, fittings, junction/terminal boxes, motors, motor controllers, and other electrical equipment.
    b. Cable list that includes all power, control, signal, and communications cable requirements.
    c. Electrical load list including all loads and their locations.
4. Instrumentation and Control System Submittals:
    a. Catalog data for all instrumentation and control system components.
    b. List of miscellaneous items, cables, spare and replenishment parts, and chemicals to be provided, including material safety data sheets (MSDSs).
    c. Piping and Instrumentation Diagram (P&ID) schematic representation of the process equipment and piping; instrumentation; control system interconnection.
    d. Panel layout diagrams indicating physical panel layout of components drawn to scale for interior and exterior sectional views. Show location of conduit entry. Include Bill of Material and cross-identify panel components with the Bill of Material.
    e. Panel wiring diagrams showing detailed internal and external wiring for the panel. Clearly distinguish between skid factory wiring, skid interconnection wiring, and external wiring.
5. Elementary Diagram: Show the wiring of instrument and electrical control devices in elementary ladder or schematic format. A single line diagram is acceptable.
6. Power Calculations: Spread sheet of the panel loads (volt-amps) for each power supply (AC and DC).
7. Control System PLC: Outline the fundamental logic of how the PLC interacts with equipment including control, alarms, shutdown interlocks, monitoring, and data communication.
8. Assembler's Installation Instructions: Submit anchoring details and service clearances required. Provide recommendations for short-term storage prior to installation.
9. Assembler's Certificate and Warranty: Certify that products meet or exceed specified requirements and provide an equipment warranty including the warranty provisions specified herein.
10. O&M Manuals: Submit operations and maintenance manuals for all equipment. Assembler shall compile all O&M submittals from suppliers and manufacturers. The manual shall be supplemented with text describing the system O&M.

1.05 PERMITS

A. Air Discharge approval for the operation of the SVE and oxidation system will be obtained by the Owner.

B. The Contractor shall submit a Critical Lift Plan in accordance with the requirements in the Port of Seattle Construction Safety Manual for crane operations to unload and place the equipment skids if crane is used.

1.06 RELATED WORK SPECIFIED ELSEWHERE

A. Well Installation

B. Electrical

C. Thermal/Catalytic Oxidizer

D. Earthwork

E. Piping and Wellheads

1.07 QUALIFICATIONS

A. Assembler: Company specializing in assembling air sparging and soil vapor extraction equipment skids specified in this section with minimum ten years' experience.

B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect skid packages from damage at all times.

B. Loading, transportation, unloading, and installation shall be provided by the Contractor from the assembler to the installation location.

1.09 EXTRA MATERIALS

A. Spare and extra parts that are typically replaced during routine maintenance shall be identified for all products. Provide spare parts anticipated for the first year of operation. Include spare parts information in Operation and Maintenance Manuals.

1.10 EQUIPMENT ENCLOSURE

A. All equipment must fit into the space shown as the Equipment Enclosure Area on the Drawings.

1.11 ELECTRICAL SUPPLY

A. Existing Service Capacity: Blower packages, thermal/catalytical oxidizer and pumps must be capable of operating on a single 480 volt, 100 amp, 3 phase, and 60 hertz circuit.

1.12 WIRING

A. All equipment will be wired per UL and NEC.

B. Wiring will be per NEC for Class I, Division 2, Group D hazardous environment within 18 inches of all SVE equipment, and will be non-classified elsewhere.

1.13 GROUNDING

A. Where required by NEC, UL, and local codes, provide ground fault protection and grounding of equipment.

B. Provide required grounding and continuity testing for grounded structures and components.

PART 2 PRODUCTS

2.01 GENERAL

A. Sea Water Corrosion Resistance: All products will be installed outside, exposed to weather, within 100 feet of a marine surface water body. Material selection and design should be based on providing a 10 year design life under these conditions.

B. Storm Water Protection: No galvanized metal surfaces shall be exposed to the atmosphere.

C. Valves: All valves will be constructed with PTFE seats.

2.02 AIR SPARGE PACKAGE

A. Assemblers: Seneca Companies, H2K Technologies, Intellishare, Anguil, Enviro-Equipment, or Approved Equal.

B. Basic Unit:

1. Blower: Positive displacement blower capable of delivering 120 standard cubic feet per minute (scfm) at 9 pounds per square inch gauge pressure (psig).
2. Variable Frequency Drive (VFD): Provide a VFD capable of adjusting the motor speed of the blower to reduce or increase the blower output.
3. Programmable logic controls: Provide logic controls to allow programming of 4 electrically actuated ball valves to provide on/off control for up to 4 air sparge zones.
4. Manifolds: Provide manifolds for 3 air sparge zones as shown on the Drawings. Provide a blind 4th line and space to add a 4th manifold zone for up to 10 sparge points.
5. Skid:
    a. Continuously welded (fillet and bevel weld) steel construction
    b. Polyuria spray coating
    c. Forklift channels and lift points to facilitate either forklift or crane movement and placement.
6. Blower Sound Enclosure
    a. Insulated and capable of reducing noise level to 70 dB within 10 feet of the outside of enclosure when sealed.
    b. Steel or aluminum construction.
    c. Access doors or removable sides for easy blower access and maintenance.
    d. Vent fan to prevent blower from overheating.

C. Blower:

1. Inlet air filter with replaceable element of blower intake and differential pressure gauge
2. Flexible couplings for vibration isolation on inlet and outlet

3. Discharge silencer/stand, reactive silencer
4. Silencer on blower intake
5. Pressure relief valve, check valve, temperature gauge, pressure gauge, and pressure switch on discharge.
6. Outlet oil filter to minimize oil discharge into the air sparge piping.

D. Heat Exchanger:

1. Capable of reducing blower discharge temperature to within pressure rated operational temperature range for SDR11 HDPE sparge pipes.
2. Temperature gauge, pressure gauge, and temperature switch on outlet

E. Manifold:

1. Schedule 40 painted steel
2. Bleed air line with gate valve and silencer
3. Labels for each zone and each sparge line
4. Each zone of the manifold will be controlled using an electrical actuated brass ball valve
5. Manual controls for each sparge line shall include:
    a. Brass globe valve
    b. Visible float acrylic rotameter with end connections or vane rotameter capable of measuring flows between 0 and 20 scfm.
    c. Pressure gauge

2.03 VAPOR EXTRACTION PACKAGE

A. Assemblers: Seneca Companies, H2K Technologies, Intellishare, Anguil, Enviro-Equipment, Or Approved Equal.

B. Basic Unit:

1. Blower: Explosion-proof blower with Class 1, Division 2 motor capable of extracting 340 scfm at 70 inches water column.
2. Variable Frequency Drive (VFD): provide a VFD and interface capable of adjusting the motor speed of the blower to reduce or increase the blower vacuum and flow.
3. Manifolds: Provide manifolds to 9 soil vapor extraction wells as shown on the Drawings. Provide a blind line and space to add piping, instrumentation, and valves for up to 2 soil vapor extraction wells.
4. Skid:
    a. Continuously welded (fillet and bevel weld) steel construction
    b. Industrial polyurethane enamel finish
    c. Forklift channels and lift points to facilitate either forklift or crane movement and placement.
5. Blower Sound Enclosure:

        a. Insulated and capable of reducing noise level to 70 dB within 10 feet of the outside of enclosure when sealed.
        b. Steel or aluminum construction.
        c. Access doors or removable sides for easy blower access and maintenance.
        d. Vent fan to prevent blower from overheating.
    6. All components in contact with the air and liquid stream must be resistant to petroleum fuels.

C. Blower:
    1. Inlet and Outlet silencers
    2. Sample port on discharge (1/4-inch brass ball valve)
    3. Pressure gauge and pressure switch on blower discharge
    4. Temperature gauge on blower intake and discharge
    5. Pitot tube flow meter on inlet before bleed air

D. Manifold:
    1. Schedule 40 painted steel or Schedule 80 PVC
    2. Labels for each vapor extraction line
    3. Manual controls for each vapor extraction line shall include:
        a. Diaphragm valve
        b. Vane rotameter flow meter
        c. Pressure/vacuum gauge
        d. Sample port (1/4-inch brass ball valve)

E. Moisture Separator
    1. Tangential inlet and demister for >99% moisture removal
    2. Minimum of 40-gallon holding capacity
    3. 17 inches Hg vacuum design rating
    4. Clear sight glass with low and high level switches used to automatically control the integrated water transfer pump.
    5. High-high level switch used to automatically shut down required system components in the event of a high-high level condition.
    6. Drain valve
    7. 12-inch access port located on the side of the tank to facilitate cleaning.
    8. Vacuum gauge on inlet
    9. Ball valve on inlet
    10. Sample port (1/4-inch FNPT ball valve) on inlet
    11. Vacuum relief valve on tank

12. Low vacuum switch on inlet
13. Forklift channels and lift points to facilitate either forklift or crane movement and placement.
14. Integrated centrifugal water transfer pump with Class 1, Division 2 motor capable of 20 gallons per minute and total head of 40 feet.
15. All components in contact with the air and liquid stream must be resistant to petroleum fuels.

F. Condensate Storage Tank
    1. 2,000-gallon polyethylene storage tank with lid
    2. Piped to receive discharge from water transfer pump
    3. High level alarm
    4. High-high level switch used to automatically shut down required system components in the event of a high-high level condition
    5. Access port to allow draining of tank using a vacuum truck hose

G. Air Dilution Intake Line
    1. Gate valve
    2. Filter silencer
    3. Inline filter with replaceable 10 micron element
    4. Differential pressure gauge across filter

2.04 CONTROL PANEL

A. NEMA 4X, mounted and wired in a non-classified area on the AS or SVE skid. Must be located at least 18 inches from blower or blower piping outside of sound enclosure.

B. To control sparge blower skid, SVE blower skid, water transfer pump, and apparatus.

C. To be interlocked with control panel for thermal/catalytic oxidizer.

D. Inner door for switches and indicators.

E. Motor starters and overloads for blowers, fans, and pumps.

F. Direct logic programmable logic controller.

G. Hand-Off-Auto switches for blowers, fans, and pumps.

H. Hour meters for blowers

I. Phase monitor for incoming power

J. Light (red/LED) alarms

K. Push button alarm resets

L. Lightning surge protectors

M. Intrinsically safe barriers

N. Engraved laminated legends for all door mounted devices

O. Terminal blocks for external connections and fusing, as required

P. Color-coded wiring with wire markers for all terminations

Q. Full documented, assembled, wired, programmed, and pre-shipment tested

R. UL 698A serialized label

S. GFCI 20A outlet with weather proof cover mounted adjacent to control panel with circuit breaker (120V, single phase, 15A)

T. Integrated cellular signal alarm notification system.

2.05 PANEL BOARD

A. NEMA 4X enclosure mounted next to control panel

B. Main power circuit breaker

C. Circuit breakers for sparge blower, SVE blower, pumps, heat exchanger fan, and sound enclosure fans

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

A. Skid mounted packages shall be protected from damage during delivery, offloading, and storage.

3.02 INSTALLATION

A. The skid mounted packages shall be handled and installed in accordance with assembler's recommendations. All material shall be inspected for defects before and during installation. Material found to be defective shall be replaced with sound material.

B. Manufacturer's representative shall inspect all components and be present during initial start-up and shakedown.

3.03 AUTOMATIC SYSTEM SHUTDOWN

A. The following automatic shutdowns shall be incorporated into the control system. Systems shall not auto-restart after self-shutdown. Light alarms shall be installed to notify personnel that a shutdown has occurred.

B. SVE SHUTDOWNS

1. High temperature in the exhaust from the blower
2. High-high water level in the moisture separator
3. Thermal/catalytic oxidizer shutdown or temperature outside manufacturers' recommended operating temperatures
4. Thermal overload of the SVE blower motor
5. Low vacuum
6. High-high level in the water storage tank

C. AS SHUTDOWNS

1. Thermal/catalytic oxidizer shutdown or temperature outside manufacturers' recommended operating temperatures

2. SVE shutdown
3. Over pressure on AS blower discharge
4. Thermal overload of AS blower motor

3.04 AS BUILTS

A. Contractor shall record all field changes on the Contract Drawings using red ink and provide these changes to the Engineer after installation completion.

3.05 FIELD QUALITY CONTROL AND START-UP SUPPORT

A. Assembler shall provide field quality control, including:

1. Calibrate instrumentation
2. Demonstrate operation of all valves and instrumentation
3. Demonstrate operation of all alarms and emergency shutdown procedures
4. Demonstrate operation of cellular signal alarm notifications system
5. Demonstrate operation of systems and controls

B. Assembler shall be provide field orientation and support until system has been in full (AS, SVE, and oxidizer), continuous operation for 24 consecutive hours.

3.06 WARRANTY

A. Materials, equipment, and workmanship shall carry a one year warranty against defects in material and workmanship. Failure which may develop due to defective or improper material, equipment, or workmanship shall be made good, forthwith, by and at the expense of the contractor, including damage done to areas, materials, and other systems resulting from this failure.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for “AS/SVE System Install” shall be as a lump sum unit.

4.02 PAYMENT

A. Payment for “AS/SVE System Install” will be made at the Contract lump sum price as stated in the Schedule of Prices and will be full compensation for furnishing all labor, equipment, testing, and incidentals required to accomplish the installation and startup of the AS/SVE System as specified. Cost associated with the installation of the AS/SVE system wells and piping installed in the utility trench and to the AS/SVE wells is not included in the “AS/SVE System Install” item.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. This section includes general requirements for the Thermal/Catalytic Oxidizer. All materials shall be as specified or approved equal. The Contractor shall design and specify the system to be provided for approval by the Engineer.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. National Electrical Code (NEC)
B. National Fuel Gas Code, NFPA 54, ANSI Z223.1
C. Standard on Incinerators and Waste and Linen Handling Systems and Equipment, NFPA 82
D. Standard for Exhaust Systems for Air Conveying Vapors, Gases, Mists, and Particulate Solids, NFPA 91
E. Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances, NFPA 211

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers' technical literature, standard details, product specifications, and installation instructions for all products. Submittals shall include the following:

1. Product Data: Basis of unit selection, process logic, optimization plan, estimate of percent destruction, estimated propane gas use rate, electrical one line diagram, and electrical schematic of control panels
2. Manufacturer's publications to include: Technical specifications, installation guidelines, operational recommendations, certifications, Warranties
3. As-Built Drawings
4. Operation and Maintenance manual(s)

1.04 PERMITS

A. Air Discharge approval for operation of the AS/SVE system will be obtained by the Owner.

1.05 INFLUENT AIR QUALITY

A. Soil vapor samples from 5 site monitoring wells (MW-42, 39A, 36A, 93 and MW-59) were collected on October 25 and 26, 2017 for analysis of volatile organic carbons (VOCs, Method TO-15) and petroleum hydrocarbons (MA-APH). Results indicate that vapor treatment is required prior to discharge to the atmosphere. Results are included in Table 1.

Table 1: Soil Vapor Results

	MW-36A	MW-39A	MW-42	MW-59	MW-93
	10/26/2017	10/26/2017	10/25/2017	10/25/2017	10/26/2017
	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
Volatile Organic Compounds (TO-15 Method)					
Benzene	160 U	**140,000**	**14,000**	160 U	3,700 U
Cyclohexane	**23,000**	**2,900,000 E**	**280,000**	3,400 U	**530,000**
Cyclopentane	140 U	**270,000**	**14,000**	140 U	**13,000**
Ethylbenzene	220 U	**9,300**	5,600 U	220 U	5,000 U
Hexane	**21,000**	**3,200,000 E**	**300,000**	1,800 U	**670,000**
Pentane	**30,000**	**3,300,000 E**	**330,000**	1,500	**940,000**
Propene	**500**	8,600 U	8,900 U	350 U	7,900 U
Massachusetts Air Petroleum Hydrocarbons (MA-APH)					
EC5-8 aliphatics	**2,700,000 E**	**86,000,000 E**	**12,000,000**	**420,000**	**14,000,000 E**
EC9-12 aliphatics	**270,000**	**1,000,000**	910,000 U	**190,000**	800,000 U
EC9-10 aromatics	25,000 U	620,000 U	650,000 U	25,000 U	570,000 U

Notes:
E - exceeded the calibration range
U - not detected above the reporting limit
Bold = detection
ug/m^3 = micrograms per cubic meter

1.06 QUALITY ASSURANCE

A. Treatment destruction shall be 99% or greater in thermal mode and 98% or greater in catalytic mode.

B. Treatment system shall perform in compliance with all Washington State Puget Sound Clean Air Agency guidelines and permit requirements.

C. Installation of the thermal/catalytic oxidizer shall be complete and the system operational prior to completion of the Soil Vapor Extraction/Air Sparge system. Point source release of untreated off-gas shall be avoided to the maximum extent consistent with completion of the contract. Sampling and analyses to demonstrate system performance and emission compliance shall be performed in accordance with Section 01 45 29 Independent Testing and Inspection Service.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.08 FIELD MEASUREMENTS

Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide a thermal/catalytic oxidation system as a complete unit process for destruction of organic contaminants carried in the vapor. Equipment shall be new and unused and include, but shall not be limited to, a complete and operational thermal/catalytic oxidation system, including supporting equipment and accessories. An automatic dilution valve and blower shall be included with the oxidizer. This blower shall be independent of the SVE blower.

B. Provide the thermal/oxidation system in conformance with section 60.18 of 40 CFR 60. Provide vertical and lateral supports for the stack in accordance with NFPA 82 and NFPA 211, as applicable, for the wind forces indicated. Design the system for the following parameters:

1. The thermal oxidizer shall meet the following general requirements:
    a. TBD – record keeping/PLC/LEL meter, air prover switch, stack height details and design
    b. Design flow rate = 350 scfm
    c. Electrical – equipment shall operate using main input of 460/230 volts, 3-phase, 60 Hertz. Maximum amperage must be coordinated with AS/SVE system so that the maximum total amperage is at or below 100 Amps.
    d. Propane gas supplemental fuel, 2-5 psig operating, 7 psig static maximum
    e. Skid mounted
    f. Outdoor operation
    g. Maximum LEL throughput: 25% or 50%
    h. Design and constructed for conversion to a catalytic oxidizer
    i. Catalytic Operating Temperature: 600 to 1,000 °F
    j. Catalyst Module: Selected and sized by manufacturer based on vapor composition identified in Table 1
    k. Low noise (<80db @ 3 meters)
    l. Auto shutdown for the following conditions:
        (1) High/low gas pressure (under 6 inches water {i.w.} and over 23 i.w.)
        (2) Loss of flame
        (3) Non-ignition
        (4) High/low temperature limit
        (5) Power interruption
        (6) Burner power failure
        (7) SVE system shutdown
        (8) Influent gas concentration in excess of 50% of the LEL, if 50% LEL throughput is the selected design configuration

2. The thermal oxidizer shall be composed of a horizontal enclosed combustion chamber, with catalyst (provided by not installed), that maintains a constant temperature by controlling fuel and combustion air. Catalyst shall be fabricated in modules for ease of installation in the combustion chamber. Thermal oxidizer shall be compatible with a reduced temperature operation with the catalyst in place and high temperature operation without using the modular catalyst unit.

PART 3 EXECUTION

3.01 Installation

A. A control cable inside steel conduit shall be installed and connected to the AS/SVE control panel to coordinate auto shutdown of the SVE system and oxidizer unit.

B. The oxidizer unit shall not auto restart after auto shutdown.

C. The manufacturer shall inspect and approve installation and be present during initial startup and testing.

D. Installation includes installing the associated two (2) - 1,000 gallon propane tanks shown on the drawings. The tanks shall be anchored and bollards installed prior to operation of the oxidizer.

E. Oxidizer shall be anchored following manufactures recommendations.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for “Thermal/Catalytic Oxidizer” shall be as a lump sum unit.

4.02 PAYMENT

A. Payment for “Thermal/Catalytic Oxidizer” will be made at the Contract lump sum price as stated in the Schedule of Prices and will be full compensation for furnishing all labor, equipment, testing, tanks, and incidentals required to accomplish the installation and startup of the Thermal Oxidizer as specified.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Electrical Work” Work is shown in the Contract Documents. This Section includes general requirements for accomplishing electrical Work as specified herein and indicated on the Drawings.

1.02 GOVERNING CODES, STANDARDS AND REFERENCES

A. FAA (Federal Aviation Administration)

B. NEC (National Electrical Code)

C. Port of Seattle Construction Health & Safety Manual Confined Space Entry Program

D. Port of Seattle Construction Health & Safety Manual Energized Electrical Work plan

E. Port of Seattle Construction Health & Safety Manual Lock-out Tag-out Policy

F. Port of Seattle Electric Shop

G. Port of Seattle Electrical Safety Rules

H. Port of Seattle Electrical Supervisor

I. Port of Seattle Health & Safety Manuals

J. Port of Seattle for highway signage, flagging, and re-routing traffic

K. Power Company

L. State of Washington Dept. of Labor & Industries.

M. Underwriters Laboratories, Inc.

N. WAC 296-44

O. WAC 296-45

P. State requirements for highway signage, flagging, and re-routing traffic

Q. State of Washington safety rules and health standards

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions.

B. Submittals shall include the following:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Manufacturer Approval Drawings: Equipment that is laid out, configured, or designed by manufacturer based on performance specifications only shall be submitted to the Engineer for approval prior to release of drawings for manufacturing.

C. Ordering Materials: Order materials within two (2) weeks of receiving reviewed submittals from the Engineer. Provide proof of order placement upon request. Failure to comply will be considered non-performance and progress payments will be suspended until proof of order placement is reviewed and accepted by the Engineer.

1.04 DRAWINGS

A. The electrical drawings are diagrammatic and are not intended to show all raceway, wiring, exact locations of equipment, terminations, or number or types of fittings required by the electrical system. Provide all related electrical Work which is specified herein, diagrammed or scheduled on the electrical drawings, required by code enforcing agencies and as indicated on other details or elevations for complete and operating electrical systems. Since the drawings are made at a small scale, outlets, devices, equipment, etc. are indicated only in their approximate location unless dimensioned or otherwise indicated. Locate outlets and apparatus symmetrically on floors where not dimensioned and as indicated and coordinate such locations with the Work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings. Refer to Civil and equipment shop drawings and project drawings for dimensions as applicable.

1.05 PRODUCTS

A. General: Products are specified by manufacturer name, description, and/or catalog number to show intended function and quality. Report discrepancies, such as discontinued equipment or catalog numbers, to the Engineer prior to bidding. If the Contractor is unable to interpret any part of the plans and/or specifications, he shall notify the Engineer, who will issue interpretation and/or additional clarifications to Bidders before the project is bid.

B. Manufacturers: Provide only equipment specified in the Contract Documents or approved by addendum. Manufacturers' catalog numbers and descriptions establish the quality of product required.

C. Warranty: Comply with Section 01 78 36 - Warranties and Bonds. Warranty shall be manufacturer’s standard or a minimum of one year unless noted otherwise in Division 26 Electrical Sections.

1.06 SUBSTITUTIONS

A. Comply with Section 01 25 00 - Substitutions.

1.07 QUALITY ASSURANCE

A. All materials shall be new, unless noted otherwise. Properly store all materials and equipment for protection from physical damage or damage due to corrosion.

B. Review accessibility of equipment for operation, maintenance and repair prior to installation. Proceed with installation only after unsatisfactory conditions have been corrected

C. Equipment Manufacturer Qualifications: Equipment manufacturers shall have at least 10 years experience in manufacturing products and accessories similar to those for this Project, with a record of successful in-service performance.

1.08 COORDINATION AND SCHEDULING

A. Comply with Section 01 32 16 - Bar Chart Schedule.

B. Coordinate and schedule electrical Work with the Work of other trades. Every reasonable effort shall be made to prevent conflicts as to space requirements, dimensions, locations, code required working spaces, access openings, drawout and removal spaces or other matters tending to obstruct or delay the Work of other trades. All changes caused by failure to coordinate shall be made at the Contractor's expense.

1.09 SAFETY AND PROTECTION

A. Safety Measures To Be Taken: The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to the means, methods, techniques, sequences or procedures required for the Contractor to perform his Work. The Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the Work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Engineer to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures, in, on or near the construction site. It shall be the Contractor's responsibility to comply with applicable safety and health regulations for construction. The Contractor shall consult with the state or federal safety inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist or whether they are or are not in compliance with state or federal regulations.

B. Protection: The Contractor shall take whatever measures are required to ensure that electrical safety and protection are maintained, including the proper covering, signage, and securing of “live” circuits.

C. Comply with Port of Seattle Construction Health & Safety Manuals and with applicable State of Washington safety rules and health standards, including WAC 296-44, WAC-294-45, and the Port of Seattle “Electrical Safety Rules.” Any violation shall result in a warning citation.

D. The Port of Seattle “Electrical Safety Rules” are as follows:

1. Work on Electrical circuits operating at over 50 volts, phase to ground, or greater shall be conducted in accordance with Port of Seattle Construction Health & Safety Manual Energized Electrical Work plan.
2. Power Outages: Any essential outages required in the course of construction, whether for temporary services, cutovers, or testing, shall be closely coordinated with the Engineer and shall occur at times approved by the Port by means of shutdown notification request. Contractor to identify all systems affected and provide copy of panel schedules of panelboards affected by shutdown notification request.
3. Electrical circuits operating at over 300 volts phase to ground, or circuits serviced by a transformer over 150 kVA, shall be de-energized before proceeding with the Work.

4. Electrical circuits shall be considered de-energized only after compliance with the Port of Seattle Construction Health & Safety Manual Lock-out Tag-out Policy and under the following conditions:
    a. Switches connecting subject circuit to the energy supply are observed in the “open” position, with an air break, and locked and tagged out in accordance with Port of Seattle Construction Health & Safety Manual Lock-out Tag-out Policy.
    b. Electrically operated switches are visibly “open”, blocked or racked in the “open” position, and locked and tagged out “open”.
    c. If the supply circuit break is not visible and clearly identified, the circuit shall be grounded. If the ground connection is not within sight of the Work area, the ground connection shall be locked and tagged out before proceeding with the Work.
    d. Oil switches are observed “open” in a sight window and locked and tagged out “open,” or fuse carrier is removed in oil fuse cutouts and locked and tagged out “open.”
5. Use of Red Safety Tags
    a. For protection of personnel working on circuits, safety tags shall be filled out and attached to any opened switch or equipment.
    b. Safety tags shall be removed only the by the Port of Seattle employee who placed the tag, or by another Port of Seattle employee who has been authorized to remove the tag in writing by the employee who placed the tag. The Port of Seattle Maintenance Electrical Systems Manager or his designated representative may authorize removal of a safety tag placed by an employee who is not available to remove the tag at the time of need only after carefully checking that the circuit is ready to be energized.
    c. Equipment with a safety tag attached shall not be operated, and connections with a safety tag attached shall not be changed.
6. Insulated cables, operated at over 300 volts to ground, shall be handled when energized only with rubber gloves tested to 22,000 volts by a Washington State approved testing laboratory.
7. Insulated cables that have been in operation shall be cut only with grounded cable shears, or shall be grounded by driving a grounded sharp tool through the shielding and the conductors before cutting.
8. All personnel working around energized electrical equipment operating at over 750 volts or more shall wear standard insulated, non-conducting hard hats and shall wear fire retardant garments with no metallic zipper fasteners.
9. Ladders used in any electrical Work shall be of wood or fiberglass construction.
10. All panelboards, junction boxes, electrical devices and other similar equipment which is being worked on and which have exposed live wires, bus bars, or terminals operating above 50 volts shall be covered adequately for the voltage with an electrical insulating material and labeled

with a “Caution” sign when Contractor personnel are not present. The Caution sign shall advise that exposed electrical parts are behind the temporary protective cover.

11. Contractors engaged on Port of Seattle projects or working on Port of Seattle property shall be governed by Port of Seattle rules. The Contractor shall place their lock and tag only after Port of Seattle Electric Shop or designee has placed a lock and tag. The Contractor shall designate a supervisor for all contract personnel and operations. This supervisor shall be on the job whenever contract operations are in progress.

E. Comply with the following procedures for medium-voltage manhole access:

1. Contact Port Electrical Shop through Seaport Maintenance Dispatch (206) 728-3350 prior to entering any manhole. After hours answering service will call out maintenance for after-hour manhole access.
2. All switching of the medium-voltage system must be approved in advance and coordinated through the Electrical Shop.
3. Schedule requests for Electrical Shop assistance a minimum of seven (7) days in advance.
4. Comply with Port of Seattle Construction Health & Safety Manual Confined Space Entry Program, lock and tag out procedures, and all other applicable State safety requirements.
5. Complete a confined space entry permit for each entry. Submit to the Engineer.
6. Ventilate and monitor the confined space. A top man is required at all times.
7. Complete lock and tag out once line clearance has been given, and attach locks and tags to any opened switch or equipment. Submit tags to Electrical Shop upon completion of the Work.
8. Provide effective barriers to prevent others from falling into the open vault. Close and secure vaults when not attended.
9. Comply with Port of Seattle and State requirements for highway signage, flagging, and re-routing traffic. (Refer to Section 01 55 26 - Traffic Control.)

F. Before entry is made into energized electrical cable vaults or manholes, an infrared tester shall be used to scan the cables and connector components. If a temperature difference of 10 degrees Fahrenheit is detected between the cable and connector components, or any reading greater than 140 degrees Fahrenheit is detected from the cables or components the entry shall not be made! The Contractor shall notify the Engineer and the POS Electrical Shop.

1.10 ELECTRICAL SERVICE

A. Temporary Electrical Construction Service: Comply with Section 01 50 00 - Temporary Facilities and Controls.

B. Continuity of Service: Provide temporary service to existing systems as required to maintain continuous operation without reducing equipment efficiency. Coordinate the extent of temporary services with the Engineer.

C. Power Outages: Outages shall be kept to an absolute minimum. Any essential outages required in the course of construction, whether for temporary services, cutovers, or testing, shall be closely coordinated with the Engineer and shall occur at times approved by the Port.

1.11 DEMOLITION

A. General: De-energize circuits in demolition areas to ensure a safe condition.

B. Existing material that is not to be reused or is not requested by the Port to be retained shall be removed from the site and shall become the property of the Contractor for salvage. All materials removed from the site shall be disposed of at facilities licensed for the material.

C. In areas of where alterations are to be done, existing conduits may be reused, with the approval of the Engineer, in their original location, unless noted otherwise.

  1. Wiring that is discovered with damaged or deteriorating insulation shall be replaced with new.
  2. No existing conduit or wiring once removed may be reused, unless noted otherwise.

D. Remove all unused exposed conduit except where located in or above existing construction, which is not being altered and would require removal and replacement of the existing construction.

1.12 ELECTRICAL EQUIPMENT INSTALLATION

A. Comply with Division 1 General Requirements Sections for environmental regulatory requirements, quality control, construction facilities and temporary controls, traffic control, access control, and signage requirements.

B. Provide electrical connection of all equipment having electrical requirements. Refer to Division 26 Electrical for motor starters and controls furnished integrally with equipment.

  1. Make electrical connections in accordance with manufacturer's written instructions, with recognized industry practices, and complying with requirements of the National Electrical Code.
  2. Verify all electrical loads (voltage, phase, full load amperes, number and point of connections, minimum circuit capacity, etc.) for equipment furnished under other divisions of this specification by reviewing respective shop drawings furnished under each division.
  3. Meet with each subcontractor furnishing equipment requiring electrical service to review electrical characteristics for each equipment item before rough-in begins. Report any variances from electrical characteristics noted on the electrical drawings to the Engineer before proceeding with rough-in Work.

C. National Electrical Code Compliance: Comply with applicable requirements of National Electrical Code as to the type of products used and provisions for electrical power connections.

D. Underwriters Laboratories acceptance: All material and equipment within the scope of the UL Re-examination service shall be approved by Underwriters

Laboratories, Inc. for the purpose for which they are used and shall bear their label.

E. Cutting and Patching: Provide and coordinate the locations of all openings required in the building construction for installation of the Work.

  1. Drill penetrations required through existing concrete slabs or walls with a diamond core drill. In no case shall any structural member be cut.

  2. Provide approved sleeves as required for electrical penetrations through floors and walls. Seal all openings around conduits in sleeves with a material of equal fire rating as the surface penetrated.

  3. Obtain written approval from a Structural Engineer licensed in the State of Washington prior to cutting any reinforcing bars.

  4. Provide weekly updated Submittal Log of all penetrations and cuts performed.

F. Equipment Bases and Fastening: Comply with seismic anchorage and bracing requirements of Section 26 05 48 - Seismic Controls for Electrical and Communication Work.

G. Equipment Accessibility: Comply with applicable codes and install equipment to be accessible for operation, maintenance or repair. Equipment deemed inaccessible shall be reported to the Engineer, and relocated as directed.

H. Electrical Work Exposed to Weather: Provide weatherproof enclosures and corrosion protection for all ferrous metal portions of electrical Work exposed to weather, including conduit, clamps, supports, and hardware.

  1. All galvanized electrical equipment exposed to the weather shall be painted to prevent leaching of zinc into the stormwater system. Paint coating shall be a minimum of 3 mils thick, and application as part of the manufacturing process is preferred over painting in the field.

1.13 EARTHWORK

A. Existing Underground Utilities: Verify, before any excavation, the location of all existing utilities in the area of new construction. Exercise extreme care with all Work adjacent to these utilities. A designated representative of the Contractor shall advise the Port of Seattle Electrical Supervisor and Power Company where they can be contacted in any emergency.

  1. Review drawings and notify the Engineer of any deviations in duct runs to avoid conflicts with existing utilities. Any changes in the Work resulting in the same quantities of trenching material shall not entitle the Contractor to any claim for an addition to this Contract.

  2. The Contractor is responsible for any damage done to existing utility installations during the course of the Work. All damaged installations shall be replaced to the satisfaction of the utility or agency involved at the expense of the Contractor.

B. Comply with the Division 1 General Requirements and Division 31 Earthwork requirements for site work, including excavation, bracing and shoring, erosion control, requirements for temporary pumping equipment, backfilling, patching and paving, sod replacement, removal of surplus material, and requirements for traffic control during construction.

1.14 PROJECT FINALIZATION

A. Fully test and adjust all equipment installed under this specification and demonstrate its proper operation.

1. Testing that involves use of instruments other than meggers and volt-ohm meters shall be performed by an independent testing agency.

B. Where circuits have been added, removed or relocated on panelboards and switchboards, the Contractor shall provide to the Port as-built panel and switchboard schedules in Port standard excel format. Coordinate submittal of schedules with Port Construction Manager.

C. Present the Port with Certificate of Inspection from the Authorities Having Jurisdiction upon completion of the Work stating that all Work complies with all applicable Codes and Ordinances.

D. Comply with Division 1 General Requirements for cleaning, closeout procedures, commissioning, training, operations and maintenance manuals, and record drawings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for “Electrical - Conduits, Wiring, Grounding, and Hardware” shall be as a lump sum unit.

4.02 PAYMENT

A. Payment for “Electrical - Conduits, Wiring, Grounding, and Hardware” will be made at the Contract lump sum price as stated in the Schedule of Prices and will be full compensation for furnishing all labor, equipment, and incidentals required to accomplish the installation as specified.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “600 Volt or Less Wire and Cable” Work is shown in the Contract Documents. This section includes requirements for insulated copper stranded conductors and associated connections for general power and control use at voltages below 600 volts, for sizes #14 AWG through 750 kcmil.

1.02 GOVERNING CODES, STANDARDS AND REFERENCES

A. ASTM B3 (American Society for Testing and Materials) – Standard Specification for Soft or Annealed copper Wire

B. ASTM B8 (American Society for Testing and Materials) – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. NECA (National Electrical Contractors Association) - National Electrical Installation Standards

D. ANSI/NEMA WC 70/ICEA S-95-658 – Power Cables Rated 2,000 V or Less for the Distribution of Electrical Energy

E. NFPA 70 (National Fire Protection Association) - National Electrical Code

F. NETA (International Electrical Testing Association) – Acceptance Testing Specifications

G. UL 44 (Underwriters Laboratories) - Thermoset-Insulated Wires and Cables

H. UL 62 (Underwriters Laboratories) – Flexible Cords and Cables

I. UL 854 (Underwriters Laboratories) – Service-Entrance Cables

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for each type of product.

B. Submittals shall include the following:

1. Field Test Reports: Submit reports on tests required in Part 3.

1.04 QUALITY ASSURANCE

A. All wire and cable shall be new and made of copper. No aluminum wire and cable allowed, unless otherwise noted.

B. Listing and Labeling: Provide wire and cable that are Listed and Labeled as defined in NFPA 70, Article 100 and marked for specific types, sizes, and combinations of conductors and connected items.

C. Comply with NFPA 70, as adopted and administered by F&I.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cables according to NEMA WC 26.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire and Cable
2. American Insulated Wire Corp.
3. BICC Brand-Rex Company.
4. Carol Cable Co., Inc.
5. Southwire Company.
6. Or Approved Equal

2.02 PRODUCTS

A. Provide wire and cable with conductor material and insulation type as specified in Part 3.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2, Type THHN-2-THWN-2, Type XHHW-2, Type UF, Type USE, and Type SO.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for, mineral-insulated, metal-sheathed cable, Type MI, Type SO and, Type USE with ground wire.

E. Flexible Metal Clad (Type MC) wiring shall not be used for general wiring purposes.

2.03 CONNECTORS AND SPLICES

A. UL listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project’s installation requirements and as specified in Part 3 “Wire and Insulation Applications” Article.

B. For #14 through #10 AWG wire sizes, provide insulated spring wire connectors or insulated compression connectors.

C. For #8 AWG wire, use solderless pressure connectors with insulating sleeves.

D. For #6 AWG and larger cable, use split bolt connectors with manufactured insulation covers or tape sufficient to provide 150% insulation level. As an option, compression connectors are acceptable using compression dies designed for the exact connector being used. Provide insulting sleeves manufactured specifically for the connector being used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine raceways and building finishes, to receive wire and cable for compliance with requirements for installation tolerances and other conditions affecting performance of wire and cable. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRE AND INSULATION APPLICATIONS

A. Use THHN/THWN stranded copper for all wet and dry interior locations.

B. Use XHHW stranded copper for all exterior locations.

C. Grounding conductors: #6 AWG and larger shall be stranded copper, bare soft drawn. #8 and smaller shall be stranded copper with green insulation.

D. Provide plenum and/or tray rated cable where required by the application.

E. NO ALUMINUM WIRE ALLOWED.

F. Provide lead-free jacketing and/or insulation where available.

3.03 INSTALLATION

A. Remove existing wire from raceway before pulling in new wire and cable.

B. Install wire and cable as indicated and according to manufacturer’s recommendations. Use NECA’s “National Electrical Installation Standards” where applicable.

C. As standard practice, route control conductors in separate raceways from power conductors. When dictated in contract document, control conductors may be routed in power raceway under the following conditions:

   1. All conductor insulation shall have a voltage rating for the highest voltage in the raceway.

   2. The largest power conductor in the raceway is #4 or smaller.

D. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary. Compound used must not deteriorate conductors or insulation. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

F. For parallel conductors of a single phase, insure that conductor lengths are equal by actual length comparison before installation.

G. Minimum conductor size for lighting and power circuits shall be #12 AWG, and for control circuits #14 AWG.

H. Provide dedicated neutrals for branch circuits. Shared neutrals shall not be allowed.

I. Provide separate raceways for 480/277V feeders/circuits and 240/120V feeders/circuits.

J. Provide phase testing for proper rotation of all motors.

K. All cables shall have their ends protected during installation.

L. Support cables according to Section 20 05 29 - Hangers and Supports.

M. Seal around cables penetrating fire-rated elements.

N. Restricted Conductors: Contractors in possession of aluminum conductors or solid copper conductors in their vehicles, storage or work areas may be removed from the site until such material is no longer on the premises.

3.04 CONNECTIONS

A. Splices in raceways are not allowed. Splice only in junction or outlet boxes in accessible locations.

B. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B (reprinted in the National Electrical Handbook Article 110-14).

   1. For bolted connections in equipment, mark lugs after torquing with red paint such that paint will be visibly disturbed if lugs are disturbed. Use copper lugs only on main circuit breakers and feeder breakers. No CU/AL lugs allowed.

C. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

D. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

E. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.05 COLOR CODING AND PHASING

A. Provide colored insulation for wires #4 AWG or smaller.

B. Color code conductors for all feeders as indicated in subparagraphs below. Provide a 2” wide minimum band of colored plastic tape, at terminations when colored insulation is not available. Tape shall be 3M Scotch No. 33, Or Approved Equal all weather vinyl plastic tape.

   1. 480-Volt, 3-phase, 3-wire systems:

Phase A (left or top)	Brown
Phase B (center)	Orange
Phase C (right or bottom)	Yellow
Ground	Green
Travelers	Pink

   2. 120/240-Volt, 1-phase, 3-wire systems (non-standard):

Phase A	Black
Phase B	Red
Neutral	White
Ground	Green

C. Control system color coding:

120 VAC Control	Red
120 VAC Control Neutral	White
DC Control (+)	Blue
DC Control (-)	Blue/White
Ground	Green

3.06 IDENTIFICATION

A. Identify wires and cables according to Section 26 05 53 - Electrical Identification.

B. Provide wire markers on each conductor in pull boxes, junction boxes and at all load connections.

3.07 FIELD QUALITY CONTROL

A. Coordinate installation and final testing with the Engineer.

B. Wire and Cable Tests: Test feeder and control circuits before they are placed in service.

1. 600-Volt Power Cable: Perform a continuity test for all cables. Megger testing for one half minute is required for all 600-volt insulated wire #2 AWG and larger using a 500-volt megger for 208- and 240-volt systems, and a 1000-volt megger for 480-volt systems. Test between phase conductors and from each conductor to ground before energizing service equipment, switchgear, switchboards, MCC’s (including all connected motors) and panelboards. Determine the values with cable disconnected at both ends. Megger wire and cable only after installation, not on the cable reel. Replace cables that do not meet Port insulation resistance requirements.

    a. Provide phasing tests:

        (1) Test and make all changes necessary to assure proper rotation of all motors.

        (2) Correct phasing and phase sequence of all circuits susceptible to being paralleled.

        (3) Perform other such phasing tests as may be required for the equipment being connected under this Contract.

    b. Using a volt/ohm meter, test all power conductors below #2 AWG for possible continuity to ground.

2. Check all control wiring for tightness of terminal contacts and continuity (especially current transformer leads) through each “run” of control circuiting. Thoroughly verify all wiring by means of battery-powered lights, buzzers, bells, or telephones. After completing these continuity checks and tests on a given control circuit, attach a temporary cardboard tag on each end of cable tested which bears the date and name of Contractor’s representative responsible for checking. Follow this procedure for each control circuit cable.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct deficiencies and retest to demonstrate compliance.
5. Record test information for all cables tested t, and provide Engineer with a copy.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Grounding” Work is shown in the Contract Documents. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this section may be supplemented by special requirements of systems described in other Sections.

1.02 GOVERNING CODES, STANDARDS AND REFERENCES

A. ASTM B8 (American Society for Testing and Materials) - Standard Specification for Concentric-Lay-Stranded Copper conductors, Hard, Medium-Hard, or Soft.

B. NFPA 70 (National Fire Protection Association) - National Electrical Code.

C. ANSI/NFPA 780 (National Fire Protection Association) - Standard for the Installation of Lightning Protection Systems.

D. ANSI/UL 96 (Underwriter's Laboratory) - Lightning Protection Components.

E. ANSI/UL 467 (Underwriter's Laboratory) - Grounding and Bonding Equipment.

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, calibration reports, and installation instructions for all products.

B. Submittals shall include the following:

1. Submit product data for the following:
    a. Grounding conductors and cables.
    b. Grounding connectors.
    c. Grounding electrodes.
    d. Ground bus.
    e. Test wells.
    f. Exothermic weld kit
2. Grounding plans and calculations for Contractor’s designed ground system.
3. Submittal log of locations where Contractor will bond grounding conductors to structural steel.
4. Field Test Reports: Submit written test reports to include the following:
    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
    d. Soil types and conditions where ground tests were performed.
5. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
    a. Test wells.

        b. Ground rods.
        c. Ground rings.
        d. Grounding arrangements and connections for separately derived systems.

1.04 QUALITY ASSURANCE

A. Listing and Labeling: Provide electrical components, devices, and accessories that are Listed and Labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authority Having Jurisdiction, and marked for specific types, sizes, and combinations of conductors and connected items.

B. Comply with IEEE 837 and UL 467.

C. Comply with IEEE Std. 142 (Green Book).

D. Comply with NFPA 70.

E. Comply with IEEE C2 for overhead-line construction and medium-voltage underground construction.

F. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductor Fittings:
    a. Erico Inc.
    b. Chance/Hubbell.
    c. Fushi Copperweld.
    d. Erico Inc.; Electrical Products Group.
    e. Framatome Connectors; Division of Bain Capital.
    f. Burndy Electrical; Division of Hubbell.
    g. Ideal Industries, Inc.
    h. ILSCO.
    i. Kearney/Cooper Power Systems.
    j. Lyncole XIT Grounding; Division of VFC.
    k. O-Z/Gedney Co.
    l. Raco, Inc.; Division of Hubbell.
    m. Thomas & Betts, Electrical; Division of ABB.
    n. Or Approved Equal.
2. Grounding Connectors and Rods:
    a. Harger

        b. Galvan
        c. Erico.
        d. ILSCO.
        e. Lyncole XIT Grounding; Division of VFC.
        f. O-Z/Gedney.
        g. Raco, Inc.; Division of Hubbell.
        h. Thomas & Betts; Division of ABB.
        i. Or Approved Equal.
    3. Acceptable Manufacturers Ground Bars
        a. Harger GBI series
        b. Erico EGBA series
        c. Or Approved Equal.

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section 26 05 19 - 600 Volt or Less Wire and Cable.

B. Material: Stranded Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation in sizes available.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, except as otherwise indicated.

G. Bare Copper Conductors: Assembly of stranded conductors, ASTM B 8.

H. Copper Bonding Conductors:

    1. Bonding Conductor: #4 or #6 AWG, stranded copper conductor, sized per drawings.
    2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Bonding Straps: Soft copper.

2.03 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Pressure Connectors: High-conductivity-plated units.

C. Bolted Connectors: Heavy-duty, copper, bolted-pressure type only.

D. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

E. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Solid copper clad steel, 3/4-inch diameter by 10-feet length.

B. Plate Electrodes: Copper, 0.10 inch thick minimum

2.05 GROUND BUS

A. Ground bus: predrilled rectangular bars of annealed copper, 1/4 inch x 4 inches in cross section with 9/32-inch holes spaced 1-1/8 inches apart arranged to allow for two-point termination of ground lugs. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V Size and location as shown on drawings.

  1. Provide a 12" long bus bar for small telecom and electrical rooms and closets. Provide a 20" long for large telecom rooms. Ground bar shall have double holes for two-point termination of lugs.

PART 3 EXECUTION

3.01 APPLICATION

A. Copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Manholes: Use bolted pressure clamps with at least two bolts.

F. Underground Grounding Conductors: Install bare stranded copper conductor, size as indicated on drawings.

  1. Copper conductor, #4/0 AWG minimum. Bury at least 24 inches below grade.
  2. Ductbank Ground Conductors: Install a #4/0 AWG bare copper conductor embedded in concrete of each medium voltage ductbank.

3.02 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in raceways with all feeders and branch circuits unless otherwise noted.

C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

D. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate insulated equipment grounding conductor with supply branch-circuit conductors.

3.03 INSTALLATION

A. Ground Rods: Install ground rod and connect to the service grounding electrode conductor.

1. Drive ground rod until top is 2 inches below finished floor or final grade.
2. Connect ground rod to grounding electrode conductors using exothermic weld, except as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment.

1. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp.
2. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts.
3. Install straps only in locations accessible for maintenance.

D. Test Wells: Drive ground rod through drilled hole in the bottom of the handhole. Ground rod shall be at a minimum 12” deep. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

E. Metallic Fence and Railing: Comply with the requirements of IEEE C2, current edition.

1. Grounding conductor shall be bare copper not less than 8 AWG.
2. Gates shall be bonded to grounding conductor with flexible bonding jumper.
3. Barbed wire shall be bonded to the grounding conductor.

3.04 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer’s written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For #8 AWG and larger, use pressure-type grounding lugs. #10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Provide flexible grounding strap mounted to raceway exterior where raceway crosses a seismic joint.

1. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing.

2. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer’s published torque-tightening values.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.05 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Ductbanks: Install a #4/0 AWG bare copper system grounding conductor embedded in the concrete of each ductbank. Provide a ground conductor with each feeder circuit sized per NEC.

B. Connections to Manhole Components: Connect all exposed-metal parts to ground loop conductors.

1. Connect continuous ground cable in duct bank and equipment grounding conductor in each conduit to ground loop.

3.06 IDENTIFICATION

A. Identify grounding system components as required by the Authority Having Jurisdiction and as specified in Section 26 05 53 - Electrical Identification.

3.07 FIELD QUALITY CONTROL

A. All ground system test shall be performed in the presence of the Engineer.

B. Testing: Perform the following field quality-control testing:

  1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

    b. Test by one of the following methods for resistance measurement, and correct any deficiencies detected during testing:

      (1) Perform fall of potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode or system for each substation and building.

      (2) Perform the two-point method test per IEEE No.81 Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.

      (3) Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. Conduct test by passing a minimum of ten amperes dc current between ground reference system and the ground point to be tested. Measure voltage drop and calculate resistance by voltage drop method.

    c. Test Requirements:

      (1) Equipment Rated 500 kVA and Less: 10 ohms.

      (2) Equipment Rated 500 to 1000 kVA: 5 ohms.

      (3) Equipment Rated More Than 1000 kVA: 2 ohms.

      (4) Power Distribution Units or Panelboards Serving Electronic Equipment: 2 ohms.

      (5) Substations, substation manholes, and Pad-Mounted Switching Equipment: 1 ohms.

      (6) Manhole Grounds: 10 ohms.

d. Excessive Ground Resistance: If resistance to ground exceeds specified values at any single ground location and as a collective ground system, notify Engineer promptly and include recommendations to reduce ground resistance.

4. Record test results. Provide bi-weekly Ground Resistance Test Report results to Engineer.

C. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes.

1. Identify each ground rod by letter in alphabetical order, and key to the record of tests and observations.
2. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Underground Ducts and Manholes” Work is shown in the Contract Documents. This section includes the requirements for trenching, backfilling and installation of underground conduits, ducts and ductbanks, and the design, fabrication, delivery and installation of pull boxes, handholes and manholes.

B. Definitions

1. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.
2. Ductbank: 2 or more conduits or other raceway installed underground in the same trench or concrete envelope.
3. Handhole: An underground junction box in a duct or duct bank.
4. Manhole: An underground utility structure, large enough for a person to enter, with facilities for installing and maintaining cables.
5. Vault: An underground utility structure, large enough for a person to enter, with facilities for installing, operating, and maintaining equipment and wiring.

1.02 GOVERNING CODES, STANDARDS AND REFERENCES

A. ASTM (American Society for Testing and Materials)

B. NFPA 70 (National Fire Protection Association) - National Electrical Code

C. WSDOT/APWA Specifications, Section 6-02.3

1.03 SUBMITTALS

A. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.

B. Submittals shall include the following:

1. Product data for accessories for manholes and handholes, conduit and duct, duct bank materials, and miscellaneous components.
2. Shop drawings showing details and design calculations for precast manholes and handholes, including reinforcing steel. Stamp drawings with seal of Professional Structural Engineer licensed in the State of Washington.
3. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections, drawn to scale and show bends and locations of expansion fittings. Drawing shall be signed and sealed by a qualified Professional Engineer licensed in the State of Washington.
4. Certificate for concrete and steel used in underground precast concrete utility structures, according to ASTM C 858.

5. Qualification Data: For Professional Engineer and testing agency responsible for testing nonconcrete handholes and boxes
6. Inspection report for factory inspections, according to ASTM C 1037.
7. Record Documents: Show dimensioned locations of underground ducts, handholes, and manholes from nearest building or permanent structure.

1.04 QUALITY ASSURANCE

A. Listing and Labeling: Provide products that are Listed and Labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authority Having Jurisdiction, and marked for intended use for the location and environment in which they are installed.

B. Comply with NFPA 70, as adopted and administered by the Authority Having Jurisdiction.

C. Comply with ANSI C2 “National Electrical Safety Code” for components and installation.

1.05 COORDINATION

A. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities as determined by field verification. Revise locations and elevations from those indicated as required to suit field conditions and ensure that duct runs drain to manholes and handholes. Contractor shall coordinate all modifications with the Engineer prior to final installation.

1.06 SAFETY REQUIREMENTS

A. Comply with safety and protection requirements of Section 26 00 00 - Electrical Work - General.

B. Perform Work in accordance with the safety requirements of the Department of Labor Occupational Safety and Health Administration, Volume 36, Number 75, Part II, Subpart P, “Excavations, Trenching, and Shoring,” and with Section 7 of the Manual of Accident Prevention in Construction as published by the Association General Contractors of America, Inc.

C. Educate supervisors and employees on safety requirements and practices to be followed during the course of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Conduits: Subject to compliance with requirements, provide products by one of the following:

1. Allied.
2. Cantex.
3. Calbrite.
4. Wheatland.
5. Or Approved Equal.

2.02 CONDUIT AND DUCTS

A. Metallic Conduit:

1. Galvanized Rigid Steel Conduit (GRC): ANSI C80.1
2. PVC-Coated Rigid Steel Conduit: ANSI RN 1. Coating thickness shall be 0.040 inch, minimum. Use in exposed corrosive environments.

B. Nonmetallic conduit: Use underground only for medium-voltage and low-voltage applications

1. Rigid Plastic Conduit: NEMA TC 2, UL 651A, Schedule 40 and Schedule 80 PVC, rated for use with 90°C conductors under all installation conditions and labeled for underground use.
2. LFNC: UL 1660.

2.03 CONDUIT FITTINGS

A. Steel Fittings: Zinc-coated, cast malleable, ferrous metal, threaded fittings, with neoprene cover gasket on each fitting installed outdoors.

B. PVC Conduit and Tubing Fittings: NEMA TC 3. Provide PVC fittings for PVC conduit and suitable watertight connections where PVC conduit connects to galvanized steel conduit.

C. “Mogul Fittings”: Provide “Mogul” size fittings for all conduit.

D. Seal Bushings: O.Z., Appleton, Or Approved Equal compound bushing on each conduit entering a building from outside underground and on each conduit passing from one space into another, which is normally at a lower temperature.

E. Hubs: Appleton “Hub” or “Hub-U” series, Thomas & Betts “370” series, Or Approved Equal hub on each conduit terminating in a box where a hub was not previously provided.

F. Unions: Appleton Type “EC”, Thomas & Betts “Erickson Coupling” conduit unions, Or Approved Equal where necessary.

2.04 DUCT SUPPORTS/SPACERS

A. Rigid PVC spacers selected to provide 3 1/2” minimum duct spacings and concrete cover depths indicated, while supporting ducts during concrete pour. Refer to drawing details for additional duct spacing requirements.

2.05 PULL BOXES

A. Cast Metal Boxes: Cast aluminum, sized as indicated on Drawings, with outside flanges and recessed, gasketed cover for flush mounting. Non-skid finish on cover with legend reading “ELECTRIC” or “SIGNAL” as appropriate.

2.06 DUCTBANK CONCRETE

A. Material:

  1. Gravel: 3/8” maximum.
  2. Slump: 4” maximum.
  3. Compressive strength: 3,000 psi at 28 days.
  4. Color: Dye ductbank concrete red.
  5. Reinforcing (except when GRC is used): Steel conforming to ASTM A15. Provide #4 rebar top and bottom, 2’-0” lap at splices (typical 4 places) and #4 @ 18” on center around perimeter with 3” minimum cover.

2.07 BACKFILL MATERIAL

A. Designer shall coordinate trenching and backfill with Civil trenching and backfill sections.

  1. Lower Trench Portion (surrounding ductbank): Sandy silt, clay silt, sand clay or other material free of stones and conglomerates larger than 2”
  2. Upper Trench Portion (one foot above ductbank up to grade): On-site backfill material consisting of rock, soil or soil-rock mixture containing no rocks or lumps over 6”

B. Reinforced Concrete Ductbanks:

  1. Below Concrete Encasement: 6” minimum compacted 5/8” minus crushed rock.
  2. Above Concrete Encasement: 3” minimum sand.
  3. Upper Trench:
     a. Areas Under Pavement: Controlled Density Fill.
        (1) Content: A mixture of Portland cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating and free flowing material which will result in a hardened, dense, non-settling and excavatable fill. Batch and mix in accordance with Section 6-02.3 of the WSDOT/APWA Specifications to provide a flowing, non-segregating mix with a slump between 6” and 8”.
     b. Areas Not Under Pavement: Select Native Fill.
        (1) Unsaturated excavated earth free of rocks, broken concrete and debris 6” and larger, and compacted in 12” lifts to prevent settlement.

2.08 CONTROLLED DENSITY FILL (CDF)

A. CDF shall be a mixture of Portland cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating and free flowing material which will result in a hardened, dense, non-settling and excavatable fill.

B. CDF shall be used as fill above utilities wherever non-settling backfill is required.

C. CDF shall be batched and mixed in accordance with Section 6-02.3 of the WSDOT/APWA Specifications.

D. CDF shall be batched to provide a flowing, non-segregating mix with a slump between 6” and 8”.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site to receive ducts for compliance with installation tolerances and other conditions affecting performance of the underground ducts. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Existing Utilities: Locate all existing utilities in the area prior to performing any excavation.

3.02 EARTHWORK

A. Comply with Section 31 00 00 - Earthwork.

B. Trenching:

1. Comply with OSHA/WISHA safety standards for trenching, including stable slope and shoring requirements.
2. Depth: Refer to Drawings for trench depth requirements. Correct points of over-excavation using mechanically-compacted backfill to form a smooth trench bottom. 18 inch minimum cover over top of conduit ductbank.
3. Width: Excavate to minimum width consistent with stability of sides.
4. Slope: Slope trenches so that conduit and ducts drain toward manholes and handholes and away from buildings and equipment.
5. Rock Excavation: Where rock pad is used for conduit trench, overexcavate 6” below the ductbanks and refill and compact with selected backfill material of same composition.
6. Muck Excavation: Where muck or unstable material is encountered, over-excavate and backfill to attain proper grade with coarse sand, gravel, or Controlled Density Fill.
7. Bedding: The entire bottom of the excavation is to be firm, stable, and at uniform density.

3.03 RACEWAY APPLICATIONS

A. Refer to Specifications and Drawings for raceway materials. Where not specified otherwise, use metallic conduit above and underground.

B. Metallic Conduit: Use above ground and where subject to physical damage.

C. Nonmetallic conduit: Use underground only.

1. Underground in Reinforced, Concrete-Encased Ductbanks: For low-voltage applications. Use Schedule 40 Rigid Plastic Conduit as standard. Use rigid steel conduit on turns 45° or greater. Use Schedule 80 Rigid Plastic Conduit under roadways.

2. Underground Direct-Burial: For low-voltage applications only. Provide rigid plastic conduit, NEMA TC 2, Schedule 40 PVC (except rigid steel under roadways), with NEMA TC3 PVC conduit and tubing fittings.

D. All underground conduit shall be a minimum of two-inch standard trade size, except it is permissible to use one-inch conduit to lighting poles.

E. Use PVC fittings for PVC conduit and suitable water-tight connections where PVC conduit connects to galvanized steel conduit.

3.04 CONDUIT AND DUCT INSTALLATION

A. Install conduit and ducts as indicated on Drawings and according to manufacturer’s written instructions.

B. Slope: For ductbanks and conduits without profiles, pitch ducts minimum of 4 inches per 100 feet to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between 2 manholes to drain in both directions. For ductbanks with profiles, install the ductbank at the elevation as shown on the drawings.

C. Curves and Bends: Use manufactured galvanized rigid steel elbows for stub-ups at equipment and at building entrances with a minimum radius of 36 inches. Use manufactured long sweep bends with a minimum radius of 25 feet both horizontally and vertically at other locations. Do not exceed 20 degrees for field bends.

D. Make joints in ducts and fittings watertight according to manufacturer’s instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

E. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches on center for 5-inch ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Core drill entrances where knockouts do not exist.

F. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install according to the following:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts or at 8 feet maximum, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concrete: Do not pour concrete until conduit installation has been approved. Spade concrete carefully during pours to prevent voids under and between conduits and at the exterior surface of the envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each ductbank between manholes or other terminations in one continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into the concrete on both sides of the joint near the corners of the envelope.

3. Reinforcing: Reinforce ductbanks where they cross disturbed earth and where indicated on Drawings.
4. Forms: Use the walls of the trench to form the side walls of the duct bank where the soil is self-supporting and the concrete envelope can be poured without soil inclusions; otherwise, use forms.
5. Minimum Clearances Between Ducts: 3 inches between ducts and exterior envelope wall, 3 inches between ducts for like services, and 12 inches between power and signal ducts.
6. Depth: Except as otherwise indicated, install top of duct bank at least 36 inches below finished grade.

G. Stub-Ups: Use rigid steel conduit for stub-ups through concrete to equipment. Install insulated grounding bushings at the conduit terminations. For equipment mounted on outdoor concrete pads, extend steel conduit a minimum of 2 feet beyond the edge of the pad. Couple steel conduits to the ducts with adapters designed for the purpose and then encase the coupling with 3 inches of concrete.

H. Sealing: Provide temporary closure at all duct terminations in manholes and vaults installed in this Project. Use sealing compound and plugs to withstand a minimum of 15 psi hydrostatic pressure.

I. Pulling Cord: Install 100-pound- test nylon cord in installed ducts, including spares.

J. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of ductbank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.05 BACKFILLING

A. Backfill only after all necessary inspections and tests have been performed.

B. Remove all debris, rocks, broken concrete, and formwork before backfilling trenches.

C. Use Controlled Density Fill under pavement areas or wherever non-settling backfill is required.

D. Deposit backfill in layers with materials described in Article 2.11, “Backfill Material.” Uniformly spread and compact backfill with suitable power tampers to the density of the adjacent soil and in such a manner so as not to disturb the alignment of the conduit. If settlement occurs, refill, compact and smooth off to conform to the surface of the ground.

E. Restore surface features at areas disturbed by excavation, and reestablish original grades.

1. Replace removed sod as soon as possible after backfilling is completed.
2. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other Work.
3. Restore vegetation and provide necessary topsoil, fertilizer, lime, seed, sod, sprigging, or mulching.
4. Replace disturbed paving.

3.06 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 Grounding.

3.07 IDENTIFICATION

A. Identify raceways, cables and equipment as specified in Section 26 05 53 - Electrical Identification.

B. Label raceways entering concealed locations from exposed locations as to the destination via the concealed area.

3.08 TESTING AND CLEANING

A. Pull brush through full length of ducts. Use round bristle brush with a diameter 1/2-inch greater than internal diameter of duct. Clean internal surfaces of vaults, manholes and handholes, including sump.

B. Duct Integrity: Swab out ducts with a mandrel 1/4 inch smaller in diameter than internal diameter of ducts.

C. Grounding: Test manhole grounding to ensure electrical continuity of bonding and grounding connections. Measure ground resistance at each ground rod and report results. Use an instrument specifically designed for ground-resistance measurements.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. This section includes seismic restraints and other earthquake-damage-reduction measures for electrical components.

B. Definitions

1. Seismic Restraint: A fixed device such as a seismic brace, an anchor bolt or stud, or a fastening assembly used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
2. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. ACI 318 (American Concrete Institute) - Building Code Requirements for Structural Concrete.

B. ASCE 7 (American Society for Testing of Civil Engineers) - Minimum Design Loads for Buildings and Other Structures.

C. ASTM - American Society for Testing and Materials.

D. ICBO - International Conference of Building Officials.

E. IBC - International Building Code as adopted by the Authority Having Jurisdiction.

F. NFPA 70 (National Fire Protection Association) - National Electrical Code.

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals.

B. Furnish manufacturers' technical literature, standard details, product specifications, and installation instructions for all products.

1.04 QUALITY ASSURANCE

A. Comply with ASCE 7 Chapter 13, Seismic Design Requirements for Nonstructural Components.

1.05 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, communication, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bracing and attachment: Subject to compliance with requirements, provide bracing and attachment products by one of the following, or other manufacturer with at least 5 years of experience in seismic-specific bracing systems:

1. Cooper B-Line; Division of Eaton.

2. Erico
3. GS Metals; Division of Cooper
4. Hilti
5. Thomas & Betts; Division of ABB
6. Unistrut
7. Or Approved Equal.

B. Anchorage: Subject to compliance with requirements, provide anchorage products by one of the following, or other manufacturer with at least 5 years of experience in seismic-specific anchorage:

1. Hilti
2. Powers Fasteners
3. Red Head
4. Simpson Strong-Tie
5. Or Approved Equal.

2.02 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: 316 stainless steel.
3. Corrosive Locations: 316 stainless steel.

2.03 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

B. Concrete Inserts: Steel-channel type.

C. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A325.

D. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.04 SEISMIC BRACING COMPONENTS

A. Slotted 316 Stainless Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches on center in webs, and flange edges turned toward web.

1. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.

B. Channel-Type Bracing Assemblies: Slotted 316 stainless steel channel, with adjustable hinged steel brackets and bolts.

C. Hanger Rod Stiffeners: Slotted 316 stainless steel channels with internally bolted connections to hanger rod.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by authority having jurisdiction, unless more stringent requirements are indicated by manufacturer’s recommendation or this section.

3.02 STRUCTURAL ATTACHMENTS

A. Use bolted connections with stainless steel brackets, slotted channel, and slotted-channel fittings to transmit the design loads.

B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.

C. Attachments to Existing Concrete: Use expansion anchors.

D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars and comply with anchor manufacturer’s recommendations.

E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.

F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.

G. Attachments to Wood Structural Members: Install bolts through members.

H. Attachments to Steel: Bolt to clamps on flanges of beams and columns, or on upper truss chords of bar joists.

3.03 ELECTRICAL AND COMMUNICATION EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. All floor-mounted equipment shall be secured to the housekeeping bases with ductile steel anchor bolts, preset in the concrete base. Secure vibration mounts, where required, to the concrete bases such that the equipment is free to vibrate but cannot move from the base.

   1. Housekeeping Bases: Provide appropriately sized concrete housekeeping bases for all floor-mounted equipment unless noted otherwise. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base, or the minimum required by the anchor manufacturer, whichever is larger. Bases shall be 4" [3 ½”] nominal thickness of concrete with #4 reinforcing bars each way on 12" centers and doweled to floor slab unless noted otherwise. Trowel finish with 1" bevel edge all around.

   2. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.

C. Wall-Mounted Equipment Fastening: Rigidly secure all flush- or surface-mounted equipment, such as panelboards or cabinets, to the structure. Use expanding type anchors for concrete or masonry construction.

1. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.

D. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

1. Mark lugs after torquing with red paint such that paint will be visibly disturbed if lugs are disturbed.

3.04 SEISMIC BRACING INSTALLATION

A. Expansion and Contraction: Install all electrical system components to allow for thermal movement of braced components.

B. Attachment to Structure:

1. If specific attachment is not indicated for conduit or other lightweight elements, anchor bracing to the structure at flanges of beams and columns, upper truss chords of bar joists, or at concrete members.
2. If specific attachment is not indicated for panels, chases, racks, and other heavier equipment, submit planned attachment detail to the Engineer for specific approval.

3.05 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

1. Where expansion or control joints are crossed, the flexible connection shall allow for movement in each direction (closing, opening, right, and left) equal to the joint’s total width or greater.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Electrical Identification” Work is shown in the Contract Documents. This section includes identification of electrical materials, equipment, and installations.

1.02 GOVERNING CODES, STANDARDS AND REFERENCES

A. ANSI/IEEE C2 - National Electrical Safety Code

B. NFPA 70 (National Fire Protection Association) - National Electrical Code, References

1.03 SUBMITTALS

A. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Submittals shall include the following:

1. Product Data for each type of product specified.
2. Schedule of identification nomenclature to be used for identification signs and labels.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70, as adopted and administered by the Authority Having Jurisdiction.

B. Comply with ANSI C2, ANSI A13.1., ANSI Z535.4, 29 CFR 1910.144 and 29 CFR 1910.145.

C. Comply with Port of Seattle standards for electrical equipment identification.

D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 PRODUCTS

2.01 LABEL TYPES

A. Manufacturer’s standard products with colors prescribed by ANSI A13.1, NFPA 70, and these Specifications. Only temporary markings that are removable without damaging finish are permitted on equipment.

  1. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Install labels and nameplates parallel to equipment lines. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

  2. Provide engraved laminated phenolic plastic or melamine label for equipment as noted below. Securely attach engraved labels with blunt end, self-tapping stainless steel screws with blunt ends. Sheet metal screws are not allowed. Provide white letters on black background for normal power, white letters on red background for emergency power.

    a. Provide 5/8-inch minimum height letters on the following equipment:

      (1) Panelboards, provide labels and warning signs. Secure nameplates to inside surface of door where panel is recessed in finished locations.

      (2) Switchboards/distribution centers, motor control centers and power centers, padmounted transformers

      (3) Secondary feeder breakers in distribution equipment

      (4) Special equipment housed in cabinets, on outside door

      (5) Terminal junction boxes and data gathering panels

    b. Provide 1/4-inch minimum height letters on the following equipment:

      (1) Disconnects and starters for motors on fixed appliances and starters in MCCs

      (2) Motor controllers and VFDs.

      (3) Enclosed switches and circuit breakers

      (4) Low voltage transformers

      (5) Feeder circuit breakers in switchboards, switchgear, and distribution panelboards. Circuit breakers shall be labeled with destination panel name or load.

      (6) Duplex receptacles (self adhesive labels indicating panel and circuit number)

      (7) Local control panels

      (8) Raceways and junction boxes

      (9) Instrumentation Labels

    c. Refer to table and descriptions in subparagraphs below for acceptable labeling procedure:

SECTION	TITLE	LABEL TYPES														
		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
26 05 19	600-Volt or Less Wire and Cable	X	X			X									X	
26 05 26	Grounding			⅝		X										
26 05 43	Underground Ducts and Manholes						X		X	X	X	X			X	
no section	Electrical Power Monitoring and Control			⅜												
26 09 26	Panelboards			½												

B. Heat-shrink preprinted tubes, flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 degree F. Comply with UL 224.

C. Preprinted, flexible, self-adhesive vinyl label laminated with a clear weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Engraved melamine plastic laminate flat stock, 1/16-inch minimum thickness for sizes up to 15 square inches. Use 1/8-inch minimum for sizes larger than 15 square inches. Black with white letters for normal power systems and red with white letters for emergency power systems, with height as shown in table above unless specified otherwise. UV-inhibited when used outdoors. Secure with stainless steel drive screws, stainless steel self-tapping screws or stainless steel oval-head 6-32 screws tapped into enclosure, or with stainless steel bolts with elastic stopnut.

E. Adhesive-backed plastic machine-printed labels, white with black letters. Indicate panel name and circuit number(s).

F. Plain-colored vinyl adhesive tape, 3-mil minimum by 1-inch wide minimum. Apply 1/2-inch minimum over-wrap through 2-inch minimum length. Refer to Section 26 05 19 – 600 Volt or Less Wire and Cable for color.

G. Engraved plastic melamine laminate flat stock. 1/16 inch minimum thickness for sizes up to and including 15 square inches, 1/8” thick for larger than 15 square inches. White background with black letters for normal power, red background with white letters for emergency power. Holes at each end for attachment with nylon ty-wraps.

H. Underground line warning tape with pre-printed warning message identifying type of system. Material shall be pigmented polyolefin, continuous-printed on one side, and compounded for unlimited life when direct buried. 6-inch minimum width by 4-mils thick. Tensile strength of 1750 psi.

1. Inscriptions for Red-Colored Tapes: ELECTRICAL LINE.
2. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATION CABLE, OPTICAL FIBER CABLE.

I. Warning signs: Baked Enamel on aluminum plate, punched or drilled for fasteners, with colors, legend, and size required for applications. ¼-inch grommets in corners for mounting. Minimum nominal size of 7 by 10 inches with 0.040-inch minimum thickness. OSHA standard wording where approved. Custom wording if required. Secure with non-corrosive fasteners.

   1. Where applicable, provide labels for multiple power source warning: “DANGER – ELECTRICAL SHOCK HAZARD – EQUIPMENT HAS MULTIPLE POWER SOURCES”

J. Stencils: Machine-punched patterns, nonfading waterproof paint with color and formulation appropriate for material and location. Minimum letter height shall be 1 inch.

K. Adhesive-backed metal labels manufactured with testing agency logo. Punched or engraved with actual settings and date. Label shall be 1/16-inch minimum thickness for sizes up to 15 square inches. Use 1/8-inch minimum for sizes larger than 20 square inches. Black with white letters for normal power systems and red with white letters for emergency power systems, with height as shown in table above unless specified otherwise.

L. Stainless-steel machine or hand-stamped wire marker plates with one hole at each end for attachment with non-corrosive fasteners that do 0.010-inch minimum thickness (for outdoor application).

M. Adhesive machine-printed plastic tape, cut to length, black with white letters unless specified otherwise. 3/8-inch minimum width of tape in unfinished areas only. Provide white lettering on red background when served by an emergency source.

2.02 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Floor Marking: Coordinate with the Port Electric Shop for painting working clearances on the floor in front of the equipment.

B. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior and interior).

PART 3 EXECUTION

3.01 INSTALLATION

A. Fasteners for labels and signs: Self tapping, blunt-ended stainless-steel screws, or stainless-steel machine screws with nuts and flat and lock washers. Sheet metal screws are not acceptable. Self-drilling screws are not allowed.

B. Install identification labels according to manufacturer’s written instructions.

C. Install labels where indicated and as required by the Authority Having Jurisdiction and the Department of Labor and Industries. Locate for optimum viewing and without interference with the operation and maintenance of equipment.

D. Verify identity of each item before installing identification products.

E. Labeling abbreviations not permitted without F&I approval.

F. Temporary markings allowed only if removable without damage to equipment or enclosure finish.

G. System Identification Color-Coding Bands for Raceways: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

1.	208/120V	Blue
2.	480/277V	Yellow
3.	Controls	Black

H. Cable Ties: For attaching tags. Use general-purpose type, fungus inert, self-extinguishing, one piece, self-locking Type 6/6 nylon, except as listed below:

  1. Outdoors: UV-stabilized nylon.
  2. In spaces handling environmental air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

J. Coordinate names, abbreviations, colors, graphics and other designations used for electrical identification with corresponding designations used in the Contract Documents or as required by codes and standards. Use consistent designations throughout the Project. Labeling abbreviations are not allowed.

K. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish Work.

  1. Coordinate installing electrical identifying labels prior to installing acoustical ceilings and similar finishes that conceal such items.

L. Clean surfaces of dust, loose material, and oily films before applying painted or self-adhesive identification products.

M. Painted Identification Products:

  1. Prime surfaces according to manufacturer’s instructions prior to applying painted labels:
    a. For galvanized metal, use single-component, acrylic vehicle coating formulated for galvanized surfaces.
    b. For concrete masonry units, use heavy-duty, acrylic-resin block filler.
    c. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.
  2. Apply one intermediate and one finish coat of paint.

3.02 IDENTIFICATION SCHEDULE

A. Panelboard Schedules:

  1. Panelboard schedules shall utilize the POS standard panel schedule in Microsoft Excel format which has provision for totaling all loads and performing demand calculations by load category.
  2. Electronic copies of schedules are available from the Facilities and Infrastructure department. The STIA standard template is available on the Port of Seattle internet site, included with the STIA Electrical Standards.

http://www.portseattle.org/Business/Construction-Projects/Airport-Tenants/Pages/Reference-Documents.aspx.

3. This schedule shall be updated with as-built information upon the completion of the project. The contractor shall post a hard copy of the revised panel schedule in any panel modified and submit an electronic copy of the panel schedule in Port standard excel format showing accurate as-built information to F&I.

B. Instrumentation Labels: Affix permanent type nameplate or tag on all field-mounted instruments, transmitters, pressure gauges, and control valves with proper identification number and service description.

1. Provide 3”x1” aluminum or stainless steel tag stamped with the instrument loop number designation and the calibrated range.

C. Accessible Raceways within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage.

1. Provide labels on all raceways, junction and pull boxes indicating panel designation and circuit number for all circuits in raceway or box, and conduit destination.

a. Conduit Label Example: B2-P4-23G-1/1,3,5, B-2601-9.

b. Provide labels at all locations where conduit penetrates walls, floors and ceilings, on both sides of penetration.

c. Provide labels at all ends or breaks in conduit runs such as electrical rooms, junction boxes, pull boxes, cabinets, maintenance holes, fire penetrations, etc.

d. Provide labels on each conduit entering junction or pull box within 12” of junction or pull box.

e. Provide labels at 25 foot maximum intervals along conduit runs.

f. Provide labels on all junction and pullboxes, including in accessible ceiling spaces and exposed in unfinished areas. Refer to specification sections for identification requirements for systems contained within.

g. Install labels parallel to equipment lines.

h. Labels in unfinished locations, including in accessible ceiling spaces and exposed unfinished areas shall be machine printed vinyl labels minimum ½ inch high, white with black letters. Labels in finished locations shall be adhesive-backed plastic machine printed labels, minimum 3/8 inch high, white with black letters.

i. Lettering shall be a minimum of ¼” high.

j. In finished locations, provide labels on inside of junction or pull box cover.

k. Provide red lettering when served by an emergency source.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for feeder and branch-circuit conductors.
    a. Provide colored insulation when available, typically for wire sized #8 AWG and smaller.
    b. Provide minimum 2 inch wide band of colored plastic tape at all terminations and splices (where allowed). 3M Scotch No. 35, DSG-Canusa CET88, Or Approved Equal Electrical Color Coding Tape.
    c. Colors for 480/277V 3Ø, 4-wire systems:
        (1) Phase A (left or top): Brown.
        (2) Phase B (center): Orange
        (3) Phase C (right or bottom): Yellow
        (4) Neutral: Gray
        (5) Ground: Green
    d. Colors for 120/240V, 1Ø, 3-wire systems: (non-standard)
        (1) Phase A: Black
        (2) Phase B: Red
        (3) Neutral: White
        (4) Ground: Green
    e. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
2. Provide wire markers on each conductor in panelboards, gutters, pull boxes, outlet and junction boxes and at the load connection. Identify with branch circuit or feeder number for power and lighting circuits.
    a. Install conductor labeling in panelboards and enclosures to ensure labels are visible.

E. Install instructional sign including the color code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

1. Provide wire markers on each conductor in wire gutters, pull boxes, outlet and junction boxes and at the equipment connection. Identify with control wire number as indicated on schematics and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

G. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

I. Conductor Identification:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
3. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape or paint to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning, Caution, and Instruction Signs:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Provide OSHA standard text where approved. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location. Mount permanently in an appropriate location. Comply with ANSI A13.1 standard color and design.
2. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
3. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

M. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/4-inch high lettering on 1-inch high label. Use white lettering on black field. Apply labels parallel to equipment lines.

N. Outdoor Equipment: Engraved, laminated acrylic or melamine label, to comply with requirements listed above. Provide panel schedule printed on 8.5x11 paper in Port standard format in each panelboard. Insert folded schedule in schedule holder on inside of panel door. Posted panel schedule shall be updated to reflect all new work in panel. Include project completion date on schedule.

O. Provide self-adhesive tape labels on all receptacle cover plates. Labels shall be machine printed with black lettering on white or clear background.

  1. Indicate source panel name and circuit number.
  2. Provide red lettering on white or clear background for devices on emergency circuits.
  3. Where receptacle faceplate is dark color, provide white letters on clear background.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Panelboards” Work is shown in the Contract Documents. This section includes Lighting and Appliance Panelboards 100 amperes through 600 amperes, and Distribution Panelboards 800 amperes through 1200 amperes, rated 600 volts and less.

1.02 GOVERNING CODES, STANDARDS AND REFERENCES

A. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers,

B. NEMA FU 1 (National Electrical Manufacturers Association) - Fuses,

C. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum),

D. NEMA PB 1 (National Electrical Manufacturers Association) - Panelboards,

E. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems,

G. NFPA 70 (National Fire Protection Association) - National Electrical Code,

H. UL 50 (Underwriters Laboratory) - Enclosures for Electrical Equipment,

I. UL 67 (Underwriters Laboratory) - Panelboards,

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.

B. Submittals shall include the following:

1. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers’ technical data on features, performance, electrical characteristics, ratings, and finishes.

2. Shop Drawings: For each panelboard and related equipment.

    a. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

        (1) Enclosure types and details for types other than NEMA 250, Type 1.

        (2) Bus configuration, current, and voltage ratings.

        (3) Short-circuit current rating of panelboards and overcurrent protective devices.

            (4) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

3. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 48 - Seismic Controls for Electrical and Communication Work. Include the following:
    a. Basis of Certification: Verify whether withstand certification is based on actual test of assembled components.
    b. The term “withstand” means “the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event.”
    c. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    d. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Field Test Reports: Written reports specified in Part 3.
5. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1 General Requirements. In addition to requirements specified in Section 01 78 23.13 - Operations and Maintenance Data include the following:
    a. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.
    b. Time-current curves, including selectable ranges for adjustable overcurrent protective devices.
6. Panelboard Schedules:
    a. Contractor shall submit updated panelboard schedules with accurate as-built information in Port Standard format upon project completion.
    b. A hard copy of the panel schedule shall be posted in the panel board.
    c. Electronic copies of all panel schedules in Microsoft Excel Port Standard format shall be submitted upon project completion. The panel schedules shall include the date of panel or circuit installation.

1.04 QUALITY ASSURANCE

A. Listing and Labeling: Provide components, devices and accessories that are Listed and Labeled as defined in NFPA 70, Article 100 and marked for intended use for the location and environment in which they are installed.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70, as adopted and administered by the Authority Having Jurisdiction.

1.05 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Pipes and ducts shall not pass over panelboards.

1.06 EXTRA MATERIALS

A. Spare and extra parts shall be identified for all products, but not provided. Include spare parts information in Operation and Maintenance Manuals.

B. Provide 15 percent spare circuit breakers of the size most used in the panel, and 20% future space load growth.

C. Provide two spares of each type of panelboard cabinet lock.

D. Provide one pint container of paint matching enclosure finish packaged with protective covering for storage and identified with labels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices and Accessories:
    a. Cutler-Hammer; Division of Eaton.
    b. General Electric.
    c. Square D; Division of Schneider Electric.
    d. Or Approved Equal.

2.02 SERVICE CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 40°C.
2. Altitude: Not exceeding 1000 feet Main
3. Breakers: Main breakers are required for all panelboards.
4. Panelboards: NEMA Type 4X, stainless steel.

2.03 FABRICATION AND FEATURES

A. Enclosures: Surface-mounted cabinets. NEMA PB 1, Type to meet environmental conditions at installed location:

1. Indoor Dry, and Clean Locations: NEMA 250, Type 1.
2. Indoor Locations Subject to dust, falling dirt, and dripping noncorrosive liquids: Nema 250, Type 12.
3. Outdoor or Damp Locations: NEMA 250, Type 3R.
4. Corrosive Locations: NEMA 250, Type 4X, stainless steel.

B. Finish: Manufacturer’s standard enamel finish over corrosion-resistant treatment or primer coat.

C. Surface-mounted panelboard front cover with same dimensions as enclosure.

D. Flush-mounted panelboard front cover oversized by 3/4-inch to cover rough opening.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard standard door.

F. Bus: Plated copper.

G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

H. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

2.04 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Hinged Front Cover: Entire front trim cover piano-hinged to box for 110-degree opening minimum. Standard door hinged within trim cover. Hinged Door-in-Door panel fronts for all panelboards, except NEMA 3R. Two locks required

1. Full size front cover shall have maintenance master keyed lock.
2. Standard door within front trim cover shall allow access to circuit breakers and shall also have maintenance master keyed lock. Depending on the user group and area, this door may remain unlocked for user group access to the circuit breakers or maintenance may optionally keep this door locked. Special locks from Maintenance shall be added to the panel.

2.06 DISTRIBUTION PANELBOARDS

A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; maintenance master keyed.

B. Main Overcurrent Protective Devices: Thermal-magnetic circuit breaker.

C. Circuit Breakers: Bolt-on type, except for use in Square D “I-Line” panelboards.

D. Hinged Front Cover: Entire front trim cover piano-hinged to box for 110-degree opening minimum. Standard door hinged within trim cover. Hinged Door-in-Door panel fronts for all panelboards, except NEMA 3R. Door shall be gasketed with vault handle & lock.

1. Full size front cover shall have maintenance master keyed lock.
2. Standard door within front trim cover shall allow access to circuit breakers and shall also have maintenance master keyed lock.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

F. Bus: Copper phase and neutral buses; 200 percent capacity neutral bus.

2.07 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. GFCI Circuit Breakers: Single- and two-pole configurations with 6mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.

  1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
  2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
  3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  4. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system.
  5. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
  6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
  7. Auxiliary Switch: One SPDT switch with “a” and “b” contacts; “a” contacts mimic circuit-breaker contacts, “b” contacts operate in reverse of circuit-breaker contacts.
  8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.08 ACCEPTABLE OPTIONS

A. Adjustable trips where engineered coordination settings are provided.

2.09 CURRENT TRANSFORMERS

A. Round, 2.5” diameter, rated for 600VAC, 50-400 Hz, flexible leads.

B. Must be compatible with Eaton PXM 2260 MA65105 meters. Instrument class meters with 5 amp secondaries. 125:5 CURRENT TRANSFORMERS ARE NOT COMPATIBLE WITH IQ 220 METERS AND WILL NOT BE ALLOWED.

C. Approved manufacturers: ITI 2DARL (for 250A and smaller), ITI 5DARL (for larger than 250 amps), Or Approved Equal.

2.10 LABEL

A. Add, “Arc Flash Hazard warning sign label” on panel as per NEC Code 110.16

PART 3 EXECUTION

3.01 EXISTING WORK

A. Where existing panelboard is to remain active, clean and repair panelboard, seal old knock outs and ensure access is maintained.

3.02 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Surface mounted panelboard fronts shall have same dimensions as enclosure.

C. Comply with mounting and anchoring requirements specified in Section 26 05 48 - Seismic Controls for Electrical and Communication Work.

D. Standard Mounting Heights: Top of trim 72-inches above finished floor, unless otherwise indicated.

  1. Maximum height of highest operating handle on distribution panelboards shall be 78”.

E. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

F. Floor Mounted Panels: Install panelboards on concrete bases, 3-1/2 inch nominal thickness. Concrete shall be rated for minimum 3000 psi.

  1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to panelboards.
  5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

G. Install filler plates in unused spaces.

H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.03 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

1. Mark lugs after torquing with black, red or yellow paint such that paint will be visibly disturbed if lugs are disturbed.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components as specified in Section 26 05 53 - Electrical Identification.

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic nameplate with panel designation, power source, source location and voltage.

   1. Provide placard at each panelboard reading: “NOTIFY AV/MAINTENANCE IMMEDIATELY AT PHONE NO. (206) 433-5311 IF ANY CIRCUIT BREAKER TRIPS OR CIRCUIT LOADS NEED TO BE ALTERED.”

C. Provide framed, typed panelboard circuit directory with accurate descriptions of the connected load. Hand-written directories are not acceptable. Complete directory only after all modifications have been made to correct load imbalance.

   1. Number circuit breakers with odd numbers on the left and even numbers on the right when facing the panel. Number consecutively, with multiple-pole breakers assigned multiple numbers.
   2. Describe branch circuit loads and identify locations using room numbers or column lines.
   3. Include date of last changes made and the name and company of the individual making changes.

D. Equipment used in emergency systems shall be labeled “Suitable for use on emergency systems” per NEC 700-3.

E. For isolated ground panels, label isolated ground bus.

F. Provide Arc Flash Hazard label on panelboard. Label shall include the following information: Date of study, Engineer of Record, Arc Flash Level and Port of Seattle Engineer initial.

G. Contractors shall utilize the POS standard panel schedule in Microsoft Excel format which has provision for totaling all loads and performing demand calculations by load category. An electronic copy of this schedule is available from the Facilities and Infrastructure department. This schedule shall be “as-built” after completion of the project and an electronic copy returned to the F&I on disk or CD.

   1. Transpose existing load identifications along with new or revised circuitry.

3.05 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit. Use 1000-volt megger for 480 volts and 500-volt megger for 240 volts.
   2. Test continuity of each circuit and all ground connections. Megger with all circuit breakers open and then with all circuit breakers closed.
   3. Check for proper phase rotation: Phase A, B, C from left to right and front to back.

4. After energizing, check load balance under normal operation. If load unbalance exceeds 10 percent, initiate corrective measures.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 ADJUSTING

A. Set field-adjustable switches and circuit breaker trip ranges.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 10 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.07 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.08 OPERATION AND MAINTENANCE MANUALS

A. Comply with Section 01 78 23.13 - Operations and Maintenance Data and Part 1 of this specification.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the applicable bid items in the Schedule of Unit Prices.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Earthwork” is indicated on the Contract Documents including excavating, filling and construction trenches, ditches, and associated Work.

B. This section includes furnishing transportation, labor, materials, equipment, and incidentals necessary to perform excavation, handling, and disposal of Subtitle” D” contaminated soil and subsurface debris as shown on the Drawings and described in these specifications.

C. This section also includes furnishing transportation, labor, materials, equipment, and incidentals necessary to perform re-grading and backfilling of the site as described in these specifications and shown on the Drawings.

D. Excavation of the Subtitle ”D” contaminated soil and subsurface debris will include removal of soil and associated debris to the limits shown on the Drawings. Subsurface debris encountered in the excavated soil will not be segregated, but may require modification (typically size limitations as dictated by the disposal facility) to make the debris suitable for disposal with the soil Excavated material shall not be stockpiled on site. During initial excavation the first 10 cubic yards of subsurface soil (below the asphalt) will be direct loaded into a 10 cubic yard roll of bin. This soil will be sampled for disposal profiling by the Engineer. All other excavated material shall be direct loaded into waiting trucks. All excavated material below the asphalt or concrete slabs (if present) shall be disposed of as Subtitle “D” contaminated soil.

E. All pavements and concrete slabs removed as a part of trenching and structure excavation shall be removed and disposed of in accordance with Section 02 41 13 – Site Demolition.

F. All Seaport project with land disturbing activities over 750 square feet must comply with City of Seattle Stormwater Code.

G. City of Seattle Terms (from the City of Seattle Stormwater Code)

1. "Earth material" means any rock, gravel, natural soil, fill, or re-sedimented soil, or any combination thereof, but does not include any solid waste as defined by RCW 70.95.

2. "Impervious Surface" means any surface exposed to rainwater from which most water runs off. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, formal planters, parking lots or storage areas, concrete or asphalt paving, permeable paving, gravel surfaces subjected to vehicular traffic, compact gravel, packed earthen materials, and oiled macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for the purposes of determining whether the thresholds for application of minimum requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of stormwater modeling.

3. "Land disturbing activity" means any activity that result in a movement of earth, or a change in the existing soil cover, both vegetative and non-vegetative, or the existing topography. Land disturbing activities include, but are not limited to: clearing, grading, filling, excavation, or addition of new or the replacement of impervious surface. Compaction, excluding hot asphalt mix that is associated with stabilization of structures and road construction shall also be considered a land disturbing activity. Vegetation maintenance practices are not considered land disturbing activities.
4. "Pollution-generating impervious surface" means those impervious surfaces considered to be a significant source of pollutants in drainage water. Such surfaces include those that are subject to: vehicular use; certain industrial activities; or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall. Erodible or leachable materials, wastes, or chemicals are those substances which, when exposed to rainfall, measurably alter the physical or chemical characteristics of the drainage water. Examples include: uncovered process wastes; manure; fertilizers; oily substances; ashes; kiln dust; and garbage dumpster leakage. Metal roofs are also considered to be PGIS unless they are coated with an inert, nonleachable material (e.g., baked-on enamel coating).
5. Vehicular Surface A surface, whether paved or not, shall be considered subject to vehicular use if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads; unvegetated road shoulders; permeable pavement; bike lanes within the traveled lane of a roadway; driveways; parking lots; unfenced fire lanes; vehicular equipment storage yards; and airport runways.
6. “Project” means the addition or replacement of impervious surface or the undertaking of land disturbing activity on a site.
7. "Replaced impervious surface" or "replacement of impervious surface" means for structures, the removal and replacement of impervious surface down to the foundation. For other impervious surface, the impervious surface that is removed down to earth material and a new impervious surface is installed.
8. “Road Maintenance Practices” exempt from treatment/flow control:
    a. Pothole and square cut patching;
    b. Overlaying existing asphalt or concrete or brick pavement with asphalt or concrete without expanding the area of coverage;
    c. Shoulder grading;
    d. Reshaping or regrading drainage ditches;
    e. Crack sealing; and
    f. Vegetation maintenance.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. References

1. WSDOT - Standard Specifications for Road, Bridge, and Municipal Construction; and Amendments (current edition):
2. ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
3. ASTM C127 Standard test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
4. ASTM C666 Standard test Method for Resistance of Concrete to Rapid Freezing and Thawing
5. ASTM D854 Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
6. ASTM D1556 Standard test Method for Density and Unit Weight of Soil in Place by Sand-cone Method
7. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
8. ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
9. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil Aggregate in by Nuclear Methods (Shallow Depth
10. USACE CRD C145 Expansive Breakdown 15 day < 8.5% {Concrete Research Division, Handbook for Concrete and Cement (USACE)}
11. WSDOT Standard Specifications paragraph 9-03.12(4) gravel borrow
12. All Seaport project with land disturbing activities over 750 square feet must comply with City of Seattle Stormwater Code.

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.

B. The Contractor shall submit an Earthwork Plan that documents the proposed approaches, equipment, means, and methods of accomplishing the excavation, handling, and disposal of soil and associated subsurface debris. The Plan shall include the sequencing approach for the completion of earthwork within each Work Area. The Plan shall address the safe handling of contaminated materials and how work will be managed within the site access restrictions. Submit a description of the proposed plan for excavations, handling and loading. Include description of intended work sequencing and scheduling of work in the Contractor’s work area throughout construction. This submittal is for the Engineer’s general information and in no way relieves the Contractor of complete responsibility for the successful performance of the work.

C. The Contractor shall submit daily excavation reports to the Engineer as part of the Contractor’s Daily Construction Report. Forms to be used shall be submitted to the Engineer for approval prior to use.

D. Submit test reports in accordance with Section 01 33 00 – Submittals, for the following:

1. Select fill borrow material sieve analysis.
2. Pipe bedding material sieve analysis.
3. Chemical testing (where required) completed specifically for this project.
4. Compaction Control Testing for subgrade and backfill as required per Article 3.06 of this Section.
5. CDF - mix design and compressive strength results based on actual test results from the proposed mix design

1.04 DEFINITIONS

Subtitle “D” Waste is defined from a regulatory standpoint in Section 02 61 13 Handling Contaminated Soil. Subtitle “D” waste includes all soil, sediment, and debris removed from the site except for demolished surface materials that can be recycled or reused.

1.05 JOB CONDITIONS

A. See Section 01 11 00 – Summary of Work for access to the site.

B. Information for subsurface explorations performed at the site is contained in The Appendices. Contractor shall make their own evaluation of the data to determine how to construct the project.

C. Existing Utilities: The Contractor shall locate existing underground and aboveground utilities in the area of the Work. Those utilities which are to remain shall be adequately protected from damage. The Contractor shall make arrangements with all utility providers that will be affected by earthwork activities and shall design site activities (shoring, dewatering) to account for the utilities.

D. Debris will be common in excavated soil. Debris encountered may include (but not be limited to) timbers, concrete debris, abandoned piping, and plastic debris. These items shall be disposed with contaminated soil removed from trenching. Encountering such obstructions shall not be the basis for extra payment. These item costs are considered incidental to the contract and are considered to be included in the Contract Bid item for the appropriate soil removal area.

E. Onsite monitoring wells shall be decommissioned in accordance with Section 33 24 13 Monitoring Well Decommissioning and Protection prior to any earthwork activities.

F. Excavated soil and associated debris shall not be stockpiled on site. Excavated material shall be direct loaded into waiting trucks.

G. The groundwater table may be encountered below approximately elevation +10’ MLLW. The Contractor shall make every effort to protect the area within the project site and surrounding properties against erosion resulting from this Work in accordance with Section 01 57 13 – Temporary Erosion and Sediment Control of these Specifications.

H. Protect all structures and facilities designated to remain in place from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation, fill, and backfill operations.

1.06 ENVIRONMENTAL PROTECTION

A. The Contractor shall provide and maintain during the life of the Contract, environmental protective measures in accordance with Section 01 57 23 Pollution Prevention Planning and Execution, Section 02 22 23 Decontamination, Section 02 27 00 TESC Planning and Execution, and other applicable Contract provisions. The measures shall include, but not be limited to, erosion control, vehicle decontamination, and spill response.

B. It is possible that disturbance of historical Native American materials may occur as a result of upland excavation operations. The excavation crew shall attend a 1-hour onsite orientation held by the site Archaeologist (retained by the Port) where personnel will be made aware of the potential to discover cultural resources within the removal areas. The Contractor will be made aware of their responsibilities during monitoring by the site Archaeologist and their obligations in the case of an inadvertent discovery. If any archaeological resources are discovered during removal, the Contractor shall cease excavation and notify the Engineer. Contractor shall allow access to work areas as requested by the Engineer to allow inspection for cultural resources.

PART 2 MATERIALS

2.01 PROJECT INFORMATION

A. Site Information: Subsurface conditions have been explored on the site through a series of environmental borings completed over the years. The Contractor shall satisfy himself as to the quality of the material which is required to be moved during this Work.

2.02 MATERIAL REQUIREMENTS

A. General

1. Materials shall be of the quality, size, shape, gradation, or equal to that manufacture as specified herein.

B. Utilities Bedding

1. Utilities bedding shall meet all the appropriate requirements of Section 9-03 of WSDOT Standard Specifications and shall meet the grading requirements of Section 9-03.12(3) – Gravel Backfill for Pipe Zone Bedding, including conformance to Sand Equivalent requirements.

C. Underground Marking Tape

1. Underground marking tape shall consist of inert polyethylene plastic, 4-mil thickness that is impervious to all known alkalis, acids, chemical reagents

and solvents likely to be encountered in the soil, with a metallic foil core to provide the most positive detection and pipeline locators.

2. The tape shall be color coded and shall be imprinted continuously over its entire length in permanent black ink. The message shall convey the type of line buried below and shall also have the word "Caution" prominently shown. Color coding of the tape shall be as follows:

UTILITY	TAPE COLOR
Electrical	Red
Gas-Oil (within the SVE/AS trench alignment)	Yellow
Storm Drains	Green

3. The width of the tape shall be as recommended by the manufacturer for the depth of installation.

D. Backfill for Horizontal SVE Pipe Runs

1. Backfill for horizontal SVE Pipe Runs shall conform to the requirements of paragraph 9-03.13 of WSDOT Standard Specifications, "Backfill for Sand Drains."

2. Chemical Acceptance Criteria: Contractor shall provide documentation of the chemical composition to demonstrate that the proposed backfill is free from environmental contamination. Backfill analytes, reporting limits, methods, and criteria are:

Analyte	Unit	Analytical Method	Reporting Limit	Criteria
PCB Aroclors	µg/kg dw	EPA 8082	4	ND
Semi-volatile organic compounds (SVOCs)	µg/kg dw	EPA 8270	20[a]	ND
Arsenic	mg/kg dw	EPA 6010	5	7.3
Cadmium			0.2	2.5
Chromium			0.5	130
Copper			0.2	195
Lead			2	225
Silver			0.3	2
Zinc			1	205
Mercury	mg/kg dw	EPA 7471	.02	0.2
Diesel range hydrocarbons	mg/kg dw	NWTPH-Dx	5	ND
Lube oil range hydrocarbons			10	

Notes: ND = not detected at reporting limit; TEQ = toxicity equivalent.

[a] : most SVOCs, such as PAHs, have reporting limits of 20 ug/kg dw. Some SVOCs have higher reporting limits: 2,4-dimethylphenol – 35, 4-methylphenol – 35, benzoic acid – 400, bis(2-ethylhexyl)phthalate - 30, hexachlorobutadiene – 90, diethylphthalate – 50,

pentachlorophenol – 200.

E. GEOTEXTILE FABRIC

1. Geotextile shall be used beneath the CDF layer above the horizontal SVE trench shown on the Plans. The geofabric shall be a woven fabric composed of polypropylene filaments that are formed into a stable network to provide puncture and tear resistance. The fabric shall be inert to biological degradation and naturally encountered chemicals, alkalis, and acids. Geotextiles shall conform WSDOT Section 9-33.2, Table 3 for Woven Separation.

F. Material Beneath Utility Structures

1. A minimum thickness of 6-inches of compacted base course aggregate shall be used beneath utility structures. Refer to Section 9-03.9(3) of WSDOT Standard Specifications for base course material.

G. CDF Backfill

1. Controlled Density Fill (CDF [also may be referred to as lean concrete]) CDF shall contain a minimum of 94 lb Type 1 cement per cubic yard. The CDF shall be uniform, excavatable, flowable, cohesive, non-bleeding, low strength concrete mix, containing a stable air generator and maximum aggregate size of 3/8”. Proportion CDF mix design so in-place strength does not exceed 200 psi during the life of fill and mix sets within six hours of placement.

2.03 QUALITY ASSURANCE

A. Inspection and Testing: Necessary testing and inspection will be provided by the Port as determined by the Engineer, except for specific testing to be performed by the Contractor as required herein. The Contractor shall provide timely access and all necessary assistance to carry out the tests and inspections by the Port at no additional cost. Contractor shall be responsible for costs associated with removal and replacement of materials if any of the materials do not meet requirements as determined by testing. The Contractor may obtain copies of test results at no cost. Additional testing requested by the Contractor shall be at its own expense.

PART 3 EXECUTION

3.01 PROJECT INFORMATION

A. Site Information: Subsurface conditions have been explored on the site through a series of environmental borings completed over the years.. The Contractor shall satisfy himself as to the quality of the material which is required to be moved during this Work.

B. Existing Utilities: The Contractor shall locate existing underground utilities in the area of the Work. Those utilities which are to remain shall be adequately protected from damage. Contractor shall immediately notify the Engineer if a utility is found to conflict with the planned Work.

3.02 PREPARATION FOR EXECUTION OF WORK

A. Excavating and grading of naturally occurring materials, whether native to the site or imported, which is made a part of this Contract, shall be removed or placed within the tolerances established or within reasonably close conformity with the alignment grade and cross sections indicated on the drawings or as established by the Engineer.

B. The Contractor shall participate in training along with all workers performing excavation activities regarding the identification of cultural resources that may be uncovered during excavation. When the Contractor’s excavation operations encounter possible artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the Engineer shall be notified.

C. If it is necessary to interrupt existing surface drainage, sewers, under-drainage, conduits, utilities, or similar underground structures not shown for removal, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. The Contractor shall at their own expense, satisfactorily repair or pay the cost of all damage to such facilities or structures which may result from any of the Contractor’s operations during the period of the contract. Contractor shall immediately notify the Engineer if a utility is found to conflict with the planned Work.

3.03 EXECUTION OF WORK

A. Excavation

1. Excavation material shall be moved with the use of mechanical equipment, such as shovels, loaders, bulldozers, graders, rippers, etc., but shall not require drilling and blasting or drilling and line breaking. Excavation by sluicing method is not permitted unless specifically approved by the Engineer. In general, excavation shall be removed in horizontal layers in such a way that the resulting material shall be a reasonable blend of the naturally occurring materials. The excavation shall be accomplished in accordance with the specification requirements and may include incidental work including, but not limited to, removal of structures or portions thereof; construction and subsequent removal of shoring; pumping or dewatering of excavated areas; protection of excavated materials from the weather; and placement and compaction of excavated material as backfill.
2. Trench Excavation: Shall be accomplished to the lines and grades designated by the Engineer. Trench excavation shall consist of the removal, placement, or disposal of all formations as described above in "Structure Excavation." The inclusions and exclusions stated above shall apply equally to "Trench Excavations" as well as "Structure Excavation." Prior to placing any utility piping, conduit, etc., the trench shall be cleaned of all unsuitable material, backfilled with the specified bedding material and approved by the Engineer.
3. The Contractor shall maintain at all times during execution of this work, safe and stable excavations as specified in Section 31 50 00 – Trench Safety Systems.
4. Trenches and excavations shall not be greater in width than is necessary to permit construction in accordance with the Plans and these Specifications.

Trenches for piping, conduit or utility structures deeper than 4-feet shall have shoring, such as trench boxes, to minimize amount of existing pavement and soil disturbance. Refer to Part 4 for measurement and payment.

5. Excavation materials from trenching may contain contaminated materials.

B. Backfill

1. Excavation backfill beyond the limits defining structure excavation, or where an imported material is required as backfill shall be made with material from the excavation and shall be considered a necessary part of, and incidental to, the excavation, except where specifications provide for the backfill material to be obtained from a designated source. In general, backfill material from excavation shall be free from large or frozen lumps, wood, excess moisture, or other extraneous material and of a quality acceptable to the Engineer.
   When the Engineer determines that the excavated material does not meet these general requirements or for any other reason is not suitable for backfilling purposes, he may require that backfill material be obtained from a source other than the excavated material.

   a. Compensation for that part of the substituted backfill material placed within the limits defining structure excavation will be made on the basis of force account as provided for in Article G-08.05 of the General Conditions, or by agreed price, under the following conditions.

      (1) When the excavated material is determined to be unsuitable for reasons other than excessive moisture or contamination.

      (2) When the excavated material is determined to be unsuitable because of excessive moisture and the Contractor has met the requirements for protection from weather and contamination of backfill material as specified.

      (3) When excavation material to be used for backfill is determined to be unsuitable for backfill because of excessive moisture resulting from weather or from contamination, either of which is the result of not meeting the requirements, dispose of the unsuitable material as directed by the Engineer and replace the lost material with suitable backfill, all at no additional cost to the Port.

   b. Water existing in the excavated area shall be removed by pumping or other means before backfilling.

   c. Place structure backfill in horizontal layers not exceeding eight inches in loose thickness and compact each layer to 100% of the maximum density. Grade the backfill flush with existing ground or as directed by the Engineer.

   d. All costs incidental to furnishing backfill, backfilling and compacting backfill beyond the limits defining structure excavation shall be at the Contractor's expense.

e. Backfill trenches with bedding material as specified and as called for on the drawings. Fine-grade the bedding material to the required slope and excavate to accommodate bell and spigot joints so the entire length of each pipe will be uniformly supported. Trench backfill shall be common material placed in horizontal layers not to exceed eight inches in loose thickness and carefully compacted by the use of small vibratory or mechanical compactors until the cover is one foot above the top of the pipe. Subsequent layers of trench backfill shall not exceed eight inches in loose thickness but may be compacted by any method which will not exceed the allowable stresses for the pipe. Each layer shall be compacted to 100% of maximum density.

C. Underground Marking Tape

1. The Contractor shall provide an approved underground marking tape to mark all underground utility and conduit lines installed as part of this Contract. The underground marking tape shall extend the full length of each such line and shall be placed one foot above each line.

D. Compaction

1. Compaction shall be performed with approved compaction equipment suited to the soil being compacted. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact the total area of backfill concurrently. In areas of limited access, as determined by the Engineer, compact the backfill by using hand or hand-operated power tampers. While backfill is being placed in layers, operate the compaction equipment continuously. Each lift of material placed shall be uniformly compacted to the density indicated for the specific material and use set forth in these Specifications.

E. Compaction Control Tests

1. Laboratory and field tests shall be performed in accordance with the applicable provisions of Section 01 45 29 - Quality Control; Testing Laboratory Services and Section 01 45 16.13 - Contractor's Quality Control Program, to determine compliance with these specifications. Furnish soil samples suitable for the laboratory tests at no cost to the Port of Seattle.

2. Compaction control density shall be the maximum density at optimum moisture content as determined by ASTM D1557, Standard Methods for Moisture-Density Relationships of Soil and Soil Aggregates, Methods B, C or D as applicable.

3. Field tests to determine in-place compliance with required densities as specified, shall be performed in accordance with ASTM D1556, D2167, or D2922.

F. Grading And Leveling

1. The finished profiles of the entire area shall be graded within a tolerance of 0.05 foot plus or minus in 10 feet, ready for crushed rock base wherever pavement is to be furnished.

G. Preparation For Base Course

1. Preparation of Subgrade: Immediately prior to placement of surfacing materials, clean the entire width of the area of all debris and dispose of as directed by the Engineer. All depressions or ruts which contain storm water shall be drained.
2. Shape the entire subgrade to a smooth uniform surface, true to line, grade, and cross section as staked by the Engineer. Compact the roadbed material for a depth of six inches below the subgrade to 95% of the maximum density as determined by compaction tests ASTM Designation D1557. If soft or spongy material underlying the upper six inches of the area being prepared precludes satisfactory compaction of the upper six inches, loosen, aerate, or excavate, replace and compact to the required density as directed by the Engineer.
3. Remove and dispose of excess material which cannot be disposed of by normal drifting to low spots during blading and shaping operations or by placing in subgrade areas deficient in materials or by wasting, all as directed by the Engineer. Subgrade areas deficient in materials shall be brought to grade by importing suitable materials from other subgrade areas or other sources as directed by the Engineer. Materials added to subgrade areas deficient in materials shall be watered and compacted as necessary to yield a true finished subgrade as described above.
4. Once it is prepared, maintain the subgrade for surfacing in the finished condition until the first course of surfacing has been placed.
5. Finishing Subgrades: Before any paving material is placed, the subgrade shall be brought to the proper line, grade and cross section and shall be so maintained until the base course and paving is placed, except that extra depth of subgrade for increased thickness of the pavement, for pavement anchors, for pavement headers, and for increased thickness at the edges of the pavement may be removed just before the pavement is placed.
6. Compact the subgrade for pavement to 100% of maximum density as defined for Compaction Control Density to a minimum depth of six inches and to a width that will accommodate the paving equipment.
7. Subgrade Protection: Take all precautions necessary to protect the subgrade from damage; hauling over the finished subgrade shall be limited to that which is essential for construction purposes. Equipment used for hauling over the prepared subgrade which, in the opinion of the Engineer, is causing undue damage to the prepared subgrade or to the underlying materials, shall be removed from the Work at the request of the Engineer. Repair at the Contractor's expense all cuts, ruts and breaks in the surface of the subgrade prior to placing surfacing, treated base, or paving materials. Protect the prepared subgrade from both the Contractor's traffic and public traffic and maintain the subgrade by blading and rolling as frequently as may be necessary to preserve the subgrade in a completely satisfactory condition.

H. SUBGRADE PREPARATION FOR PAVED AREA

1. Preparation of Subgrade: Immediately prior to placement of surfacing materials, clean the entire width of the area of all debris and dispose of as directed by the Engineer. All depressions or ruts that contain storm water

shall be drained.

Shape the entire subgrade to a smooth uniform surface, true to line, grade, and cross section in accordance with the plans and to the satisfaction of the Engineer. Compact the subgrade material to a depth of 12 inches to 95% of the material's maximum dry density as determined by the Modified Proctor Compaction Test, ASTM Designation D1557. If soft or spongy material underlying the subgrade precludes satisfactory compaction, loosen, aerate, or excavate, replace and compact to the required density as directed by the Engineer.

2. Materials added to subgrade areas deficient in materials shall be watered and compacted as necessary to yield a true finished subgrade as described above. Once it is prepared, maintain the subgrade for surfacing in the finished condition until the first course of surfacing has been placed.

3. Finished Subgrades: Before any paving material is placed, the base shall be brought to the proper line, grade, and cross section and shall be so maintained until the paving is placed.

I. Reconditioning Of Subgrades

1. Where approved compacted subgrades are disturbed by the Contractor's subsequent operations or adverse weather, scarify the subgrades and compact to the required density prior to further construction thereon.

J. Surface Maintenance

1. Leave the surface free of stones or debris and wet as necessary for dust control. Maintain the surface until final treatment is applied.

K. Excess Material disposal

1. The Contractor shall be responsible for the disposal of soils that the Engineer confirms to be Excess Material. The excess soils shall be disposed of away from Port-owned property at a location permitted to receive the type of excess soils to be disposed. Prior to removing from the site, the Contractor shall coordinate with the Port for testing of the soil.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

4.02 MEASUREMENT

A. "Trenching and Excavation" will be measured by lump sum based on the lines and grades shown on the drawings.

1. No separate measurement will be made for stockpiling; modifying subsurface debris to make it suitable for offsite disposal; or loading, transporting, and disposing of soil and debris.

2. No measurement or payment will be made for the Work involved in protection of subgrade.

B. "Trench Backfill/Compaction" will be measured by lump sum based on the lines and grades shown on the drawings.

C. Measurement for “Utility Conflict/Obstruction Removal” shall be on a Force Account basis in accordance with Document 00700 – General Conditions, Paragraph G-08.06.

D. Measurement for “Archaeological Delays” shall be on a Force Account basis in accordance with Document 00700 – General Conditions, Paragraph G-08.06.

4.03 PAYMENT

A. No separate payment will be made for the “Earthwork Plan” as required by this section. The cost this plan shall be incidental to, and included in other bid items in the Schedule of Unit Prices.

B. No separate payment will be made for any other earthwork described in this Section, such as Underground Marking Tape, piping, trench safety systems, or asphalt paving Including base course. The cost for all other earthwork, including but not limited to the items above shall be incidental to, and included in other bid items in the Schedule of Unit Prices.

C. Payment for “Trenching and Excavation” will be made at the contract lump sum price stated in the Schedule of Unit Price will be full compensation for furnishing all material, labor, equipment, and tools to excavate, haul and dispose of material including loading, hauling, disposal of the material at approved disposal facility. The price shall be full compensation for furnishing all material, labor, equipment, surveying, and tools to haul and dispose of material including loading, hauling, disposal of the material at approved disposal facility, including all fees, permits and all incidentals to complete the work.

D. Payment for “Trench Backfill/Compaction” will be made at the contract lump sum price stated in the Schedule of Unit Price will be full compensation for furnishing all material, labor, equipment, and tools to complete backfilling. The price shall be full compensation for furnishing all material, labor, equipment, and tools all incidentals to complete the work, including controlled density fill, backfill sand, and geotextile fabric for separation.

E. Payment for “Utility Conflict/Obstruction Removal” as stated in the Schedule of Unit Prices will be made on a Force Account basis in accordance with Document 00700 – General Conditions, Paragraph G-08.06 and shall be full compensation to complete only scope for unanticipated obstructions during earthwork that are not part of the contract work, not covered under existing bid items and are at the specific direction of the Engineer.

F. Payment for “Archaeological Delays” as stated in the Schedule of Unit Prices will be made on a Force Account basis in accordance with Document 00700 – General Conditions, Paragraph G-08.06 and shall be full compensation to complete only unanticipated scope that are not part of the contract work, not covered under existing bid items and are at the specific direction of the Engineer.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Trench Safety System” is indicated on the Contract Documents to be used in the excavation of trenches for the construction of the utilities.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. R.C.W. Chapter 39.04.180 Public Works/Trench Excavations - Safety Systems Required

B. R.C.W. Chapter 49.17 WISHA Safety Standards (Current Edition)

C. WAC 296-155 Safety Standards for Construction Work (Current Edition)

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 – Submittals

B. Contractor will submit documentation demonstrating that the safety systems for trench excavations greater than four feet deep are designed in accordance with WAC 296-155-657 and other applicable regulations.

1.04 JOB CONDITIONS

A. Meet safety requirements for trenching activities to be used in earthwork excavation activities on this Project.

1. Include trench safety systems for earthwork activities.
2. Include trench safety systems for the following systems, including, but not limited to:
    a. All SVE/AS trenching and installation.
    b. Storm drainage system.
    c. Water main and services.
    d. Sanitary sewer main and services.
    e. Mechanical sections requiring trenching.
    f. Electrical sections requiring trenching.
    g. Structural systems requiring trenching or similar construction techniques.

B. Work of this Section is designed specifically to meet the unique conditions of the Project.

1. Perform investigative analysis as appropriate to determine safety systems designed to meet the regulations that are sufficient to protect workers and property.

1.05 DESIGN CRITERIA

A. Contractor shall verify and independently interpret the surface information presented in the Contract Documents, associated Appendices, and supplement existing data as they deem necessary in order to complete the design and construction. The costs of any supplemental information shall be included in the bid for this item

PART 2 MATERIALS (Not Used)

PART 3 EXECUTION

3.01 EXECUTION OF WORK

A. Shoring Or Extra Excavation

1. Trench Safety Systems or additional excavation shall be implemented on all utility trench excavations in excess of 4 feet in depth conforming to the referenced requirements.
2. The Contractor's trench safety system shall be designed by a qualified person and meet the referenced requirements.
3. All excavation not included in trench safety systems shall also meet the WISHA safety standards and the requirements of Section 31 00 00 - Earthwork.

3.02 DELIVERABLES

3.03 QUALITY ASSURANCE

A. Regulatory Requirements: See referenced codes, regulations in Section 01 35 29-Environmental Regulatory Requirements.

B. A qualified, experienced person familiar with the regulations and standards is required to design excavation safety systems.

C. Compliance with the regulations shall be the responsibility solely of the Contractor. The Contractor shall be responsible for worker safety and the Owner and Engineer assume no such responsibility. Damages resulting from improper shoring or failure to shore shall be the responsibility of the Contractor

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for "Trench Safety Systems" shall be as a lump sum unit.

4.02 PAYMENT

A. Payment for "Trench Safety Systems" will be made at the Contract lump sum price as stated in the Schedule of Prices and will be full compensation for furnishing all labor, equipment, materials, and incidentals required to design, provide, construct, maintain and remove safety systems for trench excavation equal to or exceeding a depth of four (4) feet.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent of "Base Course" Work is indicated in the Contract Documents. The Work includes the requirements for producing, transporting, placing, shaping and compacting base courses of one or more materials in conformance with these specifications and the dimensions and sections indicated on the drawings or within the lines and grades established by the Engineer.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction (current addition)

1.03 SUBMITTALS

A. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers' technical literature, standard details, product specifications, and installation instructions for all products.

PART 2 MATERIALS

2.01 MATERIAL REQUIREMENTS

A. General

1. All materials shall be new, not recycled.

B. Aggregates

1. Crushed Rock Base shall be manufactured from ledge rock, talus, or gravel. The materials shall be uniform in quality, free from wood, roots, bark and other extraneous material, and shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor - Top Course	25 min.
Degradation Factor - Base Course	15 min.

2. Crushed Rock Base shall meet the following requirements for grading and quality when placed in the hauling vehicle for delivery to the site:

PASSING	WT. % FOR LOWER COURSE	KEYSTONE OR TOP COURSE
1-1/4" sq. sieve		100
5/8" sq. sieve	50 to 80	100
1/4" sq. sieve	30 to 50	55 to 75
U.S. No. 40 sieve	3 to 18	8 to 24
U.S. No. 200 sieve	7.5 max.	10 max.
Sand Equivalent	40 min.	40 min.

3. Not less than 75 percent of Crushed Rock Base materials retained on a U.S. No. 10 sieve shall have at least one fractured face produced by mechanical crushing.

PART 3 EXECUTION

3.01 PREPARATION FOR EXECUTION OF WORK

A. Equipment

1. All equipment necessary for the satisfactory installation of base courses shall meet the requirements of WSDOT Standard Specifications, Sections 4-04.3(1) Ballast and Crushed Surfacing, Equipment.
2. Equip grading machines or trimmers with a spirit level or other type slope indicator which will continuously indicate the average, transverse slope of the screed. Bubble or indicator movement should be no less than 1/8 inch for each 0.1% change in transverse slope.

3.02 EXECUTION OF WORK

A. Placement of Base Course Aggregates

1. Equipment necessary for the satisfactory performance of this construction shall be on the project and approved by the Engineer prior to beginning Work. If central-mix-plant methods are used, the central mixing plant shall comply with the applicable portions of the WSDOT Standard Specifications.
2. Prepare subgrades as specified above and obtain approval of the Engineer before placing ballast or surfacing materials.
3. Mixing: After each layer of material is placed, mix the material by motor graders or other approved equipment until the mixture is uniform throughout. Add water as directed by the Engineer to facilitate mixing and compacting.
4. Placing and Spreading: Spread each layer of material by means of approved spreading equipment. Such equipment may be bottom-dump hauling equipment with transverse spreading facilities; self-propelled spreading and leveling machines; or spreader boxes equipped with wheels or so constructed as to preclude damage to the subgrade or underlying courses. Spreading in small areas of less than 2,000 square yards or in areas irregular in shape may be accomplished by other means as directed by the Engineer. The depth of any course of material shall not exceed 3-1/2.
5. Shaping and Compacting: Immediately following spreading and shaping, compact each layer to at least 95% of the standard density determined by the compaction control test for granular materials before the next succeeding layer is placed thereon. When the thickness of the base course is less than 0.15 feet, density testing may not be required and the Engineer will determine the number of coverages required for the particular compaction equipment available.
    a. Vibratory compactors or rollers shall be adequate in design and number to provide compaction and obtain the specified density for each layer while still moist. Apply a mist spray of water as needed to replace moisture lost by evaporation. The completed layer shall

have a smooth, tight, uniform surface true to the line, grade and cross section indicated on the drawings, or as staked by the Engineer.

b. Variations in the surface of the top course shall be a maximum of 1/4 inch in 10 feet. Shave off or fill in variations greater than the allowable and re-compact that area.

c. When directed by the Engineer, use crushed stone surfacing top course for keystone to key the top surface of ballast, gravel base, crushed surfacing base course, or any other course which requires keying. Spread the keystone evenly on top of the surfacing course requiring it, in the quantity ordered by the Engineer, by means of approved spreading equipment. Water the surface and, if necessary, blade lightly until the keystone is worked into the interstices of the material without excessive displacement, and then compact. Continue the operations of adding keystone, wetting, blading and compacting until the course has become thoroughly keyed, compacted and approved.

6. Surface Maintenance: Maintain the surface of each layer of material true to line, grade and cross section by blading, watering and rolling until placing the succeeding course. Place the first course of material on all available subgrade before placing the succeeding course unless otherwise authorized by the Engineer. Should irregularities develop in any surface during or after compaction, remedy by loosening the surface and correcting the defects, then thoroughly re-compact the entire area, including the surrounding surface. In the event that additional materials are necessary to make the repairs, they shall be provided at no additional cost to the Port.

7. Route hauling equipment over the roadway in such a manner as to be most effective in the compacting of the material. Hauling over the surfacing in the process of construction will not be permitted when, in the opinion of the Engineer, the effect will be detrimental.

3.03 QUALITY ASSURANCE

A. Inspection and Testing: The Port of Seattle will provide field or plant inspection and testing service to the satisfaction of the Engineer. Sampling and testing to assure compliance with the contract provisions shall be in accordance with Section 01 45 29 - Quality Control; Testing Laboratory Services of these specifications. The Contractor may obtain copies of results of tests performed by the Port of Seattle from the office of the Engineer at no cost. Tests conducted for the sole benefit of the Contractor shall be at the Contractor's expense.

PART 4 MEASUREMENT AND PAYMENT

4.01 GENERAL

A. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to, and included in the payments made for the bid item “Asphalt Paving including Base Course” in the Schedule of Unit Prices as described in Section 32 12 16 – Bituminous Concrete Pavement of these specifications.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Bituminous Concrete Pavement” Work is indicated in the Contract Documents. “Bituminous Concrete Pavement” is also referred to as “Hot Mix Asphalt” or HMA herein and on the drawings.

B. The work covered by this Section includes the furnishing of all labor, materials, equipment and necessary services to construct asphalt pavements to the sections and at the locations as specified in this Section and as indicated on the Contract Drawings.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge and Municipal Construction (current edition).

B. AASHTO T168 – Sampling Hot Mix Asphalt Paving Mixtures

C. AASHTO T209 – Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt

D. AASHTO T 329 – Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

1.03 SUBMITTALS

A. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products. Submittals shall include the following:

1. Samples: Aggregate Blend, Tack Coat, Joint Sealer, Asphalt Binders
2. Certified Test Reports: Performance Graded Asphalt Binder, Course Aggregate, Fine Aggregate, Anti-strip Agent
3. Tests: Asphalt Quality Control Tests
4. Asphalt Concrete Mix Design
5. Asphalt Binder Supplier

B. The certification(s) shall show the appropriate AASHTO/ASTM test(s) for each material, test results, and a statement that the material meets the specification requirement.

C. The job mix formula for each mixture shall be in effect until modified in writing by the Engineer. Should a change in mix or sources of materials be made, a new job mix formula must be tested and resubmitted for approved by the Engineer before the new mix is used.

D. Submit smoothness measurements and surface grade survey results to the Engineer prior to application for payment

E. Equipment List: The Contractor shall submit a list of equipment to be used for placing asphalt concrete to the Engineer prior to utilization on the job.

1.04 CONTRACTOR QUALITY CONTROL

A. The Contractor shall be responsible for developing the asphalt mix designs specified herein. The mix designs shall be developed and/or certified by a laboratory accredited by AASHTO under the AASHTO re:source program. Mixtures on WSDOT's QPL are considered to be certified.

B. Quality Control Testing: The Contractor shall conduct any and all quality control (QC) testing that he deems necessary to properly control the quality, consistency, and uniformity of the asphalt concrete mix being produced. No minimum number of quality control tests is required for this Contract.

C. If the Contractor chooses to conduct quality control tests, the information and data determined through that testing shall be made available for inspection by the Engineer. In no case, however, shall the Contractor's quality control test data be used by the Engineer for acceptance or payment purposes.

D. Surface Grades: Grades shall conform to the tolerance requirements specified herein, except where closer tolerance is required for the proper functioning of appurtenant structures and drainage as determined by the Engineer.

PART 2 MATERIALS

2.01 MATERIAL REQUIREMENTS

A. PAVEMENT CLASS

1. Bituminous concrete pavement shall be HMA Class 1" and HMA Class ½" as indicated on the drawings.

B. AGGREGATES

1. Aggregates for bituminous concrete shall be manufactured from ledge rock, talus, or gravel and shall meet the requirements of the WSDOT Standard Specifications, Section 9-03.8.
2. Tests: Tests, testing methods and results shall be as specified in the WSDOT Standard Specifications, Section 9-03.8(2).
3. Grading: Shall be as required by the WSDOT Standard Specifications for HMA Class 1" " and HMA Class ½" asphalt concrete, Section 9-03.8(3).
4. Course and fine aggregates shall be proportioned in the approximate ratio of 35% Coarse to 65% Fine aggregates.
5. Mineral Filler shall meet the requirements of the WSDOT Standard Specifications, Section 9-03.8(5).

C. BITUMINOUS MATERIALS

1. Bituminous Materials shall meet the requirements of the WSDOT Standard Specifications.
    a. Tack coat shall be CSS-1, CSS-1h, or STE-1 emulsified asphalt conforming to WSDOT Standard Specification 9-02.1(6). The CSS-1 and CSS-1h emulsified asphalt may be diluted with water at a rate not to exceed one part water to one part emulsified asphalt. The tack coat shall not exceed the maximum temperature recommended by the emulsified asphalt manufacturer.
    b. Joint Sealant shall conform to the requirements of WSDOT Standard Specification Section 9-04.2(1)A2.

c. Asphalt for concrete shall be Performance Graded Asphalt Binder (PGAB) PG 70-22 per WSDOT Standard Specification Section 9-02.1(4).

d. Mix designs shall include a minimum of 0.1 percent by weight of binder, anti-stripping additive conforming to the requirements of WSDOT Standard Specification Section 9-02.4.

D. PROPORTIONS OF MATERIALS

1. The materials of which Bituminous concrete is composed shall be of such sizes, gradings and quantities that, when proportioned and mixed together, they will produce a well-graded mixture within the requirements listed in the WSDOT Standard Specifications.

2. The actual proportions of the several components to be used in the production of the asphalt concrete mixture shall be within the WSDOT specified limits to provide a pavement having surface texture, air voids, Voids in Mineral Aggregate (VMA), and Voids Filled with Asphalt (VFA) values satisfactory to the Engineer. The proportions so fixed shall be changed only by the Engineer’s approval.

PART 3 EXECUTION

3.01 JOB CONDITIONS

A. Environmental Requirements:

1. Do not place asphalt beginning October 1st through March 31st of the following year, without written concurrence from the Engineer.

2. Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the surface temperature is less than 50 F, unless approved by the Engineer.

3. In case of sudden rain, the Engineer may permit placing of mixture then in transport from the plant provided that the surface upon which the mix is placed is dry. In addition, the laydown temperatures must conform to the above requirements. Such permission, however, shall not be interpreted as a waiver of any of the quality requirements.

B. New and existing manholes, catch basins, and utility vault covers shall be adjusted to conform to the new pavement grades. All lids, vaults, frames, grates, and other appurtenances shall be set to final grade and accepted by the Engineer. Paving shall be finished 1/4-inch to 1/2-inch higher than adjacent structures, unless otherwise shown or specified.

C. All permanent utilities shall be installed prior to final paving. All utility trenches shall be patched with asphalt pavement as shown on the Contract Drawings.

D. Dust Control: The Contractor shall be responsible for dust control at the site. As a minimum, a water truck and vacuum truck shall be used on site for dust control when required by the Engineer.

3.02 EXECUTION OF WORK

A. Asphalt Mixing Plant – Asphalt shall be produced at a plant approved by WSDOT. Plants shall conform to WSDOT Standard Specifications Section 5-04.3(3)A.

B. Hauling Equipment:

  1. Hauling equipment shall conform to WSDOT Standard Specifications Section 5-04.3(3)B, as modified herein.

  2. Trucks shall be equipped with tarps, in good condition without holes, which can be tied down over the sides and ends of the truck beds during periods of inclement weather to prevent rain from entering the truck bed and coming in contact with the asphalt concrete mix.

  3. Trucks shall be loaded using a multiple-drop method (front then back the middle) to minimize truck to truck segregation.

C. Paving Equipment – Asphalt pavers shall conform to WSDOT Standard Specifications Section 5-04.3(3)C.

D. Compaction Equipment – Rollers shall conform to WSDOT Standard Specifications Section 5-04.3(3)E.

E. Preparation of Asphalt Binder Material (asphalt cement):

  1. The binder shall be stored within the temperature range specified by the supplier of the binder for the grade of asphalt cement being used. Different grades of asphalt binder shall be stored separately and not mixed together at any time.

  2. The binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature.

  3. The temperature of the binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 350 degrees F unless otherwise required by the asphalt binder manufacturer.

F. Preparation of Aggregates:

  1. The aggregate for the mixture shall be heated and dried prior to introduction into the mixer. Aggregate shall be dry with no moisture content prior to introduction into the mixer. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates.

  2. The aggregate temperature shall not be lower than is required to obtain complete coating and uniform distribution of the aggregate particles and to provide a mixture of satisfactory workability.

G. Preparation of Bituminous Mixture:

  1. Asphalt plant shall not exceed production rate certified by manufacturer.

  2. Mixing shall conform to WSDOT Standard Specifications Section 5-04.3(6), as modified herein.

  3. The aggregates and the bituminous material shall be properly proportioned and introduced into the mixer in the amount specified by the job mix formula.

  4. Job mix formula production tolerances shall conform to WSDOT Standard Specifications Section 9-03.8(7), except the tolerance limits for

aggregate shall not exceed the limits of the control points specified herein.

5. The moisture content of all bituminous mix upon discharge shall not exceed one (1) percent. Asphalt sampling shall be performed in accordance with AASHTO T 168 and moisture content testing shall be performed in accordance with AASHTO T 329. Results of the moisture content testing shall be submitted to the Engineer.

H. Preparation of Underlying Surface:

1. Preparation shall conform to WSDOT Standard Specifications Sections 5-04.3(4), and, 5-04.3(4)C as modified herein.

2. Asphalt materials shall not be placed until the underlying course has been tested and accepted by the Engineer.

3. The underlying surface shall be free of water, foreign material, and dust when the hot mix asphalt mixture is applied. Immediately before placing asphalt materials, clean all underlying surfaces and previous courses of all loose and foreign material by sweeping with hand brooms, power sweepers or blowers as directed by the Engineer.

4. Tack Coat:

    a. Tack coat shall be applied in accordance with WSDOT Standard Specifications Section 5-04.3(4), as modified herein. The Engineer shall verify that the tack coat has been properly placed prior to constructing subsequent pavement lifts. Refer to the applicable sections in Chapter 5 of the WSDOT Construction Manual for guidance on tack coat application and inspection.

    b. Apply tack coat only when the underlying surface is free of water, foreign material, dust, and the ambient temperature meets the requirements for the pavement course being placed.

    c. Residual asphalt coating shall be 0.03 to 0.05 gallons per square yard on newly placed asphalt surfaces.

    d. Residual asphalt coating shall be 0.06 to 0.08 gallons per square yard on existing or milled asphalt surfaces.

    e. Residual asphalt coating shall be 0.06 to 0.08 gallons per square yard on compacted subgrade.

    f. Tack coat shall be applied to all vertical surfaces of existing pavement, curbs, gutters, utility structures, concrete edge of the wharf, and construction joints in the asphalt against which additional material is to be placed.

    g. Exposed surfaces of utility vault lids, frames, grates, valve boxes, inlets and other appurtenances within the area to be paved shall be protected from tack coating.

5. Manholes, valve boxes, inlets, frames, grates, lids, and other appurtenances within the area to be paved shall be adjusted to final grade as shown on the Contract Drawings, shall be in place during paving operations, and shall not be paved over as part of the paving

operation. Permanent curbs, gutters, and other supports shall be constructed and backfilled prior to placing asphalt. All contact surfaces shall be coated with tack coat.

I. Transporting, Placing, and Finishing

1. The asphalt concrete mixture shall be transported from the mixing plant to the site in vehicles conforming to the requirements specified herein.
2. Hauling over freshly placed material shall be not permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature.
3. Placing and finishing of the asphalt mixture shall be in accordance with WSDOT Standard Specifications Section 5-04.3(7), as modified herein.
4. The nominal compacted depth of any layer of any course shall not exceed five (5) times the nominal maximum aggregate size of the asphalt mix.
5. The hot mix asphalt mixture shall not be placed during unsuitable weather or when the surface temperature of the underlying course is less than that specified below. Asphalt shall not be placed unless the atmospheric temperature is at least 50 degrees F and rising. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

Lift Thickness, T (inches)	Minimum Base Temperature (degrees F)
T > 3	40
2 < T < 3	45
T < 2	55

6. The initial placement of the asphalt concrete mixture shall occur at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250 degrees F, unless approved by the Engineer.
7. Upon arrival, the mixture shall be placed to the full width of the paving lane. It shall be struck off in a uniform layer of such depth that, when the mix is properly compacted, shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat. Unless otherwise permitted, placement of the mixtures shall begin along the centerline of a crowned section or on the high side or areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10-feet except where edge lanes require less width to complete the area.
    a. For density determination, each day's production will be treated as a lot. A minimum of ten sublots will be tested each day; 15 if production tonnage is expected to exceed 600 tons for that day. In no case shall the sublot size for density determination exceed 40

tons. Random test locations will be determined according to WSDOT Test Method T 716.

b. In-place density shall be a minimum of 93% of the reference theoretical maximum density as determined by WSDOT FOP for WAQTC TM 8. Evidence of gauge calibration to cores, required in the test method, shall be provided for the approved job-mix being placed at a similar thickness or the gauge will be calibrated as described in the test method.

c. Determine reference theoretical maximum density as the moving average of the most recent five determinations for the lot of asphalt concrete being placed according to WSDOT Materials Manual Standard Operating Procedure 729.

d. Engineer may evaluate cyclic density as described in WSDOT Standard Specifications Section 5-04.3(10)B to assess segregation.

8. Joints:

a. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 6-inches; however, the joint in the surface course shall be at the centerline of the pavement if that pavement is to be used by normal car or truck traffic.

b. Longitudinal joint density shall be assessed once per sublot in accordance with WSDOT SOP 735. Low density is defined as less than 91 percent of reference maximum density. When placing a single paver width patch, consecutive density tests will be taken on alternating sides of the patch.

c. Transverse joints in one course shall be offset by at least 10-feet longitudinally from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10-feet.

9. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and raked by hand tools.

10. Formation of all joints shall be made to ensure a continuous bond between courses and obtain required density. Joints shall have same texture as other sections of course and meet requirements for smoothness and grade.

11. Roller shall not pass over unprotected transverse end of freshly laid mixture except when necessary to form a temporary stop. After a temporary stop, and prior to continuation of paving, the tapered edge shall be cut back to its full depth and width on a straight line, to expose a vertical face, before placing the adjacent lane.

Longitudinal joints which are irregular, damaged, uncompacted, or otherwise defective shall be cut back to expose a clean, vertical, sound, surface for the full depth of the course. Apply tack coat on all newly exposed contact surfaces before placing any fresh mixture against the joint.

3.03 COMPACTION OF MIXTURE

A. After placing, the mixture shall be thoroughly and uniformly compacted by rolling. Surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. Sequence of rolling operations and the type of rollers shall be at the discretion of the Contractor.

B. Compaction shall be completed before the mixture cools below 175 degrees F, unless otherwise approved by the Engineer. Temperature shall be determined using an infrared thermometer by the Engineer.

C. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

D. In areas not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers.

E. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at Contractor's expense. Skin patching will not be allowed.

F. Compaction of the asphalt mixture shall be in accordance with WSDOT Standard Specifications Section 5-04.3(10), as modified herein.

  1. For density determination, each day’s production will be treated as a lot. A minimum of ten sublots will be tested each day; 15 if production tonnage is expected to exceed 600 tons for that day. In no case shall the sublot size for density determination exceed 40 tons. Random test locations will be determined according to WSDOT Test Method T 716.

  2. In-place density shall be a minimum of 93% of the reference theoretical maximum density as determined by WSDOT FOP for AASHTO T209. A minimum of two cores per day/lot will be taken by the Contracting Agency or their representative to confirm gauge calibration. At the Contracting Agencies discretion, cores can be used as the sole means of density acceptance with a testing frequency meeting the requirements of Section F(1).

  3. Determine reference theoretical maximum density as the moving average of the most recent five determinations for the lot of asphalt concrete being placed according to WSDOT Materials Manual Standard Operating Procedure 729.

  4. Engineer may evaluate cyclic density as described in WSDOT Standard Specifications Section 5-04.3(10)B to assess segregation.

G. Joints:

  1. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 6-inches; however, the joint in the surface course shall be at the centerline of the pavement if that pavement is to be used by normal car or truck traffic.

2. Longitudinal joint density shall be assessed once per sublot in accordance with WSDOT SOP 735. Low density is defined as less than 91 percent of reference maximum density. When placing a single paver width patch, consecutive density tests will be taken on alternating sides of the patch.
3. Transverse joints in one course shall be offset by at least 10-feet longitudinally from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10-feet.

3.04 JOINT SEALANT

A. Apply joint sealant to the edges of new paving joints, at the meet lines to concrete structures and as directed by the Engineer.

3.05 SURFACE SMOOTHNESS

A. The completed surface of the wearing course shall conform to the smoothness tolerance requirements of WSDOT Standard Specifications Section 5-04.3(13).

3.06 QUALITY ASSURANCE

A. Inspection and Testing: The Port of Seattle will provide field or plant inspection and testing service to the satisfaction of the Engineer. Sampling and testing to assure compliance with the contract provisions shall be in accordance with Section 01 45 29 - Quality Control; Testing Laboratory Services of these specifications. The Contractor may obtain copies of results of tests performed by the Port of Seattle from the office of the Engineer at no cost. Tests conducted for the sole benefit of the Contractor shall be at the Contractor's expense. The batching plant facility shall be made available to the Engineer for inspection of the products.

B. Materials and Work shall be performed in accordance with and shall meet the requirements of the pertinent sections of the WSDOT Standard Specifications (current edition).

C. Unless otherwise referenced or modified, quality control and quality standards for this section shall be as specified in the Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge and Municipal Construction (current edition).

3.07 CLEANING

A. At the conclusion of the work and before final payment is made, Contractor shall remove all debris of every kind from the premises and leave the area broom clean.

3.08 PROTECTION

A. After final rolling, the Contractor shall not permit vehicular traffic on pavement for a minimum of 24 hours until it has cooled and hardened.

B. The Contractor shall erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. “Asphalt Paving including Base Course” will be measured by lump sum based on the lines and grades shown on the drawings.

4.02 PAYMENT

A. Payment for “Asphalt Paving including Base Course” will be made at the contract lump sum price stated in the Schedule of Unit Prices and will be full compensation for furnishing all materials, labor, tools, equipment, and all other costs and expenses necessary or incidental to the preparation, screening, loading, hauling, mixing, placing, shaping and compacting of the material, water included, and for other work required to provide a completed paved surface including the asphalt pavement base course. Requirements for Base Course Aggregates and their placement are covered in Section 32 11 00 Base Course.

B. Cost for tack coat, joint sealer and all costs associated with these work items will be considered incidental to this bid item and no additional compensation shall be made for these items of work.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of “Chain Link Fences and Gates” Work is shown in the Contract Documents. The Work includes the requirements for furnishing and installing all items and components of a completed fence system in conformance with these specifications and the dimensions and sections indicated on the drawings or as established by the Engineer.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. References

1. ASTM fittings, accessories and hardware
2. ASTM specification all steel fabric, framework and fittings shall be hot-dipped galvanized after fabrication
3. ASTM A121 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
4. ASTM A392 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
5. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
6. ASTM F626 Standard Specification for Fence Fittings
7. ASTM F668 Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric
8. ASTM F900 Standard Specification for Industrial and Commercial Steel Swing Gates
9. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
10. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.

B. Submittals shall include the following:

1. Shop and erection drawings.

PART 2 MATERIALS

2.01 CHAIN LINK FENCE

A. The fence shall be chain link fabric-supported on a steel frame, the posts of which are embedded in concrete foundations. Materials shall be heavy industrial chain link fencing in accordance with ASTM F1043, with the additional requirements as follows:

B. Fabric: The fabric shall be manufactured in accordance with ASTM A392 for Class 1 coating, except that the wire shall be No. 11 gage and the fabric shall be twisted and barbed on both selvages.

C. Framework:

   1. Framework and coating shall be in accordance with ASTM F1083 and ASTM F1043.

   2. Framework shall be hot dipped galvanized Schedule-40 pipe conforming to ASTM F1083 or cold rolling and radial frequency welded steel pipe conforming to ASTM A653 or A569 with a minimum yield strength of 50,000 psi. Exterior and interior coatings in accordance with ASTM F1043 Type B outside with a minimum of 0.9 oz of zinc per sq. ft. after welding, a chromite conversion coating and a clear polymer overcoat; type B inside with a minimum of 0.9 oz of zinc per sq. ft.

   3. All tubular framework shall meet the following performance requirements in accordance with ASTM B117.

      a. Exterior: 1000 hours with maximum 5% red rust.

      b. Interior: 650 hours with maximum 5% red rust.

D. Line posts shall be 2.375-inch O.D., at 3.65 pounds per foot

E. Full height privacy slats (brown) shall be included on all fencing and gates.

F. End, corner, or pull posts shall be 2.875-inch O.D., at 5.79 pounds per foot.

G. Top rails and post braces shall be 1.66-inch O.D., at 2.27 pounds per foot as detailed on the Drawings.

H. Tension Wire shall be No. 7 gage, coil spring, high tensile strength wire, marcelled and coated with not less than 0.80 oz of zinc per square foot of uncoated wire surface.

I. Fittings: All fittings, accessories, and hardware for galvanized chain link fence shall conform to the requirements of ASTM Designation F626 and other ASTM Designations listed therein.

J. Gates:

   1. Chain link gates shall be constructed with chain link fabric fastened to the end bars of the gate frame by tension bars and fabric bands, and to the top and bottom bars of the gate frames by tie wires in the same manner as specified for the chain link fence fabric.

   2. Gate frames shall be constructed in accordance with ASTM F900. The corners of the gate frame shall be manufacturer’s standard galvanized cast corner connections, or welded and coated with two coats of a fast-drying, exterior, minimum of 95% zinc cold galvanizing compound for iron and steel. The coating shall be:

      a. Lanco GALVACON

      b. ZRC Cold Galvanizing Compound

      c. or approved equal, or shall be applied in strict accordance with the manufacturers recommendations.

3. Provide diagonal cross-bracing where necessary to obtain frame rigidity without sag or twist. Cross-trussing shall be 3/8-inch galvanized steel adjustable rods.
4. Each gate shall be provided complete with necessary hinges, latch, and drop bar locking device designed for the type of gate, posts, and lock used.
5. Gates shall have positive-type latching devices with provisions for padlocking. Padlocks will be furnished by the Port of Seattle.

K. General: All steel fabric, framework, and fittings shall be hot-dipped galvanized after fabrication in accordance with the applicable ASTM specification.

L. Coatings: All fence and gate parts shall have a black vinyl clad coating in accordance with ASTM F934 and ASTM F668 Class 2A. Coating of fabric shall be extruded/bonded to 0.015 inch thick. Coating for post and rails shall be 3 MIL powder coat. All bolts, nuts, and wire ties shall be powder coated to match the color of the fence fabric.

2.02 OTHER MATERIALS

A. Concrete used in anchorage of posts shall be 2,500 psi, 28 day test, standard ready-mixed concrete from an approved plant.

2.03 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has at least three years’ experience and has completed at least five chain link fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.

B. Single-Source Responsibility: Obtain chain link fences and gates, including accessories, fittings, and fastenings, from a single source

PART 3 EXECUTION

3.01 PREPARATION FOR EXECUTION OF WORK

A. Clearing of the fence line will be required. Clearing shall consist of the removal and disposal of all vegetation measuring more than one inch in diameter or higher than 15 inches above the ground. The clearing width shall be approximately ten feet for chain-link-type fences and approximately three feet for wire-type fences.

B. Grading of the fence line shall be accomplished to eliminate abrupt changes in ground contours. Grubbing incidental to grading shall be accomplished as required. Vegetation resulting from grubbing activities shall be disposed of as cleared material. Boulders, rocks, or excess excavation shall be graded along the fence line or placed adjacent to the clearing on Port of Seattle property as directed by the Engineer.

3.02 EXECUTION OF WORK

A. General

1. The location and alignment of the fence corners and gates will be provided by the Engineer. The Contractor shall locate all intermediate line posts.
2. The Contractor shall submit shop drawings of fencing, gates and appurtenances. Shop drawings must be approved by the Engineer prior to fabrication or installation.

B. Installation

1. Fencing, gates and appurtenances shall be erected and installed by an organization regularly engaged in this business, employing labor skilled in this type of Work to provide a complete security fencing system.
2. Swing gates shall be fabricated to withstand wind and swing loads. They shall have locking bars to seat into keepers that are set in concrete in ground locations which will hold the gate rigidly in position when closed. Stops which will hold the gate open shall be provided and set in concrete at the location designated by the Engineer. Hinges shall be provided which will allow the gate to swing the entire arc indicated on the drawings. Install gates on gate posts only, do not install on buildings.
3. Fabric shall be fastened to posts, the top rail and the bottom wire, with wire ties spaced as indicated on the drawings.
4. Top rails shall be continuous. The Contractor shall provide for expansion or contraction of the continuous rail. Expansion and contraction spring couplings shall be installed at intervals of 100 feet maximum.
5. Posts shall be installed vertically in the concrete with a minimum depth of embedment indicated on the drawings and at the spacing specified for the type of posts approved for the Project. In unpaved areas, the concrete shall be struck off two inches above the surrounding grade. In paved areas it shall be struck off flush with the paving. The top of the concrete shall be troweled smooth, with a slight slope away from the posts.
    a. Minor damage to galvanizing of fabric and fence appurtenances shall be repaired by thorough cleaning of the damaged surfaces and the application of “GALVACON GC-243”, “SPRAYON ZINC-RICH COLD GALVANIZING COMPOUND”, “RUST-OLEUM COLD GALVANIZING COMPOUND PAINT ZINC RICH COATING”, Or Approved Equal, in strict accordance with the manufacturer’s recommendations. At a minimum, the coating shall be gray, fast drying (tack time 30 minutes min.), contains up to 97% pure zinc, and meet or exceed federal specifications MIL-P-26915C or MIL/DOD P-21035A.
    b. Upon completion of the fence, the Contractor shall clean the fence of all soiled places and repair marred or abraded areas.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for “AS/SVE Equipment Area Fence” shall be as a lump sum unit.

4.02 PAYMENT

A. Payment for “AS/SVE Equipment Area Fence” will be made at the Contract lump sum price as stated in the Schedule of Prices and will be full compensation for furnishing all labor, equipment, and incidentals required to accomplish the installation and protection as specified.

End of Section

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The extent and location of the “Monitoring Well Installation, Decommissioning, Refurbishment and Protection” Work is indicated in the Contract Documents.

B. The Work includes protection of existing off-site monitoring wells during construction and decommissioning of existing on-site monitoring wells.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. Department of Ecology DOE completion of all well Work on Well Record forms

B. Department of Ecology (DOE) Contractor notify intent to construct, refurbish, or decommission a well

C. Washington State Department of Ecology forms are available

D. Department of Ecology DOE provide a copy of all submittals at close of project to the Engineer

E. Department of Ecology DOE submit a copy of each submittal to the Engineer

F. Department of Ecology DOE Well Construction Notification forms

G. Chapter 18.104 RCW Water Well Construction Act

H. WAC 173-160 Minimum Standards for Construction and Maintenance of Wells

I. WAC 173-160 Minimum Standards for Construction and Maintenance of Wells PVC well casing, size and schedule

J. WAC 173-160 above ground monuments

K. WAC 173-160 Washington State well regulations

L. WAC 173-160 Type 2 surface seals for wells

M. WAC 173-160 monitoring well decommissioning

N. WAC 173-160-465 decommissioning

O. WAC 173-162 Work must be performed by a firm licensed

P. WAC 173-162 Washington State well regulations

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products. Submittals shall include the following:

1. Well Construction Notification Forms
2. Well Records
3. Forms are available from the Washington State Department of Ecology

1.04 QUALITY CONTROL

A. Work must be performed by a firm licensed for well installation, refurbishment, and decommissioning as required in WAC 173-162.

1.05 PROTECTION OF EXISTING WELLS

A. During Work activities it is the responsibility of the Contractor to protect existing monitoring wells which have not been designated for decommissioning. Work shall be conducted so as to prevent damage to existing monitoring wells.

1.06 RECORD KEEPING

A. Contractor shall notify the Department of Ecology (DOE) of their intent to construct, refurbish, or decommission a well at least seventy-two hours before starting Work. Well Construction Notification shall be submitted on forms provided by the DOE.

B. Contractor shall report the completion of all well Work on Well Record forms and submit them to the DOE within thirty (30) days of completion of well Work. The Contractor shall submit to the Engineer a copy of all Well Construction Notification forms and Well Record forms. Submit a copy of each DOE submittal to the Engineer. In addition provide a copy of all DOE submittals at close of project.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials shall be of the quality herein specified, new, free from defects, of the best commercial grade and approved by a nationally recognized testing laboratory for the purpose used, if such approval is granted to the equipment in question. Each type of material shall be of the same make and quality throughout the Project.

2.02 MONITORING WELL MONUMENTS AND SURFACE PROTECTION MATERIAL

A. PVC well casing, size and schedule shall be consistent with WAC 173-160 Minimum Standards for Construction and Maintenance of Wells.

B. Flush Mounted Monuments: Monitoring well monuments consist of a flush monument light base A/C 150-5345-42G or equivalent for Type 1 surface seals. Light bases shall be Type L-868, Class I, Size A - 10 inch (AC15XX2Q200003) including a 3/4” cover (AK300012) and a 1/2” flange ring (AF510208Y); or equivalent. The Contractor shall be responsible for providing all accessories for light bases including but not limited to spacers/adapters/rings called for on the drawings.

C. Modification

1. Monitoring Well Identification

a. The steel cover of the monument shall be clearly and permanently labeled “Monitor Well.” A permanent well identification number will be provided by the Port. The permanent well identification number will be stamped into the center of the steel cover using a Hanson Company hand held type holder and steel type kits, model number 27783, No Equal.

2.03 WELL CAP FOR FLUSH MOUNTED INSTALLATIONS

A. Lockable 2 inch well caps shall be of EBW model number 70.772-106-01, or Morris model number 318002001, Or Approved Equal. Lockable 4 inch well caps shall be Morris model number 318004001, No Equal. The Port will provide a standard keyed lock.

PART 3 EXECUTION

3.01 NOTICE

A. Contractor shall provide 5 working days notice to the Engineer prior to well installation, refurbishment or decommissioning.

B. Contractor shall notify the Department of Ecology (DOE) of their intent to decommission a well at least seventy-two hours before starting work or as otherwise required by the DOE. Notice of Intent to Decommission a Well Forms shall be submitted to the DOE as required.

3.02 PROTECTION OF MONITORING WELLS DURING CONSTRUCTION ACTIVITIES

A. Contractor shall be responsible for the protection of monitoring wells during construction activities. Contractor shall be responsible for the repair of wells identified to remain or be protected which become damaged during construction activities.

B. Wells identified to be protected, which are damaged and unable to be repaired, shall be decommissioned and replaced at Contractors expense.

3.03 INSTALLATION OF NEW WELLS

A. Contractor shall comply with all related Washington State well regulations (WAC 173-160 and WAC 173-162) and these specifications.

3.04 MONITORING WELL IDENTIFICATION

A. The monitoring well number shall be stamped onto the cover and painted onto the surface seal using 3 inch character stencils.

3.05 SURFACE SEAL

A. Seal Type 1:

1. Type 1 surface seal shall consist of a 20 inch diameter by 18 inch thick reinforced concrete pad. The concrete pad shall be steel reinforced with #3 and #4 rebar Grade 60 as specified on the drawing. The surface elevation of the concrete pad shall match the surrounding surface. Where the existing surface is concrete or asphalt, joint sealing filler (Section 32 13 73 – Joint Sealing Filler) shall be used to seal the contact joint.

3.06 BASES

A. The bases shall be installed as indicated on the drawings.

3.07 PROTECTION DURING CONSTRUCTION

A. Maintain a minimum undisturbed one foot radius around wellheads, or submit alternate protection plan for approval.

3.08 WASTE GENERATED DURING INSTALLATION, REFURBISHMENT AND DECOMMISSIONING

A. All waste materials generated from the installation, refurbishment and decommissioning of monitoring wells shall be disposed of off-site at Contractors expense and according to all pertinent federal and state requirements.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for “AS/SVE and Recovery Well Install” and shall be as a lump sum unit.

4.02 PAYMENT

A. Payment for “AS/SVE and Recovery Well Install” will be made at the Contract lump sum price as stated in the Schedule of Prices and will be full compensation for furnishing all labor, equipment, and incidentals required to accomplish the installation and protection of wells as specified.

End of Section

A.GENERAL

1.01 SUMMARY OF WORK

A. Pipe all AS wells to the equipment skid location indicated in the drawings.

B. Install SVE horizontal collection wells and pipe all SVE horizontal and vertical wells to the equipment skid location indicated in the drawings.

C. Connect AS and SVE well piping to the manifolds on the AS and SVE equipment skids. All piping running along the ground surface shall be adequately supported.

D. Install well head piping and instrumentation for AS, SVE, and LNAPL recovery wells.

E. The contractor shall only work in an active work area. Meaning that all work shall be completed prior to starting work in a new work area. Work areas are shown on the drawings.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

A. ASTM D3350-14 (Standard Specification for High-Density Polyethylene Pipe and Fittings)

B. D3261-16 (Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing)

C. D1785-15 (Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120))

D. D2466-15 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

E. D2467-15 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

F. F667/F667M-16 (Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings)

G. F2620-13 (Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings)

H. F2206-14 (Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE))

1.03 SUBMITTALS

A. Submit materials data in accordance with of Section 01 32 19 – Preconstruction Submittals. Submittals shall include the following:

1. Piping plan. Include a pipe supporting plan for subsurface piping and piping running along the ground surface and include how pipes will daylight and connect into the AS/SVE System.

B. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers' technical literature, standard details, product specifications, and installation instructions for all products. Submittals shall include the following:

1. Pipe and fittings
2. Proposed buried pipe field quality control test procedure

B.PRODUCTS

2.01 GENERAL

A. Materials shall be of the quality herein specified, new, free from defects, of the best commercial grade and approved by a nationally recognized testing laboratory for the purpose used, if such approval is granted to the equipment in question. Each type of material shall be of the same make and quality throughout the Project.

2.02 SVE HORIZONTAL WELL PIPE AND FITTINGS

A. Pipe: 4-inch corrugated, perforated, double-walled (smooth interior) pipe (ASTM F2648) with corrugations per ASTM F405

B. Perforations: Three 1/8-inch slots at 120 degrees, rotated every valley.

C. Fabric Wrap (Sock): Circular knitted polyester geotextile fabric (ASTM D6707)

D. End Cap or End Plug: As recommended by manufacturer

E. Connectors: Snap couplings (ASTM F667) with rubber gaskets (ASTM D1056 Grade 2A)

F. Adapter to HDPE SDR 11 pipe: Rubber or mastic/polypropylene connection for dissimilar pipe

2.03 SVE PIPE AND FITTINGS

A. Pipe: 3- and 4-inch SDR 11 HDPE pipe (PE4710)
B. Elbows: SDR 11 Black Butt Fusion Fittings
C. Adapters to National Pipe Thread (NPT): Epoxy coated carbon steel and SDR 11 HDPE

2.04 AS PIPE AND FITTINGS

A. Pipe: 1-inch SDR 11 HDPE pipe (PE4710)
B. Elbows: SDR 11 Black Butt Fusion Fittings
C. Adapters to NPT: Epoxy coated carbon steel and SDR 11 HDPE

2.05 WELL HEAD PIPE AND FITTINGS

A. Air Sparging:
  1. Pipe and Fittings: Schedule 40 or 80 PVC.
  2. Ball valve: ¼-inch brass or stainless steel
  3. Pressure gauge: 0-10 psig, back mount

B. Vapor Extraction:
  1. Pipe and Fittings: Schedule 40 or 80 PVC.
  2. Ball valve: ¼-inch brass or stainless steel
  3. Vacuum gauge: 0-100 inches H20, back mount

C. LNAPL Recovery:
  1. Well Seal – 4-inch ABS plastic, single drop (1 inch), with rubber packer and ½-inch and 1-inch NPT threads
  2. Ball Valves: ½-inch and ¾-inch brass or stainless steel
  3. Pipe and Fittings: Schedule 40 or 80 PVC
  4. Camlock Fittings (Male and Cap): Polypropylene with locking feature

C.EXECUTION

3.01 GENERAL

A. The contractor shall only work in an active work area. Meaning that all work shall be completed prior to starting work in a new work area. Work areas are shown on the drawings.

B. In the event of conflict within these requirements, the Contractor shall request resolution from the Engineer.

C. PVC pipe may be solvent welded however spill management of primer and glue shall be included in the Contractor’s Technical Execution Plan (Section 01330 – Submittal Procedures).

D. Well Head Placement: The installation of the AS and SVE wells shall be conducted by a licensed driller and may be installed prior to SVE/AS system install. Wellhead completions shall be constructed in accordance with the requirements shown on the drawings. Each AS and SVE remedial well shall be temporarily capped with a PVC threaded plug and appropriate plumber’s tape for the pipe threads. The temporary sand installed in the air sparging well annulus shall be replaced with a cement grout seal. A two-foot square by ten inch thick well pad shall be placed around each well monument. The monument must be level with the surrounding concrete pad as well as surrounding surface material.

E. Buried Pipe Installation

1. All types of buried PVC pipe are to be bedded per AWWA C605-05 using Type 5 embedment.
2. Any type of steel buried pipe must be bedded per AWWA C605-05 using Type 1 embedment (unless buried alongside PVC pipe).
3. Buried pipe must be placed as level as possible without low points or pockets.
4. The minimum burial depth for all pipe is 12 inches of soil and/or asphalt cover or 6 inches of concrete.
5. All buried piping is considered to be for vapor service without concern for freeze protection..

F. Utilities Planning

1. The Contractor shall identify when and how all underground utilities crossings will be addressed in the Technical Execution Plan.
2. Pipe level placement requirements are retained despite any effort to avoid buried utilities or structures.

3.02 SVE HORIZONTAL WELL PIPING

A. SVE horizontal well piping shall be placed at the locations indicated in the Drawing.

B. Installation shall be in accordance with ASTM D2321 and manufacturer recommended installation guidelines, including connectors, end caps or plugs, and the transition fitting to SDR-11 HDPE pipe.

C. Backfill and overlying fabric placement will be performed in accordance with Section 31 00 00 – Earhwork.

3.03 AS AND SVE PIPING

A. AS and SVE piping shall be installed at the locations and depths identified in the Drawings.

B. Pipes shall be installed at the spacings shown in the drawings. Pipes shall be placed level and straight and shall not be in contact with other pipes.

C. All SDR-11 HDPE pipe connections shall be butt fusion welded in accordance with ASTM F2620-13. Most welding equipment is not explosion-proof. Consult fusion equipment manufacturer’s instructions for welding in volatile and potentially explosive environments.

3.04 WELLHEAD PIPING

A. All wellhead piping and fittings shall be constructed to fit within the well monument and provide a watertight seal. Pressure and vacuum gauges shall be readable and ball valves shall be fully operational through each well monument cover when opened.

3.05 FIELD QUALITY CONTROL TESTING

A. All butt fusion welded pipe and fittings shall be subject to field quality control testing. Testing shall be completed prior to starting work in a new work area.

B. For each welding machine, perform a trial weld on a test specimen to verify the fusion procedures and machine set-up are appropriate. Subject the test specimen to the bent strap test. Each welding machine shall not begin field welding until a successful bent strap test has been performed.

C. Each field weld will be visually inspected for defects Inspection shall be completed prior to starting work in a new work area.

D. Contractor shall performed hydrostatic (ASTM F2164) or pneumatic pressure testing of all buried AS and SVE lines. Contractor shall submit recommended quality control test procedures to Engineer for review and approval.

E. Any leaks shall be repaired and pressure tests repeated until a successful test has been performed

F. Records of all pressure testing shall be submitted to the Engineer prior to Substantial Completion.

3.06 CONSTRUCTION REQUIREMENTS

A. Temporary Piping/Plugs and Connections:

1. The Contractor may install temporary piping plugs, caps etc. to accommodate the Work. At the completion of the Work, temporary piping features shall all be removed to conform and comply with the Drawings.

D.MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Measurement for completion of the piping and wellheads associated with the AS/SVE system are included in “Piping and Well Head Installation” and shall be as a lump sum unit.

4.02 PAYMENT

A. Payment for “Piping and Well Head Installation” will be made at the Contract lump sum price as stated in the Schedule of Prices and will be full compensation for furnishing all labor, equipment, testing, tanks, and incidentals required to accomplish the installation and of the Piping and Well Head Installation as specified. This item does not include the payment associated with backfill, well head monument placement, or pavement completion at wellheads.

End of Section

Appendix C

Draft Operation, Monitoring, and Maintenance Plan

APPENDIX C
DRAFT – OPERATION, MONITORING & MAINTENANCE PLAN
Draft – 100% Design

Terminal 30 Cleanup Project

Port of Seattle

Terminal 30 Site

December 20, 2018

APPENDIX C
DRAFT – OPERATION, MONITORING & MAINTENANCE PLAN

Terminal 30 Cleanup Project
Draft – 100% Design

Port of Seattle
Terminal 30 Site

December 20, 2018

PREPARED BY:

CRETE
CONSULTING, INC.

Table of Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

This is a draft document. The final will be submitted following construction when specifics of the remediation system are known. 'Placeholders' have been inserted and will be updated in the final document.

This Draft Operation, Monitoring and Maintenance Plan (OM&M Plan) has been prepared for the Port of Seattle (Port) Terminal 30 (T30, Figure 1-1) Site cleanup action. This OM&M Plan includes operation, monitoring, and maintenance details for the combined SVE and AS system operating and the light non-aqueous phase liquid (LNAPL) product recovery wells installed during the T30 cleanup action completed in xxplaceholderxx. This plan was prepared as required by the Washington State Department of Ecology (Ecology) Consent Decree dated July 19, 2017 between Ecology and the Port of Seattle for the T30 Site. Documentation of the SVE/AS system construction, including startup monitoring, can be found in the Construction and Startup Completion Report (xxplaceholderxx). Construction as-builts are included in Appendix A.

The Site is generally located at 1901 East Marginal Way South, Seattle, Washington, approximately one mile southwest of downtown Seattle, in King County, Washington on the shoreline of the East Waterway (Figure 1-1). The Site encompasses about 7 acres of a 34-acre intermodal container terminal where petroleum contamination is present and includes light non-aqueous phase liquid (LNAPL), soil, and groundwater contamination.

1.1 General Safety Consideration

Worker health and safety measures will be implemented by all parties performing work outlined in this OM&M Plan per Washington Administrative Code (WAC) 173-340-810, Worker Safety and Health, which provides general provisions and requirements for health and safety plans for work at MTCA sites. General provisions are based on requirements under the Occupational Safety and Health Act of 1970 and the Washington Industrial Safety and Health Act. General Occupational Health Standards for the State of Washington, as established in WAC 296-62, are applicable to work associated with OM&M activities at T30 and provide rules designed to protect the health of employees by establishing requirements to control health hazards.

Prior to performing work onsite, operating personnel must review and be familiar with emergency response procedures outlined in the site-specific Health and Safety Plan (xxplaceholderxx).

1.2 General Operations

Full time operating personnel are not required for the operation of the SVE/AS system or the LNAPL product recovery wells. During the course of the system's lifetime, it is anticipated that site visits will be conducted regularly by a trained technician in order to collect monitoring data and perform preventative maintenance.

The following contacts are provided as references, but should be updated on a periodic basis:

Table 1-1 Terminal 30 Project Contacts

Role	Contact Name	Affiliation	Contact Details
Property Owner	Roy Kuroiwa T30 Environmental Manager	Port of Seattle	(206) 787-3814 kuroiwa.r@portseattle.org
Remediation Engineer	Mike Byers Project Manager	CRETE Consulting	(206) 491-7554 mike.byers@creteconsulting.com
Tenant Coordination Services	Steven Queen - North Harbor Management	Port of Seattle	(206) 465-3269 squeen@nwseaportalliance.com
Facility Operator	Damien Bressler – SSA Marine Terminal 30 General Manager	SSA Marine	(206) 265-1610 Damien.bressler@ssamarine.com
Construction Contractor	TBD		
System Maintenance	TBD		
Waste Disposal Contractor	TBD		

2 AS-SVE System Details

Xxplaceholderxx this section is based on Text in the 90% EDR, this will be updated to reflect the installed AS-SVE System.

2.1 Air Sparging – Network

As stated in the CAP, the purpose of the AS/SVE system is to reduce contaminant mass in groundwater in the sheen area. Air sparging will introduce air into the subsurface below the water table to strip volatile compounds (TPH-G and BTEX) and stimulate biodegradation of other compounds (TPH-D, TPH-O, and PAHs). Air sparging is also useful in the presence of LNAPL to increase the available surface area of LNAPL and promote stripping of volatile components and biodegradation.

Air Sparge Wells

Air sparge wells will be constructed of 2-inch Schedule 40 PVC with a 2-foot 10-slot (0.010-inch) well screen placed from 12 to 14 feet below the water table or 23 to 25 feet bgs. This depth was selected so that the wells remain above the former mudflat to prevent uncontrolled lateral flow of air due to heterogeneities. Well annulus sand pack (10/20 Colorado silica sand) will extend to 6 inches above the top of well screen, followed by a 3-foot bentonite seal, and the remainder of the annulus will be filled with cement-bentonite grout to 3 feet bgs. Wells will be spaced every 30 feet.

Air Sparge Flow Rates and Pressure

Due to the presence of numerous utilities and other subsurface features that could make vapor collection difficult, the air sparge flow rate will be limited to 5 to 10 scfm spell out per well.

The maximum air injection pressure will be limited to 60% of the overburden soil and groundwater pressure. The weight of soil is calculated based on 23 feet of soil above the top of well screen, a soil specific gravity of 2.7, a water density of 62.4 pounds per cubic foot (0.036 pounds per cubic inch), and a porosity of 40%. The weight of water is calculated based on 12 feet of water above the top of well screen, a specific gravity of 1, a water density of 62.4 pounds per cubic foot, and a porosity of 40%. The weight of soil is 16.1 psi and the weight of water is 2.1 psi, for a total overburden pressure of 18.2 psi. As a result, the maximum air injection pressure will be below 11 psi. At 5 to 10 scfm, 7 psi will be adequate to overcome the hydraulic head (5.2 psi) plus formation entry pressure, below the maximum injection pressure threshold of 11 psi.

The system will be operated in 3 zones as follows:

- North Zone – 10 wells (AS-1 to -10) at 6 scfm per well (60 scfm total)
- Central Zone – 6 wells (AS-11 to -16) at 9 scfm per well (54 scfm total)
- South Zone – 5 wells (AS-17 to -21) at 10 scfm per well (50 scfm total)

These flow rates vary by zone based on the estimated level of TPH contamination present. In addition, lower injection flows are used where horizontal vapor extraction is used and higher injection flows are used where vertical extraction wells will be used that allow more control of extraction.

The blower and air distribution manifold will be located at the equipment pad. The 7.5 Hp rotary lobe blower will be capable of producing 120 scfm at 9 psig. 2 zones will operate at a time and will cycle regularly using actuated butterfly valves. The cycling time will start as stated in the CAP (60 minutes on and 30 minutes off for each zone) but may be adjusted during system operation to improve performance. Air will be delivered to each well via a ¾- or 1-inch SDR11 HDPE pipe.

2.2 Soil Vapor Extraction - Network

Soil vapor extraction will be performed using horizontal wells in the North Zone and vertical wells in the Central and South Zones, shown on Figure xx.

Soil vapor extraction will be operated continuously and will not be cycled on and off like the air sparging system. Vapor extraction flows will be 2 times the air injection flow for each zone as follows:

- North Zone – 2 horizontal wells (SVE-1 and -2) at 120 scfm total
- Central Zone – 3 vertical wells (SVE-3, -4, and -5) at 40, 30, and 50 scfm each, respectively, due to variable well spacing to avoid utilities and potential short-circuiting
- South Zone – 4 vertical wells (SVE-6, -7, -8, and -9) at 25 scfm each

The blower and air distribution manifold will be located at the equipment pad. The 10 Hp regenerative blower will be capable of extracting 350 scfm at 5 inches Hg (70 inches H2O). Vapor monitoring points will be used to assess vapor extraction effectiveness and flow rates will be adjusted as needed. Air will be extracted from each well via a 3- or 4-inch SDR17 HDPE pipe.

2.3 System Components and Equipment

xxPlaceholderxx – this will be updated based on installed product details/equipment.

2.4 Off-Gas Treatment Systems

xxPlaceholderxx – this will be updated based on installed product details/equipment.

2.5 Process Control Systems

xxPlaceholderxx – this will be updated based on installed product details/equipment.

2.6 Electrical Service and Distribution System

xxPlaceholderxx – this will be updated based on installed product details/equipment.

3 LNALP Recovery System Details

Xxplaceholderxx this section is based on Text in the 90% EDR, this will be updated to reflect the installed LNAPL Recovery System.

Ten 4-inch wells will be installed at the locations indicated on Drawing C-2 (Appendix A) to better define the extent of LNAPL and perform free product recovery. The wells are oriented in 3 rows that are spaced 25 feet with wells staggered along these rows at 35 foot spacing. Free product recovery wells RW-100 to RW-110 are located to minimize conflicts with intermodal container storage. These wells, plus RW-12 and possibly MW-59, will be accessible within the drive lane even when containers are present. As a result, recovery events at these wells can be scheduled to occur on a recurring schedule. Recovery wells RW-108 to RW-110 are located beneath where containers are stored and will require additional coordination with terminal operations to obtain access. As a result, these recovery wells may not be accessible on a routine schedule.

The 4-inch recovery wells will be constructed of 4-inch Schedule 40 PVC in a 12-inch borehole with a 10 slot screen (0.010-inch) from 5 to 15 feet below grade. Well annulus sand pack (10/20 Colorado silica sand) will extend to 12 inches above the top of well screen, followed by a 3-foot bentonite seal. The well head will be completed in concrete vault (Oldcastle Precast 3030-LA, or similar) to allow room for a quick disconnect on the 2-inch well stinger for connection to a vacuum truck hose plus a vacuum make-up air valve and a well gauging port.

No dedicated pumps or tubing will be in the wells. During removal events a vacuum truck will be used to remove the product. No operating or maintenance of the LNAPL system is expected.

4 SVE/AS Operating Procedures

Operation of the SVE/AS system primarily deals with performance monitoring of the SVE/AS systems, evaluation of the monitoring data, and making adjustments to increase the effectiveness of the SVE and AS processes described in Section 2. Performance monitoring of the remediation system includes the following elements:

- Operational monitoring of SVE/AS parameters; and
- Soil vapor migration monitoring.

The following sections provide an overview of the SVE/AS system operating procedures, the frequency of performance monitoring is provided in Table 1. Data collected during performance monitoring will be documented on the forms provided in Appendix C or a field notebook, and the results will be transferred to spreadsheets for evaluation. Sampling and chemical analysis will be performed in accordance with the standard methods and procedures summarized in this section and Appendix D.

Basic information and procedures for system operation are provided in the SVE/AS system manual, developed by the Contractor, in Appendix A (xxxPlaceholderxxx), including:

- Electrical schematics and programmable logic controller (PLC) programming;
- A description of the control panel, switches, and indicator lamps;
- A description of system alarms; and
- A system startup procedure.

5 SVE/AS System Maintenance

The SVE/AS system contains specialized and complex process equipment. Routine maintenance conducted on a monthly basis in conjunction with performance monitoring is required to ensure that process equipment continues to operate properly. Disabled or improperly working equipment will reduce treatment efficiency of the system. Repair costs for poorly maintained equipment usually exceed the cost of regular preventative maintenance and may increase the downtime of the remediation system.

5.1 Housekeeping

The SVE/AS system is location on Port of Seattle property, on an area leased by SSA. It is important to keep the site clean and in good repair. Housekeeping will cover the equipment area located within the fenced equipment enclosure, and the areas near AS/SVE wells and piping. Poor housekeeping creates safety and health hazards and can mask or create process and mechanical problems.

5.2 Equipment Maintenance

During routine monthly site visits equipment will be inspected and routine housekeeping will be performed. The following sections detail recommended maintenance for the various system components; if it is determined they require it, following inspection. Component literature is contained in the system manual provided by xxplaceholder – insert manufacture - in Appendix A.

5.2.1 **Air Sparge Wells**

The screens of the AS wells will require redevelopment if they become plugged. If the system operator notices a reduction or blockage of air flow to an AS well, plugging may be a factor. Several types of plugging are possible, including:

- Precipitation of calcium carbonate (calcite) due to solubility changes as the pH increases;
- Precipitation of iron and magnesium due to oxidation of dissolved inorganic species in the stripping well; or
- Growth of iron bacteria or other slime within the well casing.

The specific cause of plugging must be ascertained to develop an appropriate control or redevelopment approach.

5.2.2 **Soil Vapor Extraction Piping**

SVE piping was installed to minimize the entrainment of water in the lines; however, if the system is experiencing a drop in flow from a well, or an increase in vacuum to maintain air flow, it will be necessary to clear the lines of condensate because water has accumulated to the point that it is affecting system performance.

Water entrainment is primarily a seasonal condition becoming more of a problem in winter when warmer air being extracted from below ground contacts colder piping above ground, causing condensation to form inside the piping. It can also be aggravated by a higher water table and air sparging action causing bubbling within SVE wells. If left untreated water entrainment can result in decreased performance or even complete blockage of portions of the SVE system. If 1) the system operator notices steadily decreasing flows or increasing vacuums for a given SVE well or trench over the course of three or more monthly performance monitoring visits; 2) a complete loss of flow is noted during a single visit; or 3) SVE flow from a well or trench has reduced such that the AS/SVE balance requirements are not being met then the following actions will be performed to restore SVE performance:

- Tag the valves on SVE lines and AS wells associated with the zone of the SVE system that shows reduced performance.
- Temporarily shut down the AS wells in the affected zone closing the valves. Allow time for pressures at the AS wells to stabilize.
- Temporarily shut down the affected SVE lines closing the valves. Allow time for entrained water to gravity drain back to the SVE wells, sumps, or trenches.
- Restart the affected SVE lines by opening the valves and monitoring SVE performance for 10 minutes.
- If the problem persists after 10 minutes, it is likely that water is entrained within a portion of the SVE line where it cannot gravity drain. In this case, the SVE line will require modification to remove entrained water (e.g. installing a drainage port at low point in the pipe or an access point to allow tubing from a peristaltic pump to reach the blockage). Water drained from the SVE system will be collected and transferred to the condensate storage tank.
- If the problem does not recur after 10 minutes, continue to evaluate the performance of the SVE system during monthly performance monitoring.

5.3 Soil Vapor Extraction Blower

The xxplaceholder insert blower idxx SVE blower is equipped with sealed bearings and does not require regular maintenance or lubrication. The blower will be visually inspected on a monthly basis for the accumulation of dirt, oil, grime, etc. Accumulation of these substances on surfaces can inhibit heat dissipation from the equipment, which can cause damage through overheating. The surfaces of the blower will be wiped down when accumulation of dirt/grime is apparent.

5.4 Moisture Separator and Pump

The moisture separator (MS) and internal filter sock will be visually inspected on a monthly basis. If the MS contains water, it will be drained. The filter sock will be replaced if it shows signs of plugging. If the vacuum gauge between the SVE blower and the MS indicates an increase of greater than 5 inches water column from normal operating pressure, then the filter sock is becoming plugged.

The MS pump will be visually inspected on a monthly basis for the accumulation of dirt, oil, grime, etc. Accumulation of these substances on surfaces can inhibit heat dissipation from the equipment, which can cause damage through overheating. The surfaces of the pump will be wiped down when accumulation of dirt/grime is apparent. This is a closed coupled unit and ball bearings are located inside the motor, they are permanently lubricated, no greasing is required.

5.5 Air Sparge Compressor

The xxx plachholder insert compressor type xxx AS compressor will be visually inspected on a monthly basis for the accumulation of dirt, oil, grime, etc. Accumulation of these substances on surfaces can inhibit heat dissipation from the equipment, which can cause damage through overheating. The surfaces of the compressor will be wiped down when accumulation of dirt/grime is apparent. Additional maintenance needs for internal parts of the compressor include:

- Lubrication of the bearings on an annual basis;
- Visual inspection of the carbon vanes for wear at 6 months intervals. Based on past experience vanes require replacement after approximately 8 months of operation; and
- Visual inspection and replacement as necessary of the inlet filter at 6 month intervals.

5.6 Heat Exchanger and Ventilation Fans

The heat exchanger and ventilation fans in the SVE blower and the AS compressor sound enclosures will be visually inspected on a monthly basis for the accumulation of dust and grime on the fan guards, propellers, and motors. Accumulation of these substances on surfaces can inhibit heat dissipation from the equipment, which can cause damage through overheating. The surfaces of the fans will be wiped down when accumulation of dirt/grime is apparent. The motor bearings will be lubricated every six months using Society of Automotive Engineers (SAE) 20 oil or based on manufacture’s specifications.

5.7 Condensate Storage Tank

The condensate storage tank will be visually inspected on a monthly basis for accumulation of water. Accumulation of condensate in the storage tank, if it occurs at all, will likely be generated during manual draining of SVE lines using drainage ports installed at low points in the piping, or a peristaltic pump to access low points in piping where drainage port installation is not feasible due to spatial constraints. The amount of condensate generated during draining of SVE lines will vary seasonally, but is not expected to be more than a few gallons per month. Condensate water removal, transport, and disposal will be performed by the Waste Disposal Contractor.

5.8 Granular Activated Carbon Units

The influent and effluent stream through the GAC units will be sampled on a monthly basis for breakthrough according to the operating procedures. Once it has been determined that breakthrough has occurred, the GAC Contractor will be contacted regarding change out and disposal of the spent GAC. After the lead GAC unit has been changed out, the lag unit will become the new lead and the GAC units will be reconnected to the system in series.

6 References

Placeholder – will be updated for Final.

Tables *(will be included in final)*

Figures *(will be included in final)*

Appendix A Remediation System As-Builts *(will be included in final)*

Appendix B Standard Operation Procedures *(will be included in final)*

Appendix C System Field Operation Log Forms *(will be included in final)*

Appendix D Equipment Cut Sheets *(will be included in final)*

Appendix E SVE Emissions Monitoring Protocol *(will be included in final)*

Appendix D

Archaeological Monitoring and Discovery Plan

Cultural Resource Consultants

TECHNICAL MEMO 1703M-1

DATE: August 23, 2017

TO: Mike Byers
Crete Consulting

FROM: Margaret Berger, Principal Investigator

RE: Archaeological Overview and Monitoring Plan for the Terminal 30 Remediation Project, Seattle, King County, Washington

DAHP Project: 2017-03-01803

The attached short report form constitutes our brief overview and archaeological monitoring plan for the above referenced project. Background research did not identify any previously recorded cultural resources within the project location. No further archaeological investigations are recommended prior to construction. An inadvertent discovery protocol, and contingent archaeological monitoring and treatment plan is attached. Please contact our office should you have any questions about our findings and/or recommendations.

1416 NW 46TH STREET, STE 105 PMB 346 SEATTLE, WA 98107
PHONE 206 855-9020 - info@crcwa.com

CULTURAL RESOURCES REPORT COVER SHEET

Author: Sonja Kassa

Title of Report: Archaeological Overview and Monitoring Plan for the Terminal 30 Remediation Project, Seattle, King County, Washington

Date of Report: August 23, 2017

County(ies): King Section: 07 Township: 24 N Range: 04 E

Quad: Seattle South, WA Acres: 11

PDF of report submitted (REQUIRED) ☐ Yes

Historic Property Inventory Forms to be Approved Online? ☐ Yes ☒ No

Archaeological Site(s)/Isolate(s) Found or Amended? ☐ Yes ☒ No

TCP(s) found? ☐ Yes ☒ No

Replace a draft? ☐ Yes ☒ No

Satisfy a DAHP Archaeological Excavation Permit requirement? ☐ Yes # ☒ No

Were Human Remains Found? ☐ Yes DAHP Case # ☒ No

DAHP Archaeological Site #:

- Submission of PDFs is required.
- Please be sure that any PDF submitted to DAHP has its cover sheet, figures, graphics, appendices, attachments, correspondence, etc., compiled into one single PDF file.
- Please check that the PDF displays correctly when opened.

Archaeological Overview and Monitoring Plan for the Terminal 30 Remediation Project, Seattle, King County, Washington

Table of Contents

Management Summary

This report describes the Archaeological Overview and Monitoring Plan for the Terminal 30 Remediation Project in Seattle, King County, Washington. Port of Seattle plans to conduct cleanup on portions of Terminal 30. This work will include in situ treatment of contaminated soils. Ground disturbance is anticipated to include excavation trenches for vapor extraction lines. DAHP has requested that an archaeological monitoring plan be developed for the project. Background research conducted by Cultural Resource Consultants, LLC (CRC) did not result in the identification of previously recorded cultural resources within the project location. Based on review of available project information, the proposed project actions have a low probability to encounter precontact deposits and a low probability to encounter significant (i.e. intact) historic era deposits. In addition, a majority of ground disturbing activities will likely be restricted to recently deposited fill material. An inadvertent discovery protocol and contingent archaeological monitoring and treatment plan is attached should cultural resources be identified during the course of the project.

1.0 Administrative Data

1.1 Overview

Report Title: Archaeological Overview and Monitoring Plan for the Terminal 30 Remediation Project, Seattle, King County, Washington

Author (s): Sonja Kassa

Report Date: August 23, 2017

Location: This project is located at 1901 E Marginal Way S in Seattle, King County, Washington, approximately one mile southwest of downtown Seattle, in King County, Washington on the shoreline of the East Waterway.

Legal Description: The legal description for the project is Section 07, Township 24 North, Range 04 East, W.M. It is located on King County Tax Parcel 7666207830.

USGS 7.5' Topographic Map(s): Seattle South, WA (Figure 1).

Total Area Involved: 11 acres.

1.2 Research Design

This assessment was developed as a component of preconstruction environmental review with the goal of preventing cultural resources from being disturbed during construction of the proposed project by identifying the potential for any as-yet unrecorded archaeological or historic sites within the project location. CRC's work was intended, in part, to assist in addressing state regulations pertaining to the identification and protection of cultural resources (e.g., RCW 27.44, RCW 27.53). The Archaeological Sites and Resources Act (RCW 27.53) prohibits knowingly disturbing archaeological sites without a permit from the Department of Archaeology and Historic Preservation (DAHP), the Indian Graves and Records Act (RCW 27.44) prohibits knowingly disturbing Native American or historic graves. This project is subject to permitting under the State Environmental Policy Act (SEPA), which requires that impacts to cultural resources be considered during the public environmental review process. Under SEPA, the DAHP is the sole agency with technical expertise in regard to cultural resources and provides formal opinions to local governments and other state agencies on a site's significance and the impact of proposed projects upon such sites.

CRC's investigations consisted of review of available project information and correspondence provided by the project proponent, local environmental and cultural information, and historical maps. This assessment utilized a research design that considered previous studies, the magnitude and nature of the undertaking, the nature and extent of potential effects on historic properties, and the likely nature and location of historic properties within the project, as well as other applicable laws, standards, and guidelines (per 36CFR800.4 (b)(1)) (DAHP 2017a).

1.3 Project Description

The Port of Seattle plans to conduct cleanup on portions of Terminal 30. This work will include in situ treatment of contaminated soils. Ground disturbance is anticipated to include excavation for wells and trenches for vapor extraction lines. Wells will be installed with a drill rig to a depth of 25 feet. Trenches will occur between well locations and will be approximately 4 feet wide and no greater than 6 feet deep with most excavation occurring to a depth of 4 feet. DAHP has requested that an archaeological monitoring plan be developed for the project.

For purposes of this assessment, the project location for cultural resources is considered to contain the locations of all project elements as described above and as shown in Figures 1 – 3.

2.0 Background Research

2.1 Overview

Background research was conducted in August 2017.

Recorded Cultural Resources Present: Yes [ ] No [x]

Context Overview: The context presented here summarizes environmental, ethnographic, historical, and archaeological information presented in previously conducted local cultural resource reports by reference; archaeological and historic data from DAHP and WISAARD records search; ethnographic resources; geological and soils surveys (e.g., USDA NRCS 2017; WA DNR 2017); and historical maps and documents, and in CRC's library. The context overview for this project is primarily taken from Berger (2014).

2.2 Environmental Context

As described by Berger (2014:3-4), the project is geographically situated in the Puget Lowland physiographic province. The project is on the filled former tidelands at the confluence of the Duwamish River and Elliott Bay. Historically, forested terraces and ridges of the West Seattle peninsula were present to the west and Elliott Bay was present to the east (Collins and Sheikh 2005:Figure 6, Figure 8; USGS 1897). The topography and geology of the area were formed during the Late Pleistocene, following the advance of several glaciations that originated from

Canada and extended between the Cascade and Olympic mountain ranges into the Puget Lowland (Kruckeberg 1991:12). The most recent glacial event in the Puget Sound, termed the Vashon Stade, is largely responsible for the region's contemporary landscape; glacial advance and retreat scoured and compacted underlying geology while meltwaters carved drainage channels into glacial outwash deposits (Booth et al. 2003; Downing 1983). Following rising temperatures, the glacier retreated rapidly to the north and left the region ice-free and suitable for inhabitants by approximately 11,000 years ago (Kruckeberg 1991:22).

The Duwamish River valley is a relict meltwater channel that formed in glacial advance outwash deposits as the glacier retreated from the area (Dragovich et al. 1994:9). Land surfaces that had been covered by ice uplifted. This isostatic rebound varied locally and was much more subtle in the southern Puget Lowland than in the north (Thorson 1989). Marine waters began to fill Puget Sound once the Strait of Juan de Fuca and Admiralty Inlet were no longer blocked by ice. In southern and central Puget Sound, sea levels began to rise rapidly after 8,000 years ago (Eronen et al. 1987) and then rates of increase slowed around 5,000 years ago (Booth et al. 2003:26). Eustatic sea levels were within one meter of present-day levels by about 1000 years ago (Eronen et al. 1987).

The Duwamish River delta formed at the head of the Duwamish marine embayment southeast of the project near Auburn, prograding over time towards its historical position at Elliott Bay (Dragovich et al. 1994). Delta progradation was spurred by a series of lahars originating on Mount Rainier. The first was the Osceola Mudflow, which descended the northeastern slopes of Mount Rainier about 5,700 years ago and created the ancient Duwamish River delta. The valley floor was filled with the Osceola Mudflow; deltaic and fluvial sediments; and andesitic sand deposits (Dragovich et al. 1994). Over time, sediments carried to the Duwamish by the Green, White, and Cedar Rivers pushed the delta front seaward. Increased sediment load due to the mudflow caused the delta to prograde rapidly at an average rate of about 6.9 m/year (Dragovich et al. 1994). Deltaic development occurred as sediments transported from riverine and marine waters were deposited or contained at the river mouth (Waters 1992:261). During times of slow currents, sediments settled out of suspension, the heaviest sediments falling first, and the sediment surface built upward. Sediments continued to accumulate, extending the deltaic plain seaward and creating new wetlands while leaving the older portion of the delta landward. The accumulation of sediments created a delta platform consisting of "mud deposits rich in organic material that [collect] in the inner delta wetlands, sand deposits in tidal and distributary channels, and other intertidal sediments of finer texture" (Downing 1983:22). By about 2,200 years ago, the delta front had prograded from the Auburn area to near what is now Tukwila (Zehfuss et al. 2003:9, Figure 2). The shoreline of the Duwamish embayment was pushed to near its historical (i.e., pre-industrial) position by another lahar about 1,200 years ago (Zehfuss et al. 2003).

Seismic events also shaped the landscape of Elliott Bay and adjacent uplands. The project is located within the Seattle Fault Zone, an east-west trending fault zone that extends through central Puget Sound (Nelson et al. 2002) where repeated seismic events of considerable magnitude have occurred over the past 2,000 years. An earthquake that occurred approximately 1,100 years ago affected topography in the vicinity of the project by increasing the elevation of the lower Duwamish valley by several meters (Bucknam et al. 1992). The Duwamish River incised into the valley forming its historical floodplain bounded by terraces of 1,200-year old lahar deposits (Collins and Sheikh 2005:3). The nearest of these terraces is approximately one mile upstream from the project location (Collins and Sheikh 2005:Figure 1).

Marine waters initially deposited tideflat sediments of the Duwamish valley following deglaciation. The Duwamish River delta aggraded towards Elliott Bay as the Duwamish valley filled with alluvium and as sea level rose. These sediments are up to 50 meters thick at the mouth of the Duwamish River (Troost et al. 2005). Tideflat sediments in the project vicinity are composed of silt, sand, organic sediment and detritus with some shells. Tideflats form in partially enclosed or protected waters with a supply of sediment from tidal currents or a nearby river and low wave energy (Downing 1983). These deposits were historically exposed in broad coastal benches at low tide and are now covered with fill (Troost et al. 2005).

As described by the Washington State Department of Ecology (2015:4),

> Two stratigraphic units have been identified at the Terminal 30 site: fill and native deposits. Fill was derived at least in part from dredging and can be difficult to physically differentiate from similar native tidal flat and alluvial deposits. Key characteristics of these units include:
>
> - Fill Unit—consists of sand and gravel with varying amounts of silt, wood, bricks, and construction debris; the unit thickens and dips westward toward the East Waterway. Fill units were described as “laterally discontinuous” with a lower contact approximately 15 to 20 feet below ground surface or the approximate historic MLLW tide line. Most of the fill materials were classified as well-sorted sands and less commonly as sandy gravels, silty sand, and silts. During construction of Terminal 30 in 1984-1985, additional fill for an engineered slope was placed after dredging operations were completed. This fill included sand with a surface layer of rip-rap extending to the base of the East Waterway.
> - Native Deposits—consist of non-glacial, fluvial and estuarine, black, fine-to-medium sand with varying amounts of silt. Shell fragments and occasional organic materials were frequently observed in the native deposits.
>
> Native soils and overlying fill comprise a shallow water table aquifer at the Terminal 30 site. Average depth to water ranges from 8 to 14 feet across the site. Recharge to the water table aquifer originates as precipitation in uplands and unpaved areas offsite; insignificant recharge originates at the Terminal 30 site due to the asphalt cover and the stormwater management system.

The Pacific Groundwater Group (2016) identifies the upper ~2.5-5 feet of material within the project as gray to black sand with varying amounts of gravel and silt (fill) and represents the fill placed on site during construction in the mid-1980s. Below this, to ~10 feet below surface is black sand with variable amounts of silt and occasional construction debris, followed by native/fill (gray to black silts and sands with occasional shell) over native sediments (black sands and silts with occasional shell).

2.3 Cultural Context

Based upon the above geological context, archaeological sites predating the late Holocene stabilization of the Duwamish delta are not expected at the elevation of the project. As described in Berger (2014), characteristic of the ethnographic pattern in Puget Sound, seasonal residence and logistical mobility occurred from about 3000 BP. Organic materials, including basketry, wood and food stuffs, are more likely to be preserved in sites from this late precontact period, both in submerged, anaerobic sites and in sealed storage pits. Sites dating from this period represent specialized seasonal spring and summer fishing and root-gathering campsites and winter village locations. These kinds of sites have been identified in the Puget Sound lowlands, typically located adjacent to, or near, rivers or marine transportation routes. Fish weirs and other permanent constructions are often associated with large occupation sites. Common artifact assemblages consist of a range of hunting, fishing and food processing tools, bone and shell implements and midden deposits. Similar economic and occupational trends persisted throughout the Puget Sound region until the arrival of European explorers.

Ethnohistoric economies of people in the southern Puget Sound were structured upon a variable rotation of seasonally available resources. Permanent villages provided a central hub from which seasonal activities radiated. During the spring, summer and fall, temporary camps were utilized while traveling to obtain resources that included foodstuffs such as fish, shellfish, waterfowl, deer, roots and berries. Salmon was the single most important food source and was caught in weirs, traps, nets and other fashioned implements (Smith 1940).

The project is within the traditional territory of the Duwamish Tribe of Southern Lushootseed speakers; historically, members of Suquamish and Muckleshoot Tribes also utilized this vicinity (Suttles and Lane 1990; Waterman 2001). Local Indian people shared many broadly defined traditions with their inland Puget Sound neighbors, including subsistence emphasis on salmon and other fish, land game, and a wide variety of abundant vegetable foods, and household and village communities linked by family and exchange relations (Suttles and Lane 1990).

Major Duwamish winter villages were formerly located on the Cedar, Duwamish, Sammamish, and Black Rivers, Lake Sammamish, Lake Washington, Lake Union, Elliott Bay, and Salmon Bay (Waterman ca. 1920, 1922). The Muckleshoot Indian Tribe includes the descendants of an amalgam of tribes that lived in the Green River and White River valleys, including the Skopamish, Smulkamish, Stkamish, Yilalkoamish, and Twakwamish (Suttles and Lane 1990). The Suquamish occupied Kitsap Peninsula (Spier 1936:34), as well as Bainbridge and Whidbey Islands prior to implementation of the Point Elliot Treaty of 1855 (Ruby and Brown 1992). Precontact Suquamish settlements were often located on major waterways, and heads of bays or inlets.

Two precontact village locations have been recorded in proximity to the project. *Tóó7ool7altxW* or *Tul*^{3}*a'ltu*, translated as "Herring's House," is the Duwamish village recorded nearest to the project location (Waterman ca. 1920, 2001:62). *Tóó7ool7altxW* was an important village with a large potlatch house and at least four longhouses. Duwamish people used this village well into the historic period (Thrush and Thompson 2007:234). This village is described as being on the west bank of the Duwamish River (Buerge 1980; Smith 1940), "at the foot of the bluff of West Seattle" (Waterman 2001:62), just south of Pigeon Point (Waterman ca. 1920). A park at Port of Seattle Terminal 107 has been named for Herring's House although the village was not located there.

Djidjila'lltc is a village located in proximity to the present day King Street Station where historically there was a little promontory covered by few trees and adjacent to a lagoon. This name means "a little place where one crosses over" (Waterman 2001:46). Here there was a trail the led from the beach to the lagoon and two Indian villages were present on either side of the promontory. Numerous other place names have been recorded in the project vicinity and are depicted in Figure 5. The project is nearest to a Native fishing area but is located primarily waterward of the historic era mean high tide line (Gillis et al. 2005:Figure 7).

2.4 Historical Context and Records Search

The history of the project location and surrounding area has been complied from a variety of sources. According to Sheridan (2008:11),

> Throughout the 1880s, piers and trestles were built along the waterfront to accommodate both local and national rail lines…In 1900, more ambitious efforts began to fill a larger area of tideflats to provide space for the railroads and for commercial and industrial expansion…Additional filling and regrade operations were also conducted specifically to increase the land available for industrial plants. Eventually over 1,400 acres of tideflats were reclaimed. The massive S. Jackson Street regrade and Dearborn cut (1907-09) opened up access to the Rainier Valley. Material from these cuts was deposited on the tideflats north of Connecticut Street, and Fourth Avenue S. was extended to S. Holgate Street, on fill…
>
> The increased industrial land and the greatly expanded rail facilities encouraged the development of manufacturing and distribution industries that could take advantage of the rail and maritime network for the import and export of raw materials and finished products…

As described by the Department of Ecology (2015), One of the first industrial operations within the northern portion of Terminal 30 (present project location) was the Standard Oil Company (now Chevron) bulk fuel terminal in 1905. During its operation, a variety of fuels and petroleum products were stored at the site. The southern portion of the terminal outside of the project was used for variety of purposes including a lumberyard, a machine shop, and a shipyard until 1950. At this time, Chevron expanded the fuel terminal to the southern portion of the site. The terminal was purchased by the Port of Seattle in 1985. Between December 1984 and about November 1985 the Port demolished the fuel yard and redeveloped the 33.9-acre terminal as a container facility. As part of the redevelopment in 2007, a site-wide asphalt cover was constructed. From 2003 to 2008, the site also included a cruise ship terminal. Terminal 30 currently operates as a freight terminal and also provides temporary freight storage.

Terminal fuel yard operation activities succeeded in contaminating the underlying sediments within the terminal. Efforts to clean up these pollutants were initiated in the 1980s by the Port of Seattle who initiated several cleanup projects (DOE 2013). These efforts included:

- Removal and off-site disposal of more than 170,000 gallons of petroleum liquid;
- Removal and off-site disposal of more than 24,000 cubic yards of petroleum-contaminated soil;
- Installation of a site-wide asphalt barrier;

- Installation of more than 100 monitoring and recovery wells;
- Treatment of contaminated groundwater at one of the monitoring wells; and
- Installation of a stormwater system that treats runoff with an oil/water separator and filtration [DOE 2013].

Historic records search shows that the project was historically located within the tidal flats of Elliot Bay (USSG 1862; U. S. Coast Survey 1875; USGS 1897) (Figures 6-8). Filling of Elliot Bay to reclaim the tidal flats occurred sometime around the end of the nineteenth century. By 1905, at least the northeastern portion of the project had been filled and was under industrial use (Figure 9) and by 1916, the majority of the project had been filled and developed for industrial use (Figure 10). 1936 imagery depicts large holding tanks in the northeastern portion of the project with the remainder of the project characterized by docks and large warehouse structures (Figure 11), which are also present on 1946 imagery (Figure 12). By 1950, many of the warehouses had been removed and the majority of the project was then paved with large cylindrical holding tanks; these conditions persisted into the early 1980s (Figure 13 - 16). By 1985, the existing structures within the project had been demolished and cleared (Figure 17) and the project had been paved over by 1990 to accommodate the storage of shipping containers, which has remained the use until the present day (Figures 18 -20).

2.5 Cultural Resources Database Review

Cultural Resource Assessments: Two cultural resource assessments have encompassed the proposed project. Sheridan (2012) conducted an assessment to evaluate the historic resources in the vicinity of the proposed SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project. This assessment contained two buildings listed on the NRHP, six industrial buildings that have been identified as eligible for listing in the NRHP, and the Alaskan Way Viaduct, also determined eligible for listing in the NRHP, in addition to all of the buildings constructed prior to 1962. Adverse effects were anticipated for two historic properties: the Alaskan Way Viaduct and the Bemis Building. These effects were described and mitigation measures were recommended. None of these structures were within the proposed project location.

Reed et al. (2008) conducted monitoring for the SR 99 South Holgate Street to South King Street Viaduct Replacement Project Stage 2. This project consisted of replacing or repairing approximately one mile of the seismically vulnerable SR 99 highway corridor south of downtown Seattle. The area of potential effects for this project encompasses the proposed project location; however, the construction footprint and area monitored did not encompass the proposed project location. The construction footprint nearest to the project was located immediately to east along the Highway 99 corridor. This assessment assigned the portion of the construction footprint between S Atlantic Street and the southern terminus of the construction area (just south of the proposed project) as having a low probability to contain archaeological deposits. As this area was assigned as lower probability, it was not included in Reed et al. (2010) monitoring efforts. Areas monitored in moderate and higher probability locations to the north did not identify NRHP-eligible archaeological resources during monitoring efforts.

Assessments completed immediately adjacent to the project location consist of three monitoring reports, Bartoy (2011), Casella et al. (2010) and Gillis et al. (2005). None of these efforts identified definitive archaeological deposits during monitoring. Gillis et al. (2005) monitored geotechnical borings along the SR 99 corridor extending from the project location into Seattle's Belltown neighborhood. Borings were noted as absent of archaeological resources, having possible precontact or historic period resources, or a combination of both precontact and historic period resources. The majority of the borings noted as having possible archaeological bearing deposits were located north of the project in the area of Pioneer Square north to Beltown corresponding with the historic period shoreline. One exception to this was in a boring located just south of the project, which was noted to have possible historic period deposits, though this area was located within the mudflats of Elliot Bay prior to historic fill events.

Historic Register Properties: The nearest historic register listed property is located immediately north of the project near the northeast corner. This property is known as the World's First Service Station Site, at which gasoline was dispensed by hose directly into the tanks of motor vehicles beginning in 1907, resulting in what became known as service stations or gas stations (Martin 1969). Standard Oil Company of California recognized the need to supply oil directly to customers and built this service station adjacent to the refining facility. Subsequently, the drive up gas station took hold across the United States. This location has since been redeveloped.

Historic Inventory Properties:The nearest inventoried historic structure is the California Ink Company located at 1727 Alaskan Way S approximately .17 mile northeast of the project. According to the DAHP inventory (2008), this structure is located near the waterfront just south of Pier 36. It is a simple concrete factory structure originally rectangular in plan, but presently has an irregular footprint from two additions. The structure was built in 1950 and remodeled in 1972. In 2000, the Port of Seattle purchased the building and it was renovated to accommodate the Pacific Maritime Institute, which trains seamen for the merchant marine and other commercial ships.

Precontact and Historic-era Archaeological Sites: The nearest recorded precontact site is located approximately .9 mile northeast of the project. Site 45KI18 is located near the intersection of S Massachusetts Street and Airport Way S and had been disturbed during the construction of I-5 (Dlane 1966). Here, pecked and polished sinker stones were collected by individuals. This area had been a location where native peoples tied up their canoes and corresponds with the historic period shoreline of Elliot Bay. This area had also been used as a dump historically.

Previously recorded historic ear archaeological sites are between approximately .4 and .5 mile northeast of the project location and include sites 45KI924, 45KI942, 45KI947, and 45KI1188 recorded in close proximity together. These sites all represent the remains of historic era development.

Site 45KI924, also known as the Dearborn South Tideland Site, measures 1244 feet N-S by 335 feet E-W and ranges between 4 and 9 feet below surface (Shong and Valentino 2009). The site is a portion of historic Seattle south of downtown (SODO) commercial and industrial district. It covers three blocks west of 1st Avenue on filled tidelands. The site contains structural remains, refuse accumulations, and other cultural features associated with historic development of the tideflats area south of Denny Island between 1895 and 1910. The site is currently bounded by Connecticut Avenue (now S Royal Brougham Way), 1st Avenue S, Dearborn Avenue, and

Railroad Avenue (now Alaskan Way S). This site has been determined eligible for listing on historic registers.

Site 45KI942, also known as W. L. McCabe's Machine Shop Site, measures 375 feet N-S by 344 feet E-W and ranging between 2 to 9 feet below surface (Meyer 2009). The site is a subsurface deposit representing a historic commercial/industrial district in the SODO area of downtown Seattle. The site consists of demolition debris and historic material accumulations associated with a c. 1905 machine shop, tool shed, storage buildings, dwellings and other small out buildings. There are three stratigraphic units visible at the site representing temporally distinct fill events that occurred between c. 1895 and c. 1950. This site was determined not eligible for historic registers.

Site 45KI947 consists of historic residential structures measuring 165 feet N-S by 90 feet E-W at ta depth of 10 feet (Meyers and Shong 2010). The site is a subsurface deposit of historic material associated with former dwellings, outbuildings and commercial properties shown on the 1904 Sanborn map, and originally included as part of site 45KI942. There are three stratigraphic units visible at the site representing temporally distinct fill events that occurred between c. 1895 and c. 1950. This site was determined not eligible for historic registers.

Site 45KI1188 measures 143 feet N-S by 92 feet with a depth of 4.75 feet E-W (Riser and Graham 2014). It is described as the brick, sandstone, and concrete foundations of three industrial structures and a burned deposit containing an historic refuse scatter. It listed as potentially eligible for historic registers.

Cemeteries: The nearest recorded evidence of human remains are represented at archaeological site 45KI1036 located just over .5 mile northeast of the project. No additional information was available.

City of Seattle Landmarks: The nearest landmark is the Flatiron Building located at 551 1st Ave S approximately .85 mile northeast of the project.

3.0 Archaeological Expectations

3.1 Archaeological Predictive Model

The DAHP statewide predictive model uses environmental data about the locations of known archaeological sites to identify where previously unknown sites are more likely to be found. The model correlates locations of known archaeological data to environmental data "to determine the probability that, under a particular set of environmental conditions, another location would be expected to contain an archaeological site" (Kauhi and Markert 2009:2-3). Environmental data categories included in the model are elevation, slope, aspect, distance to water, geology, soils, and landforms. According to the model, the project location is ranked as "Survey Highly Advised: Very High Risk."

3.2 Archaeological Expectations

This assessment considers the implications of the predictive model coupled with an understanding of geomorphological context, local settlement patterns, and post-depositional processes to characterize the potential for archaeological deposits to be encountered. Prior to the early 1900s the project was located in the tideflats of Elliot Bay just waterward of the historic mean high tide line. The tideflats stabilized approximately 1,200 years ago.

Beginning in at the turn of the twentieth century, successive fill episodes reclaimed the tidelands including the project location and industrial development subsequently spread into the area. During the 1900s, the project was used for a variety of industrial uses from ship and lumberyards to a bulk fuel terminal, and most recently for shipping. The project has also been subject to at least two demolition episodes occurring in the 1950s with the expansion of the Chevron facility and in the 1980s with the transition of the property to a shipping container holding area. Past industrial operations, primarily those of Standard Oil/Chevron, succeeded in contaminating the underlying soils, which were subsequently removed in the 1980s. At this time new fill was placed in the project location and was overlain with a paved surface. As such, the upper sediments within the project that would have likely contained potentially intact anthropogenic surfaces and materials have likely been removed. Previously mapped subsurface conditions demonstrate that the circa 1980s fill material extends to approximately 5 feet below surface and in underlain by older fill deposits that contain some construction debris. Below the fill material, native sediments are present in the form of silts and sands with occasional shell fragments.

Recorded precontact sites located in proximity to the project are located along the historic 1860s shoreline, landward of the proposed project location. Archaeological deposits that may be present in the project location are anticipated to date to the historic period based on a review of locally recorded archaeological sites; though given the past remediation efforts, it is not expected that significant (i.e. intact) historic deposits will be present within the project location. As discussed by previous researchers, the historic-era resources most likely to be found in the project location are types that were previously determined not to meet eligibility criteria for listing in the NRHP (Miss, Hudson, et al. 2010:75). These kinds of resources included:

- pilings, decking, trestle, ballast, and railroad track and ties, unless of clearly unusual construction;
- remains of infrastructure including abandoned utilities, portions of seawall, and brick or planked roadways, unless of clearly unusual construction;
- mass deposits of wood, lumber, coal, or cinders;
- loose bricks, mortar, or other architectural materials; and
- historic-period materials within unstratified dredge spoils or regraded fill that is not associated with a feature or stable surface.

Resources that could be considered to be significant would be those identified within intact strata and may consist of foundations and/or quantities of artifacts that could be linked with historic companies or individuals.

Based on review of the project location, excavation is expected to be contained primarily within more recent (e.g., 1980s) fill deposits precluding the likelihood that historic materials will be encountered. The project is anticipated to have a low potential to contain precontact deposits and a moderate potential to contain historic era deposits. However, historic era deposits are anticipated to be comprised of construction debris within fill that is unlikely to be eligible for historic registers. As such, it is not anticipated that projects actions will have an impact on potentially significant (i.e. intact) archaeological deposits and archaeological monitoring is not recommended based on available contextual information.

4.0 Inadvertent Discovery Protocol, and Contingent Archaeological Monitoring and Treatment Plan

In accordance with RCW 27.44 Indian Graves and Records Act, RCW 27.53 Archaeological Sites and Resources, RCW 68.50 Human Remains, and RCW 68.60, Abandoned and Historic Cemeteries and Historic Graves, the following protocols will be followed in the event that archaeological materials and/or human remains are discovered:

Procedures Upon Discovery of Potential or Actual Cultural Resources

1. Upon discovery of a potential or actual archaeological site, or cultural resources as defined by RCW 27.44 Indian Graves and Records Act, and RCW 27.53 Archaeological Sites and Resources, the Port of Seattle, its employees, its contractors and sub-contractors shall:

> (a) Immediately cease or halt ground disturbing, construction, or other activities around the area of the discovery and secure the area with a perimeter of not less than thirty (30) feet until all procedures are completed and the parties agree that activities can resume. If such a perimeter would materially impact agency functions mandated by law, related to health, safety or environmental concerns, then the secured area shall be of a size and extent practicable to provide maximum protection to the resource under the circumstances. Project activities that are not ground disturbing may continue outside the secured perimeter around the findings. No one shall excavate any findings and all findings will be left in place, undisturbed and without analysis, until consultation with DAHP and identified area Tribes regarding a final disposition of the findings has been completed. In accordance with RCW 27.53.060, no one shall knowingly remove or collect any archaeological objects without obtaining a permit.
>
> (b) Notify the Local Government Archaeologist at DAHP and identified area Tribes of the discovery as soon as possible, but in any event, no later than (24) hours of the discovery. If human remains are found, the Port of Seattle shall follow notification procedures specified below (see “Human Remains and Associated Funerary Objects”).
>
> (c) Arrange for the parties to conduct a joint viewing of the discovery within (48) forty-eight hours of the notification, or at the earliest possible time thereafter, the Port of Seattle or their authorized representative shall arrange for the archaeologist to attend the joint viewing. After the joint viewing, taking into account any recommendations of the Tribe(s), DAHP, and the archaeologist, the parties shall discuss the potential significance, if any, of the discovery.
>
> (d) Consult with the identified area Tribes and DAHP on the transfer and final disposition of artifacts. Until the Tribe has a repository that meets the standards of curation established 36 CFR Part 79, artifacts shall be curated using an institution or organization that meets curation standards, selected through consultation with the Tribes.

Inadvertent Discovery of Human Skeletal Remains on Non-Federal and Non-Tribal Land in the State of Washington (RCWs 68.50.645, 27.44.055, and 68.60.055)

2. If ground-disturbing activities encounter human skeletal remains during the course of construction, then all activity must cease that may cause further disturbance to those remains and the area of the find must be secured and protected from further disturbance. In addition, the finding of human skeletal remains must be reported to the King County Coroner's Office and King County Sheriff's Office in the most expeditious manner possible. The remains should not be touched, moved, or further disturbed.

3. The King County Coroner's Office will assume jurisdiction over the human skeletal remains and make a determination of whether those remains are forensic or non-forensic. If the county coroner determines the remains are non-forensic, then they will report that finding to DAHP who will then take jurisdiction over the remains and report them to the appropriate cemeteries and affected tribes. The State Physical Anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes. DAHP will then handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

4. DAHP will handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains if there is no federal agency involved.

Confidentiality of Information

5. The Port of Seattle or their authorized representative recognizes that archaeological properties are of a sensitive nature and sites where cultural resources are discovered can become targets of vandalism and illegal removal activities. The Port of Seattle or their authorized representative shall keep and maintain as confidential all information regarding any discovered cultural resources, particularly the location of known or suspected archaeological property, and exempt all such information from public disclosure consistent with RCW 42.17.300.

Contact Information

6. The lead representatives and primary contacts of each party under this plan are as identified below. The parties may identify other specific personnel before the commencement of any particular project element as the contacts.

Crete Consulting
108 S Washington Street, Suite 300, Seattle WA 98104
Primary Contact: Mike Byers, 206-491-7554

Cultural Resource Consultants, LLC
1416 NW 46th St, Seattle, WA 98107
Primary Contact: Margaret Berger, Principal Investigator, 206-855-9020

Duwamish Tribe
4705 West Marginal Way SW, Seattle, WA 98106
Lead Representative and Primary Contact: Cecile Hansen, Chair, 206-431-1582

Puyallup Tribe
3009 East Portland Avenue, Tacoma, WA 98404
Primary Contact: Brandon Reynon, Cultural Resources, 253-573-7986

Muckleshoot Tribe
39015 172nd Avenue SE, Auburn, WA 98092
Primary Contact: Laura Murphy, Archaeologist, Cultural Resources, 253-876-3272

Nisqually Tribe
4820 She-Nah-Num Drive SE
Olympia, WA 98513-9105
Primary Contact: Jackie Wall, Cultural Resources, 360-456-5221x2180

Suquamish Tribe
PO Box 498, Suquamish, WA 98392-0498
Primary Contact: Dennis Lewarch, THPO Cultural Resources, 360-394-8529

Washington Department of Archaeology and Historic Preservation
PO Box 48343, Olympia, WA 98504-8343
Lead Representative: Allyson Brooks, State Historic Preservation Officer, 360-586-3066, cell: 360-586-3066
Primary Contact: Gretchen Kaehler, Local Government Archaeologist, 360-586-3088, cell: 360-628-2755
Primary Contact for Human Remains: Guy Tasa, State Physical Anthropologist, 360-586-3534, cell: 360-790-1633

King County Historic Preservation Program
201 S. Jackson St., Suite 700, Seattle, WA 98104
Primary Contact: Phil LeTourneau, Archaeologist, 206-477-4529

King County Medical Examiner
908 Jefferson Street, Seattle, WA 98104
Primary Contact: Richard Harruff, Medical Officer, 206-731-3232

King County Sheriff
516 Third Avenue, Room W-116, Seattle, WA 98104-2312
Primary Contact: John Urquhart, Sheriff, 206-296-3311

Contingent Archaeological Monitoring and Treatment Plan

In the unlikely event that cultural resources are inadvertently encountered during the course of excavation, the archaeologist will ensure the proper documentation and assessment of any discovered cultural resources in cooperation with the lead regulatory agency, Port of Seattle, WA DAHP, and affected tribes.

Work outside the discovery location may continue while documentation and assessment of the cultural resources proceed. In consultation with WA DAHP and affected Tribe(s), the Project Manager and consulting archaeologist will determine the appropriate level of documentation and treatment of the resource. Pending this consultation, it may be recommended that an archaeologist monitor remaining ground-disturbing work, until it can be determined that impacts to resources will be avoided.

Archaeological monitoring would entail having an archaeologist present during construction excavation to observe subsurface conditions and identify any archaeological materials that may be encountered. Prior to ground disturbance the archaeologist would flag the site boundary and provide a construction crew orientation to ensure that the site would be avoided. Monitoring will be performed by a "professional archaeologist" (RCW 27.53.030 (8)) or under the supervision of a professional archaeologist. The monitoring archaeologist would stand in proximity to construction equipment in order to view subsurface deposits as they are exposed, and would be in close communication with equipment operators to ensure adequate opportunity for observation and documentation. Archaeological monitoring will seek to identify potential buried surfaces, anthropogenic sediments, and archaeological features, or artifact-bearing strata. The monitoring archaeologist will inspect project excavations and the recovered sediments for indications of such archaeological resources. The archaeologist will be provided the opportunity to screen excavated sediments and matrix samples when this is judged useful to the identification process. It is not expected that any modern fill or glacial till sediments, if present, would be included in screening procedures. Excavated spoils may be examined in the course of monitoring. If cultural materials are observed in spoils piles, it is expected that the opportunity to screen these would be available.

A professional archaeologist will record archaeological resources on State of Washington archaeological site or isolate forms using standard techniques. Site overviews, features, and artifacts will be photographed; and stratigraphic profiles and soil/sediment descriptions will be prepared for subsurface exposures. Discovery locations will be documented on scaled site plans and site location maps.

In the event that the project cannot avoid impacts to archaeological resources, it would be necessary for the project proponent to obtain an Archaeological Site Excavation and Alteration Permit from WA DAHP (Washington Administrative Code 25-48-060). Cultural features, horizons, and artifacts detected in buried sediments may require further evaluation using hand-dug probes or mechanically excavated pits or trenches. Due to the project location's surface conditions and the thickness of fill deposits, it may be necessary to use mechanical equipment (e.g., a backhoe) to expand soil exposures for the purposes of testing. Test pits or trenches would be excavated in shallow lifts using a flat-edged bucket. A test excavation unit or small trench might also be used to determine if an intact occupation surface is present. Units may be dug in controlled fashion to expose features, collect samples from undisturbed contexts, or interpret complex stratigraphy. Test units will be used only when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance.

Spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil will be recorded for each probe on a standard form. Test excavation units will be recorded on unit-level forms, which include plan maps for each excavated level, and material type, number, and vertical provenience (depth below surface and stratum association where applicable) for all artifacts recovered from the level. A stratigraphic profile will be drawn for at least one wall of each test excavation unit.

Sediments excavated for purposes of archaeological investigation will be screened through ⅛-inch mesh, unless soil conditions warrant ¼-inch mesh. All prehistoric and historic artifacts collected will be analyzed, catalogued, and temporarily curated. Ultimate disposition of cultural materials will be determined in consultation with the Port of Seattle, WA DAHP, and the affected tribes.

Within 90 days of concluding fieldwork, a technical report describing any and all monitoring and resultant archaeological excavations will be provided to Port of Seattle, WA DAHP, the affected tribes, and any other consulting parties.

If cultural resources are present and found to meet NRHP eligibility criteria, mitigation will be implemented in accordance with state, federal, and local regulations. Appropriate mitigation measures, specific to the nature of the resource identified, would be determined through consultation with the Port of Seattle, WA DAHP, the affected tribes, and any other consulting parties. These may include interpretive projects such as signage, brochures, lectures, and publications that provide public awareness of the project location’s history. Minimization or avoidance of adverse effects to the resource could be achieved through project rerouting or redesign resulting in preservation of the resource in place. If project redesign and preservation in place are not feasible, then data recovery excavations would be conducted. A data recovery plan would be prepared outlining research domains, sampling design, and methods of excavation and collection for the specific resource identified, with the intent of mitigating adverse effects resulting from the project (36 CFR 800.6).

5.0 Limitations of this Assessment

No cultural resources study can wholly eliminate uncertainty regarding the potential for prehistoric sites, historic properties or traditional cultural properties to be associated with a project. The information presented in this report is based on professional opinions derived from our analysis and interpretation of available documents, records, literature, and information identified in this report, and on our field investigation and observations as described herein. Conclusions and recommendations presented apply to project conditions existing at the time of our study and those reasonably foreseeable. The data, conclusions, and interpretations in this report should not be construed as a warranty of subsurface conditions described in this report. They cannot necessarily apply to site changes of which CRC is not aware and has not had the opportunity to evaluate.

6.0 References

Bartoy, Kevin M.
2011 SR 99: S. Hudson Street to Ward Street Automated Viaduct Closure Gates Project, Re: Results of Monitoring Program – No Adverse Effect. Washington State Department of Transportation.

Berger, Margaret

2014 Cultural Resources Assessment of the Duwamish River Habitat Restoration Program, East Side West Waterway – Site 02, Seattle, King County, Washington. Cultural Resource Consultants, Inc. Prepared for Bluefield Holdings.

Booth, Derek B., Ralph A. Haugerud, and Kathy Goetz Troost

2003 The Geology of Puget Lowland Rivers. In *Restoration of Puget Sound Rivers, Chapter 2*, edited by David R. Montgomery, Susan Bolton, Derek B. Booth, and Leslie Wall, pp. 14-45. University of Washington Press, Seattle.

Bucknam, Robert C., Elizabeth Hemphill-Haley, and Estella B. Leopold

1992 Abrupt Uplift Within the Past 1700 Years at Southern Puget Sound, Washington. *Science* 258:1611-1614.

Buerge, David

1980 Seattle Before Seattle. The [Seattle] Weekly, Dec 17-Dec 23, 1980.

Casella, Melissa, J. Tait Elder, Kurt Perkins, and Stacy Schneyder

2010 Cultural Resources Monitoring Report, SR 99 South Holgate Street to South King Street Viaduct Replacement Project Archaeological Monitoring Stage 1 Seattle King County, Washington. ICF. Prepared for Washington State Department of Transportation.

Collins, Brian, and Amir Sheikh

2005 Historical Aquatic Habitats in the Green and Duwamish River Valleys and Elliott Bay Nearshore, King County, Washington. Prepared for King County Department of Natural Resources and Parks, Seattle.

Dlane, Laurie C.

1966 University of Washington Department of Anthropology Archaeological Site Survey Record, 45KI18. On file at DAHP, Olympia.

Department of Ecology (DOE)

2013 Port of Seattle ready for final Terminal 30 cleanup planning. Electronic document, http://www.ecology.wa.gov/news/2013/242.html, accessed August 4, 2017.

2015 Port of Seattle Terminal 30. Electronic document, https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=4394, accessed August 4, 2017.

Downing, John

1983 *The Coast of Puget Sound*. University of Washington Press, Seattle.

Dragovich, Joe D., Patrick T. Pringle, and Timothy J. Walsh

1994 Extent and Geometry of the Mid-Holocene Osceola Mudflow in the Puget Lowland – Implications for Holocene Sedimentation and Paleogeography. *Washington Geology* 22(3):3-26.

Eronen, M., T. Kankainen, and M. Tsukuda
1987 Late Holocene sea-level record in a core from the Puget Lowland, Washington. *Quaternary Research* 27:147-159.

Gillis, Nichole, Dennis E. Lewarch, and Lynn L. Larson
2005 SR 99: Alaskan Way Viaduct & Seawall Replacement Project Archaeological Resources Monitoring and Review of Geotechnical Borings from South Spokane Street to the Battery Street Tunnel. LAAS. Prepared for Parsons Brinckerhoff Quade & Douglas, Inc.

Kruckeberg, Arthur R.
1991 *The Natural History of Puget Sound County*. University of Washington Press. Seattle.

Martin, Julie C.
1969 National Register of Historic Places Inventory – Nomination Form, World's First Service Station Site. On file at DAHP, Olympia.

Meyer, Yvonne
2009 State of Washington Archaeological Site Inventory Form, 45KI942. On file at DAHP, Olympia.

Meyer, Yvonne, and Michael Shong
2010 State of Washington Archaeological Site Inventory Form, 45KI947. On file at DAHP, Olympia.

Nelson, Alan R., Samuel Y. Johnson, Ray E. Wells, Silvio K. Pezzopane, Harvey M. Kelsey, Brian L. Sherrod, Lee-Ann Bradley, Rich D. Koehler III, Robert C. Bucknam, Ralph Haugerud, and William T. Laprade
2002 *Field and Laboratory Data from an Earthquake History Study of the Toe Jam Hill Fault, Bainbridge Island, Washington*. U.S. Geological Survey Open-File Report 02-0060.

Pacific Groundwater Group
2016 Port of Seattle Terminal 30 Revised 2013 Remedial Investigation/Feasibility Study. Pacific Groundwater Group. Prepared for the Port of Seattle.

Port of Seattle
2017 Port of Seattle Terminal 30. Electronic document, https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=4394, accessed August 4, 2107.

Reed, Patrick, Alexander Stevenson, Kurt Perkins, and Stacy Schneyder
2012 Cultural Resources Monitoring Report: SR 99 South Holgate Street to South King Street Viaduct Replacement Project Archaeological Monitoring Stage 2 Seattle, King County, Washington. ICF. Washington State Department of Transportation.

Riser, Lauren, and Tyler Graham
2014 State of Washington Archaeological Site Inventory Form, 45KI1188. On file at DAHP, Olympia.

Ruby, Robert H. and John A. Brown
1992 *A Guide to the Indian Tribes of the Pacific Northwest*. University of Oklahoma Press, Norman.

Sheridan, Mimi
2008 SR 99: Alaskan Way Viaduct & Seawall Replacement Program, Section 106 Technical Report Historic Resources S. Holgate Street to S. King Street Viaduct Replacement Project. On file at DAHP, Olympia.

Shong, Michael, and Alicia Valentino
2009 State of Washington Archaeological Site Inventory Form, 45KI924. On file at DAHP, Olympia.

Smith, Marian W.
1940 *The Puyallup-Nisqually*. Columbia University Press, New York.

Spier, Leslie
1936 *Tribal Distribution in Washington*. General Series in Anthropology, Number 3. George Banta Publishing Company, Menasha, Wisconsin.

Suttles, Wayne, and Barbara Lane
1990 Southern Coast Salish. In *Handbook of North American Indians, Volume 7: Northwest Coast*, edited by Wayne Suttles, pp. 485-502. Smithsonian Institution Press, Washington, D.C.

Thorson, Robert M.
1989 Glacio-isostatic response of the Puget Sound area, Washington. Geological Society of America Bulletin 101(9):1163-1174.

Thrush, Coll, and Nile Thompson
2007 An Atlas of Indigenous Seattle. In *Native Seattle: Histories from the Crossing-Over Place* by Coll Thrush, pp. 209-255. University of Washington Press, Seattle.

Troost, K. G., D. B. Booth, A. P. Wisher, and S. A. Shimel
2005 *The geologic map of Seattle - a progress report*. 1:24,000. U.S. Geological Survey Open-File Report 2005-1252. USGS, Washington, D.C.

United States Coast Survey (U.S. Cost Survey)
1875 Duwamish Bay (part of) Washington Territory . Surveyed in 1875. Register no. 1406.

United States Geological Survey (USGS)
1897 Land classification sheet, Washington, Seattle quadrangle (1897). Washington 1:125,000 topographic quadrangles. Electronic document, http://cdm16866.contentdm.oclc.org/cdm/ref/collection/maps/id/533, accessed August 4, 2017.

United States Surveyor General (USSG)

1862 Township: 024-0N, Range: 004-0E. Electronic document, https://www.blm.gov/or/landrecords/survey/yPlatView1_2.php?path=PWA&name=t240n040e_001.jpg, accessed August 4, 2107.

1863 Township: 024-0N, Range: 004-0E. Electronic document, https://www.blm.gov/or/landrecords/survey/yPlatView1_2.php?path=PWA&name=t240n040e_002.jpg, accessed August 4, 2107.

Washington State Department of Archaeology and Historic Preservation (DAHP)

2017a Washington State Standards for Cultural Resources Reporting 2017. On file at DAHP, Olympia.

2017b Washington Information System for Architectural and Archaeological Records Data (WISAARD) database. Electronic resource, https://secureaccess.wa.gov/dahp/wisaard/, accessed August 4, 2017.

2008 PROPERTY: #85746 California Ink Company. On file at DAHP, Olympia.

Waterman, T. T.

ca.1920 *Puget Sound Geography*. Unpublished manuscript, Allen Library, University of Washington, Seattle.

2001 *Puget Sound Geography*. Vi Hilbert, Jay Miller, and Zalmai Zahir, contributing editors. Lushootseed Press, Federal Way, Washington.

Waters, Michael R.

1992 *Principles of Geoarchaeology: A North American Perspective*. The University of Arizona Press, Arizona.

Zehfuss, Paul H., Brian F. Atwater, James W. Vallance, Henry Brenniman, and Thomas A. Brown

2003 Holocene lahars and their byproducts along the historical path of the White River between Mount Rainier and Seattle: Geological Society of America Field Trip. In *Western Cordillera and adjacent areas: Boulder, Colorado, Geological Society of America Field Guide 4*, edited by Terry W. Swanson, pp. 209-223.

7.0 Figures and Tables

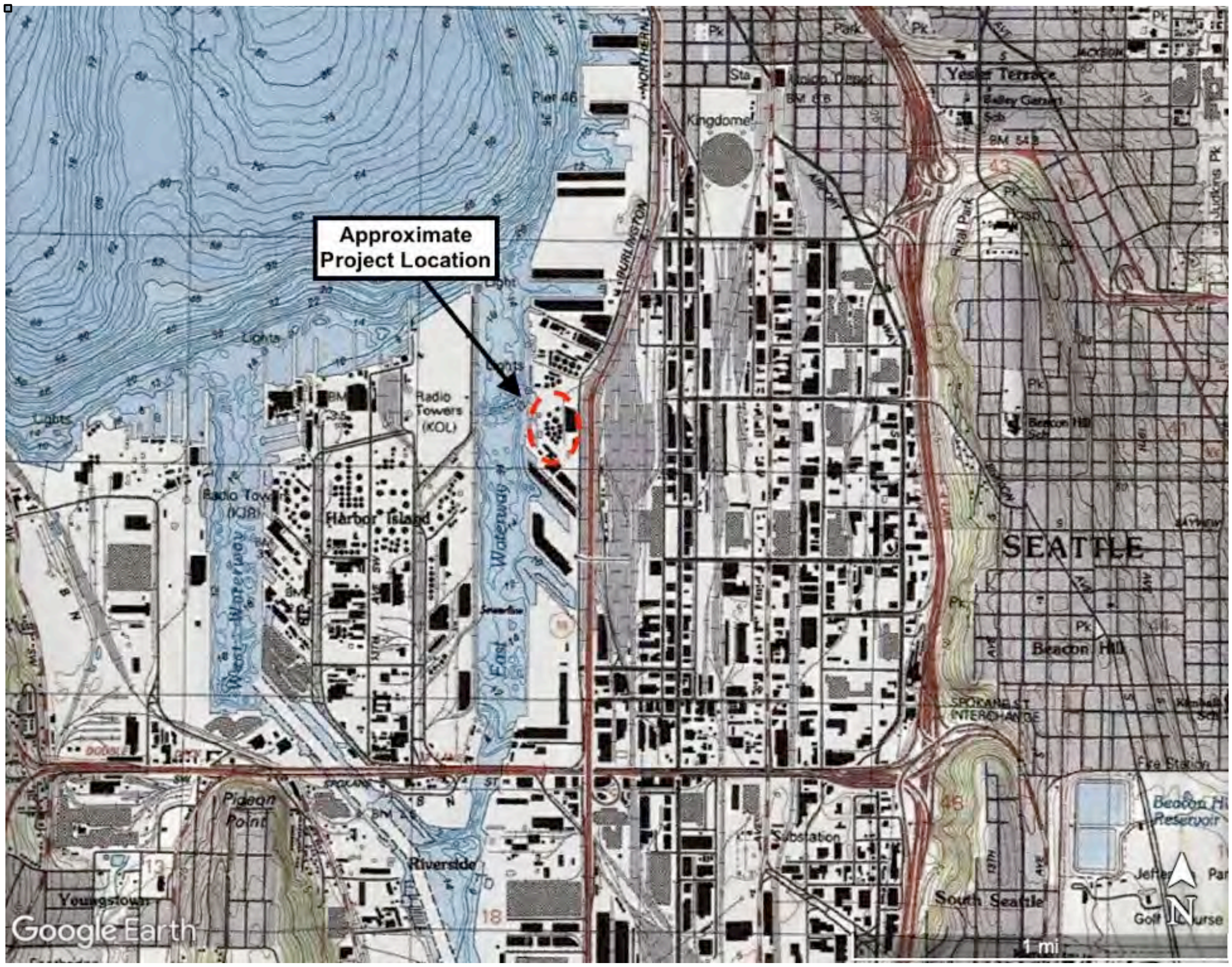


Figure 1. USGS Seattle South, WA 7.5-minute quadrangle annotated with the location of the project in red.

Figure 2. Site location map annotated with the project location in green, provided by Crete Consulting.

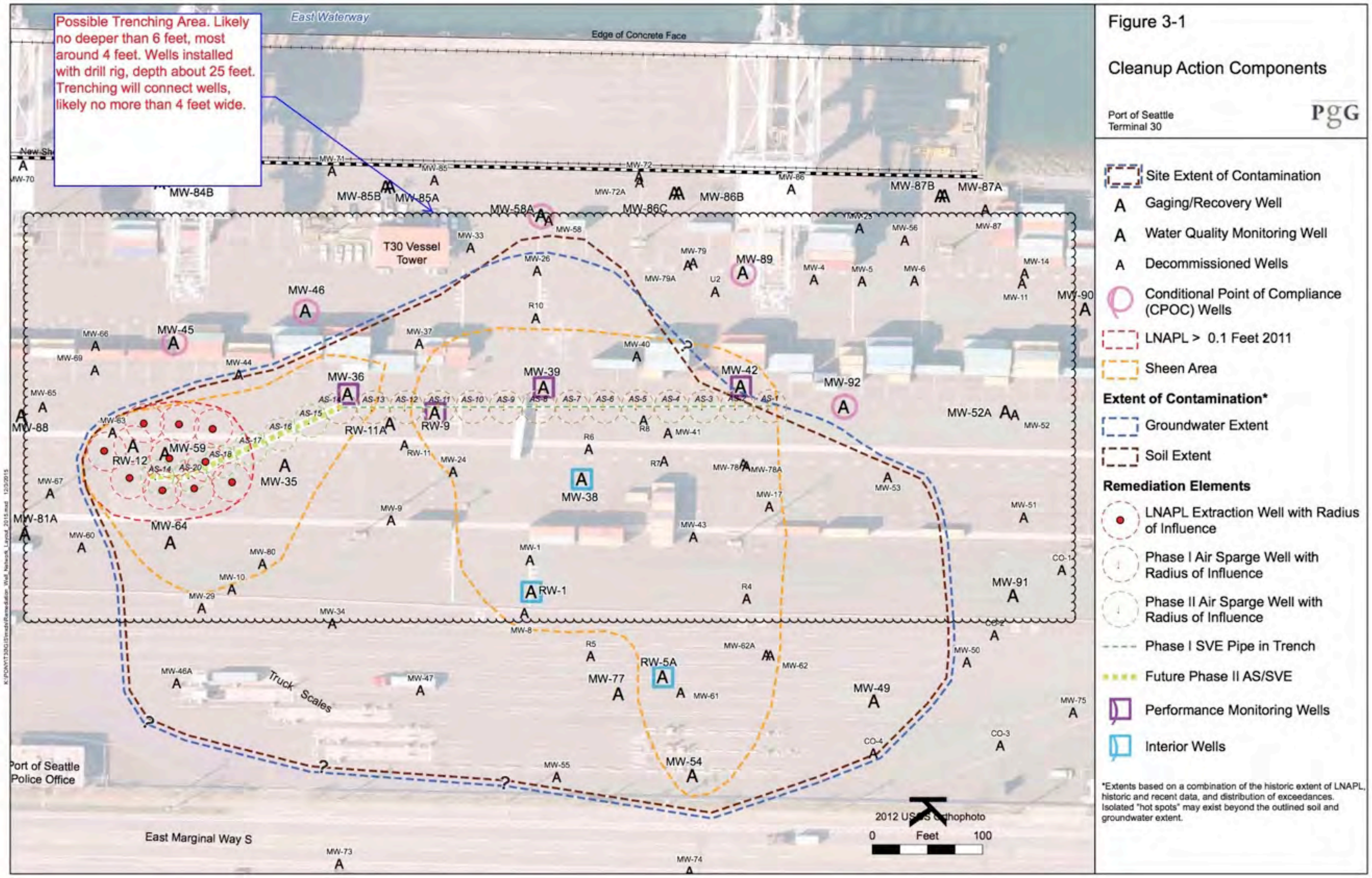
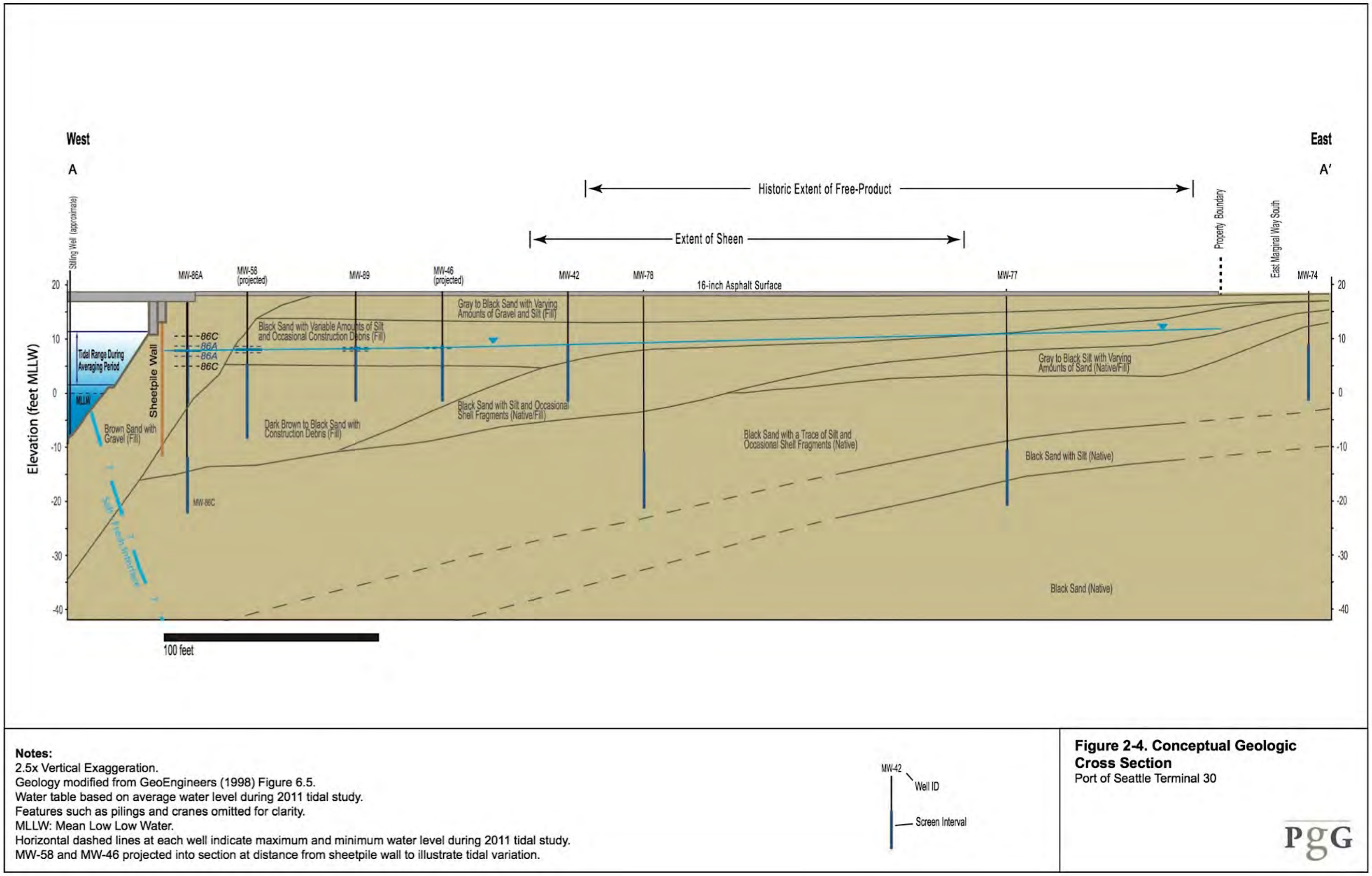


Figure 3. Project overview imagery annotated with the proposed ground disturbance.



Notes:
2.5x Vertical Exaggeration.
Geology modified from GeoEngineers (1998) Figure 6.5.
Water table based on average water level during 2011 tidal study.
Features such as pilings and cranes omitted for clarity.
MLLW: Mean Low Low Water.
Horizontal dashed lines at each well indicate maximum and minimum water level during 2011 tidal study.
MW-58 and MW-46 projected into section at distance from sheetpile wall to illustrate tidal variation.

Figure 2-4. Conceptual Geologic Cross Section
Port of Seattle Terminal 30

Figure 4. Subsurface conditions within the project location (Pacific Groundwater Group 2016: Figure 2-4).

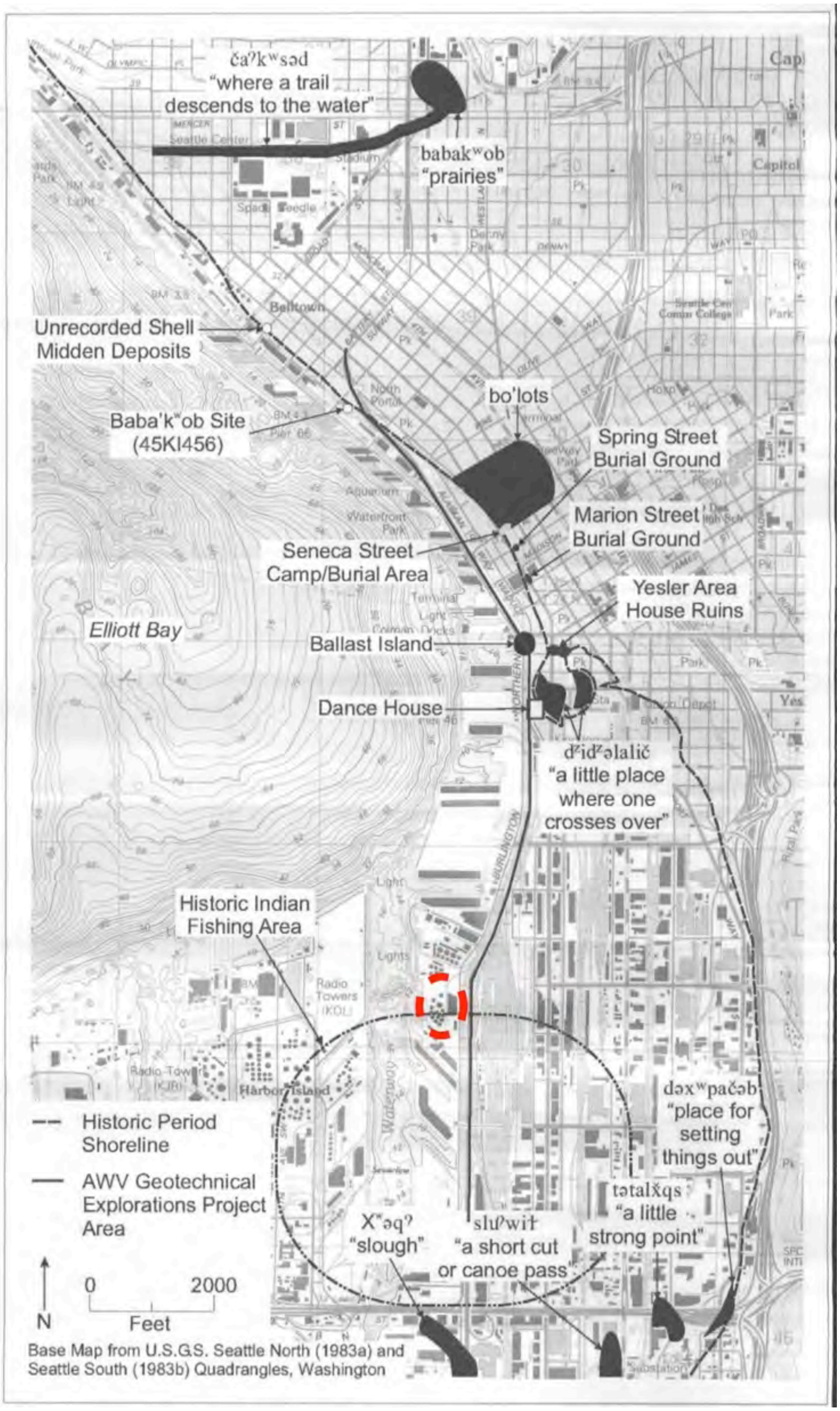


Figure 5. Map of Seattle annotated with local ethnographic place names and the approximate project location in red (Gillis et al. 2005:Figure 8).

Figure 6. USSG (1862) map annotated with the project location in red.

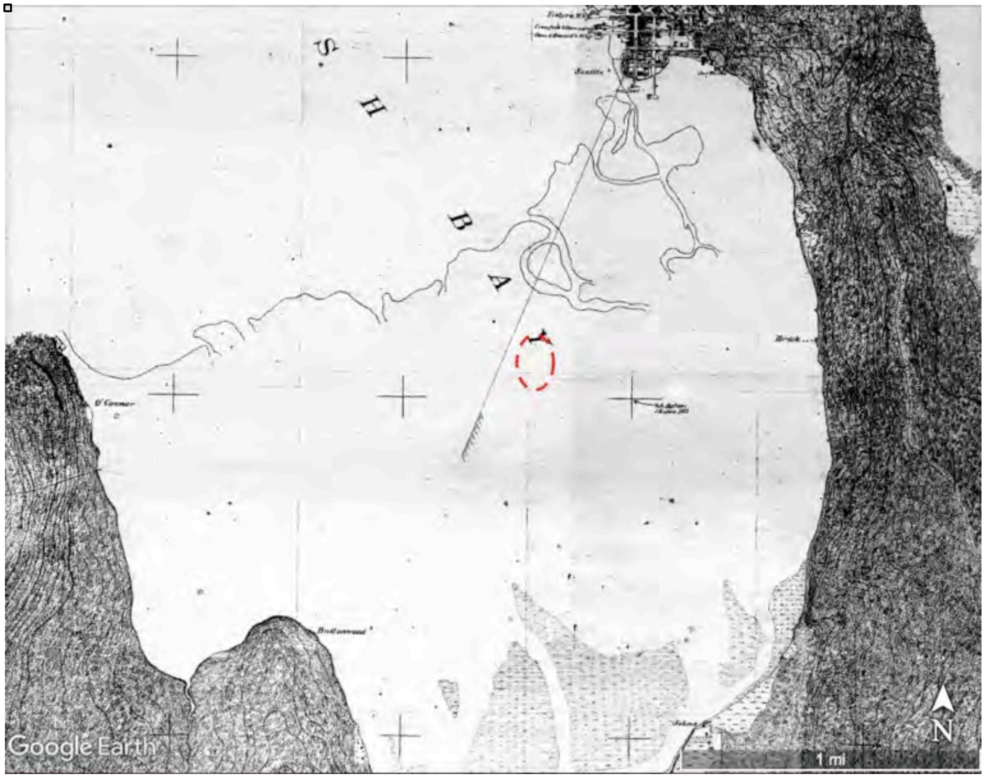


Figure 7. U.S. Cost Survey (1875) map annotated with the project location in red.

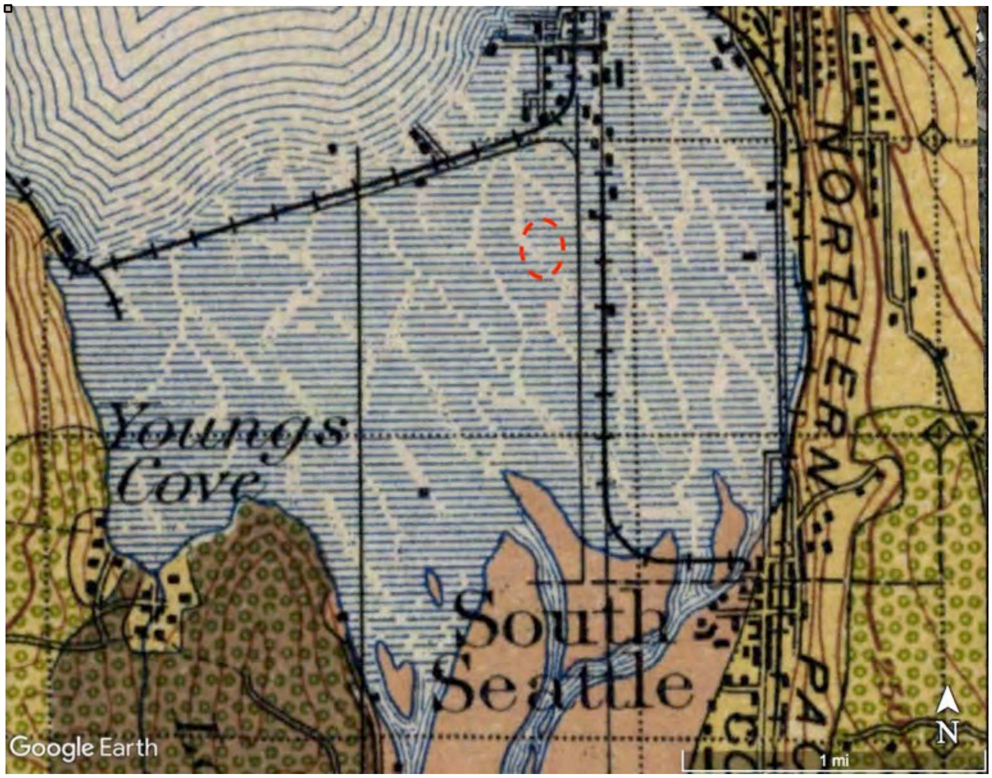


Figure 8. USGS (1897) map annotated with the project location in red.

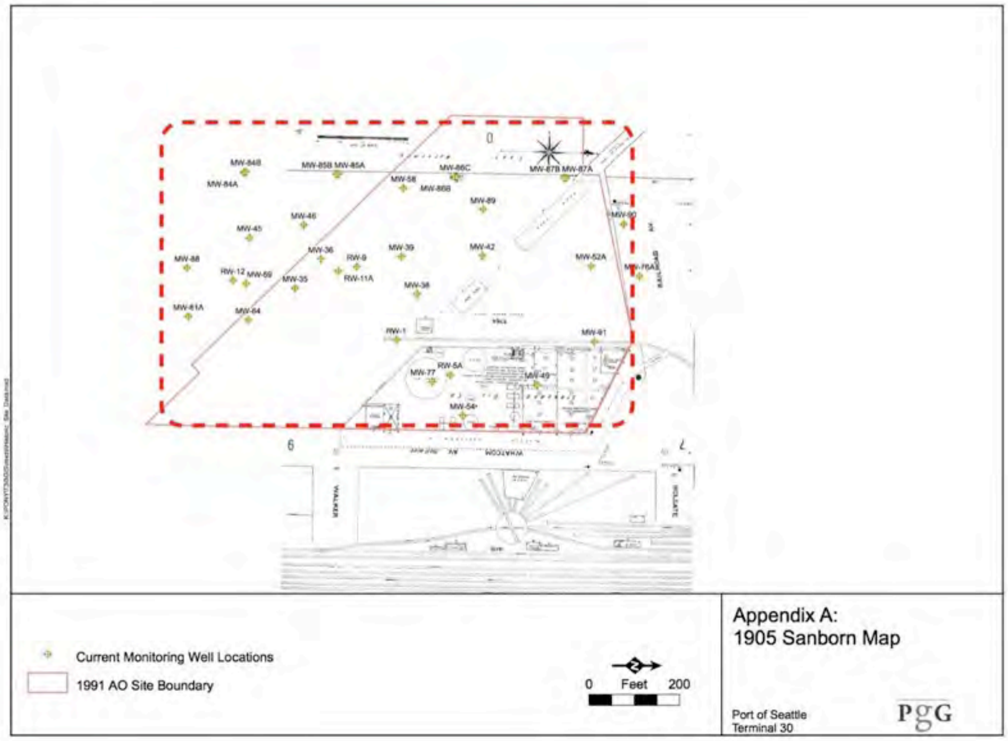


Figure 9. 1905 Sanborn map depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

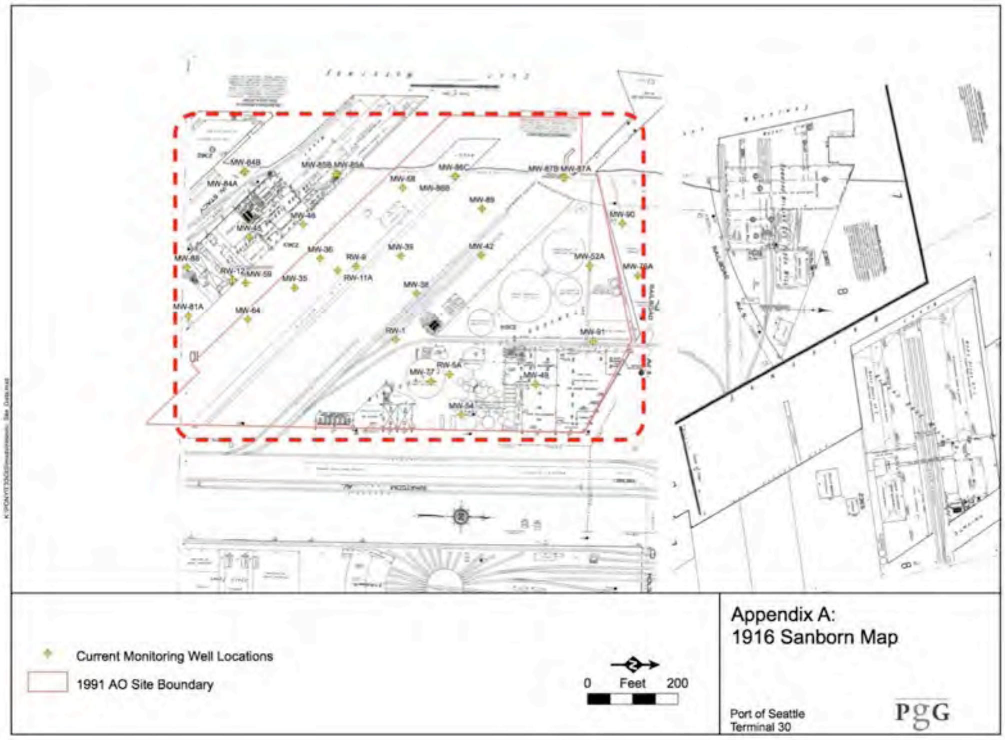


Figure 10. 1916 Sanborn map depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

Figure 11. 1936 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

Figure 12. 1946 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

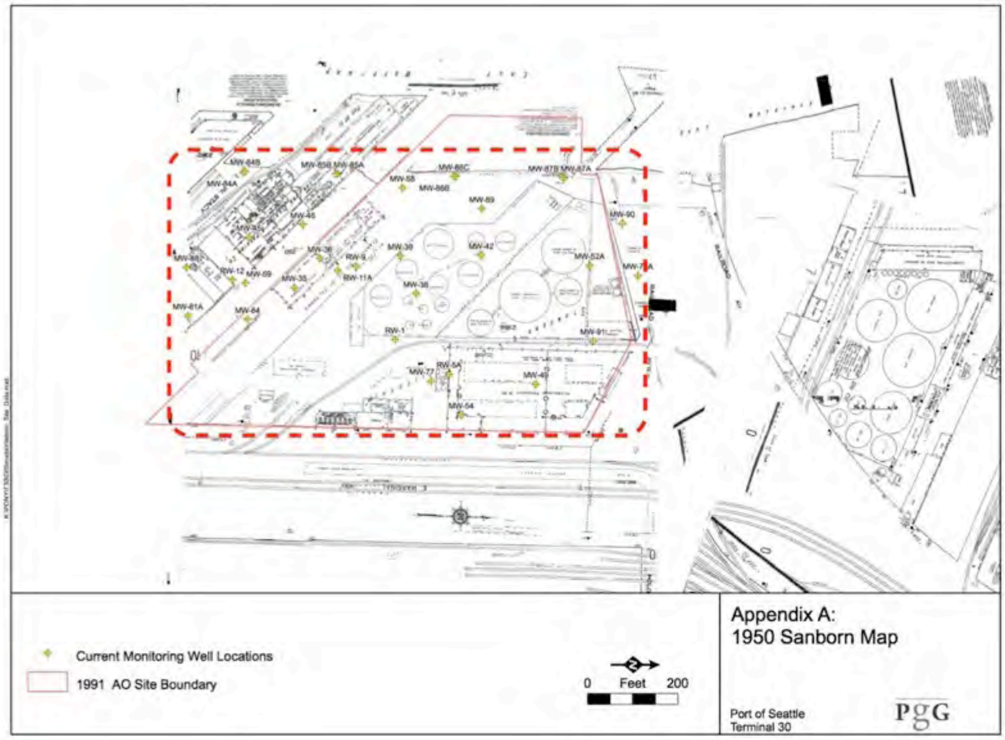


Figure 13. 1950 Sanborn map depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

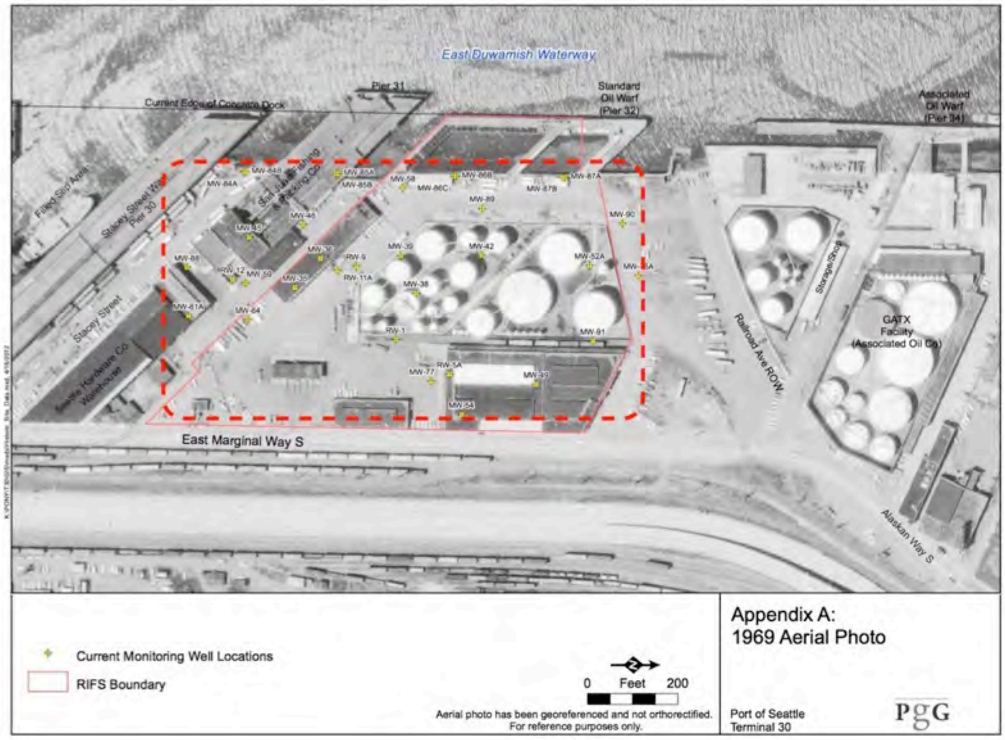


Figure 14. 1969 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

Figure 15. 1977 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

Figure 16. 1980 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

Figure 17. 1985 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

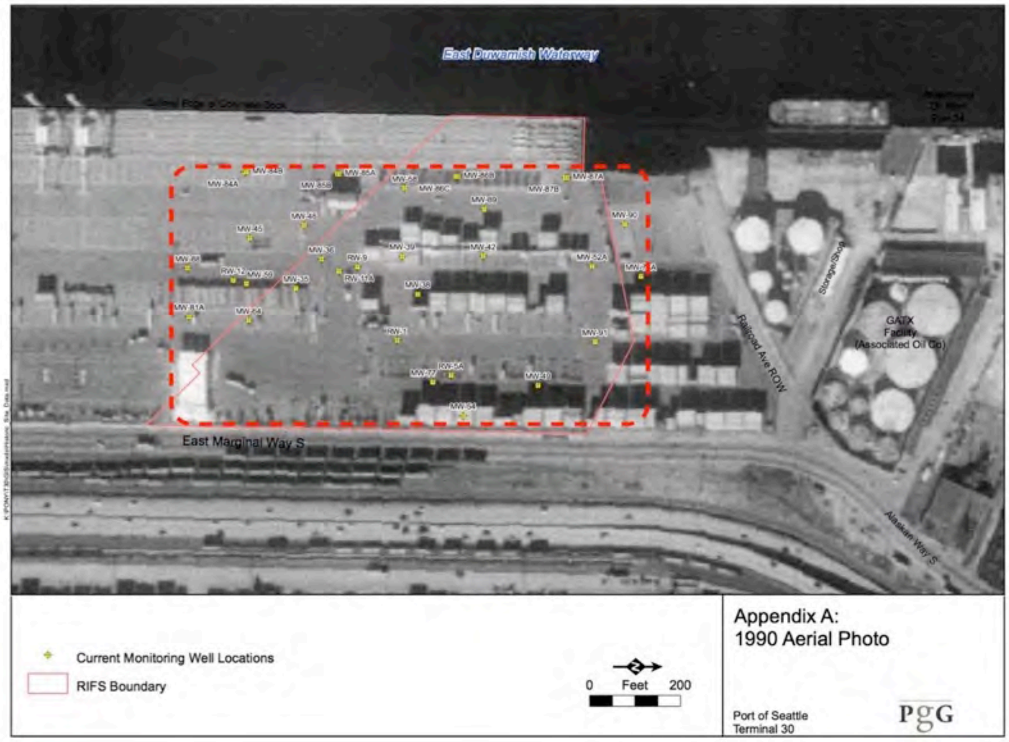


Figure 18. 1990 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

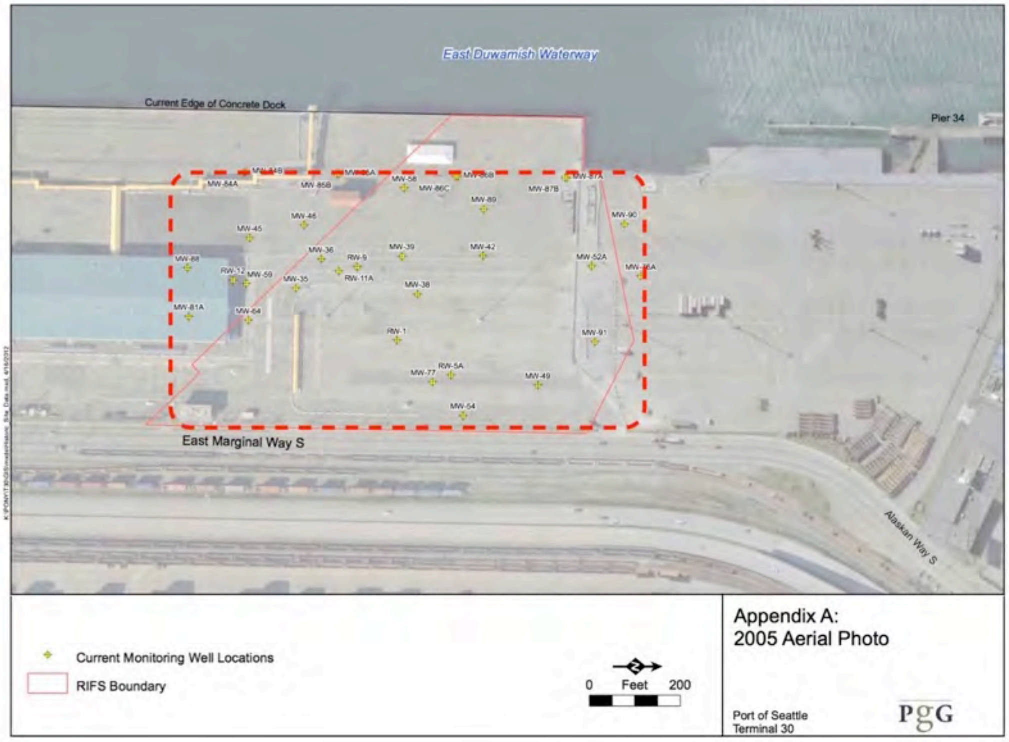


Figure 19. 2005 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

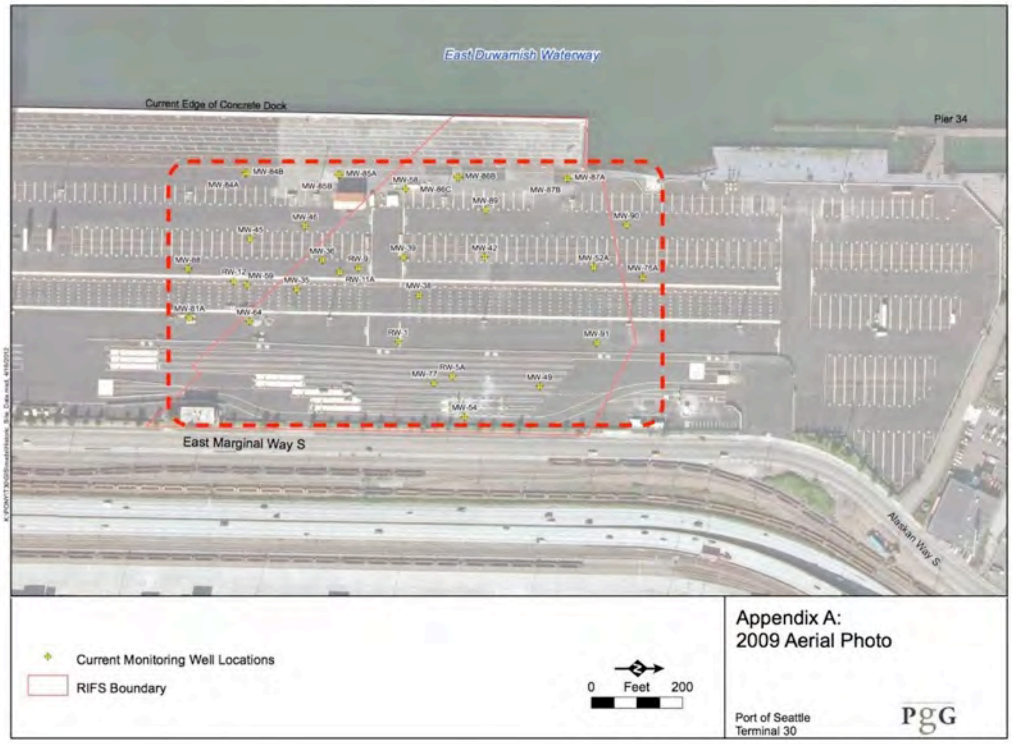
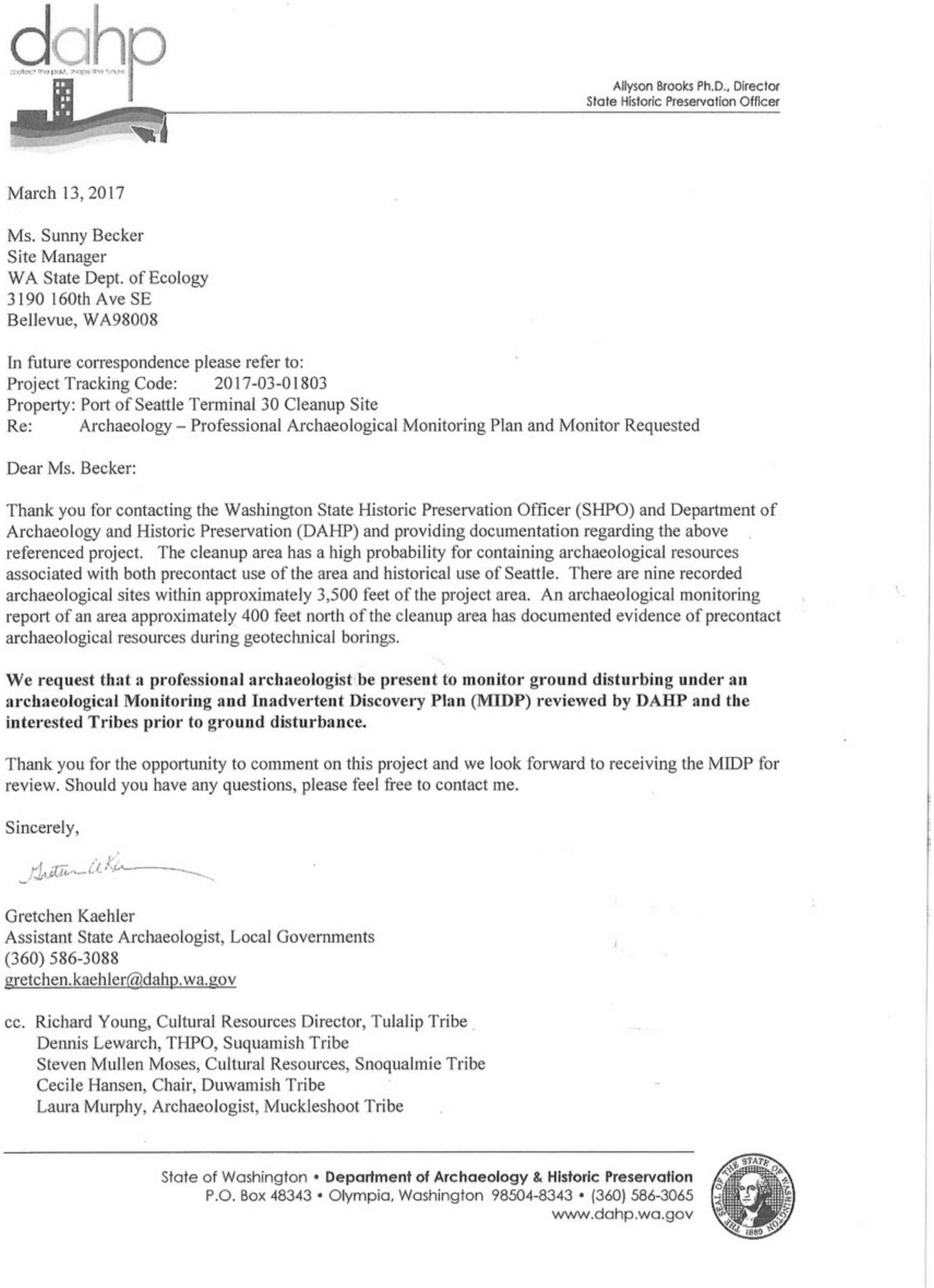


Figure 20. 2009 aerial photograph depicting the project location in red (Pacific Groundwater Group 2016: Appendix A).

Attachment A. DAHP monitoring request letter.



dahp
protect the past, shape the future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

March 13, 2017

Ms. Sunny Becker
Site Manager
WA State Dept. of Ecology
3190 160th Ave SE
Bellevue, WA98008

In future correspondence please refer to:
Project Tracking Code: 2017-03-01803
Property: Port of Seattle Terminal 30 Cleanup Site
Re: Archaeology – Professional Archaeological Monitoring Plan and Monitor Requested

Dear Ms. Becker:

Thank you for contacting the Washington State Historic Preservation Officer (SHPO) and Department of Archaeology and Historic Preservation (DAHP) and providing documentation regarding the above referenced project. The cleanup area has a high probability for containing archaeological resources associated with both precontact use of the area and historical use of Seattle. There are nine recorded archaeological sites within approximately 3,500 feet of the project area. An archaeological monitoring report of an area approximately 400 feet north of the cleanup area has documented evidence of precontact archaeological resources during geotechnical borings.

We request that a professional archaeologist be present to monitor ground disturbing under an archaeological Monitoring and Inadvertent Discovery Plan (MIDP) reviewed by DAHP and the interested Tribes prior to ground disturbance.

Thank you for the opportunity to comment on this project and we look forward to receiving the MIDP for review. Should you have any questions, please feel free to contact me.

Sincerely,

Gretchen Kaehler
Assistant State Archaeologist, Local Governments
(360) 586-3088
gretchen.kaehler@dahp.wa.gov

cc. Richard Young, Cultural Resources Director, Tulalip Tribe
Dennis Lewarch, THPO, Suquamish Tribe
Steven Mullen Moses, Cultural Resources, Snoqualmie Tribe
Cecile Hansen, Chair, Duwamish Tribe
Laura Murphy, Archaeologist, Muckleshoot Tribe

State of Washington • **Department of Archaeology & Historic Preservation**
P.O. Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3065
www.dahp.wa.gov

Appendix E

Groundwater Compliance Monitoring Plan and QAPP

APPENDIX E
GROUNDWATER COMPLIANCE MONITORING PLAN AND QUALITY ASSURANCE PROJECT PLAN

Final – 100% Design

Port of Seattle

Terminal 30 Site

December 20, 2018

APPENDIX E
GROUNDWATER COMPLIANCE MONITORING PLAN AND QUALITY ASSURANCE PROJECT PLAN
Final – 100% Design

Port of Seattle
Terminal 30 Site

December 20, 2018

PREPARED BY:

CRETE
CONSULTING, INC.

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms and Abbreviations

AS	air sparging
ALS	Australian Laboratory Services
CAP	Cleanup Action Plan
CMP	Groundwater Compliance Monitoring Plan
cPAH	carcinogenic polyaromatic hydrocarbon
COI	contaminant of interest
COC	contaminant of concern
CLP	contract laboratory program
CTD	conductivity, temperature, and depth
CRETE	Crete Consulting
DQO	data quality objective
T30 or Site	Terminal 30
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EDR	Engineering Design Report
EPA	United States Environmental Protection Agency
HCID	hydrocarbon identification
ISL	interim screening level
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LNAPL	light non-aqueous phase liquid
MDL	method detection limit
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
NAD83	North American Datum of 1983 (horizontal)
PARCC	precision, accuracy, representativeness, comparability, and completeness
PDF	portable document format
Port	Port of Seattle
PQL	practical quantitation limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
REL	remediation level
RPD	relative percent difference
SOP	standard operating procedure
SVOC	semi-volatile organic compound
SVE	soil vapor extraction
TEF	toxicity equivalency factor

TEQ	toxic equivalent concentration
TOC	total organic carbon
TPH	total petroleum hydrocarbons
VOC	volatile organic compound
WAC	Washington Administrative Code

1 Introduction

This Groundwater Compliance Monitoring Plan (CMP) was prepared in accordance with the Washington State Department of Ecology (Ecology) Consent Decree dated July 19, 2017 between Ecology and the Port of Seattle (Port) for the Terminal 30 (T30) Site (Figure 1) and the Model Toxics Control Act (MTCA), Washington Administrative Code (WAC) 173-340.

The CMP was prepared by Crete Consulting (CRETE) on behalf of the Port and was developed using information presented in the Cleanup Action Plan (CAP) and the draft Engineering Design Report (CRETE 2018). The CMP specifies the general field and laboratory methods and data quality objectives that will be used to locate, collect, and chemically analyze groundwater samples at T30 following installation of the cleanup action. This CMP also discusses the evaluation of performance and confirmational sampling data and possible contingent actions.

1.1 Scope

The CMP has been prepared in accordance with the requirements of MTCA, Chapters 173-340-410 and 173-340-720. MTCA defines three components of compliance monitoring:

- Protection monitoring, performed to confirm the protection of human health and the environment during implementation of the cleanup action (WAC 173-340-410(1)(a));
- Performance monitoring, conducted to confirm that the cleanup action has attained performance criteria (WAC 173-340-410(1)(b)); and,
- Confirmational monitoring, performed to demonstrate the long-term effectiveness of the cleanup action (WAC 173-340-410(1)(c)).

The CMP and associated Quality Assurance Project Plan (QAPP; Section 5) will replace all previous groundwater monitoring documents and programs at T30. The monitoring program defined in this CMP will be implemented at the completion of cleanup system construction. Until that time, groundwater monitoring will follow the semi-annual monitoring schedule defined in the Interim Monitoring Plan (PGG 2016b).

This CMP discusses all three components of compliance monitoring and: (1) defines the specific scope and objectives for each component; (2) provides guidance for field activities; and, (3) defines the quality assurance procedures used during monitoring, sampling, and laboratory analysis.

1.2 Report Organization

The CMP is organized into 8 sections. A brief description of each section is presented below:

- Section 1 – Introduction. Section 1 contains the purpose and organization of the CMP.
- Section 2 – Background Information. Section 2 provides a brief site description, a summary of subsurface conditions, and summarizes the Conceptual Site Model (CSM), including the cleanup action objectives and a brief description of the cleanup action.
- Section 3 – Monitoring Plan. Section 3 contains a summary of the network used to monitor the cleanup action, monitoring objectives, and monitoring locations. Section 3 also presents the methods used in monitoring well network maintenance.
- Section 4 – Sampling and Analysis Plan. Section 4 presents the groundwater sampling and analysis monitoring program.
- Section 5 – Quality Assurance Project Plan. Section 5 identifies quality assurance/quality control (QA/QC) procedures for groundwater sampling and laboratory analysis.
- Section 6 – Data Evaluation. Section 6 provides the procedures for data validation, evaluation of the free product gauging and groundwater quality data, and contingency measures.
- Section 7 – Schedule and Reporting. Section 7 briefly discusses the monitoring schedule and the quarterly, annual, and periodic review reports that will be submitted to Ecology.
- Section 8 – References. Section 8 provides the references cited in the CMP.

2 Background

The Site is located at 1901 East Marginal Way South in Seattle, Washington, approximately one mile southwest of downtown Seattle, in King County. The Site encompasses about 7 acres of a 34-acre intermodal container terminal where petroleum contamination is present and includes light non-aqueous phase liquid (LNAPL), soil, and groundwater with exceedances of MTCA cleanup levels (Figure 2).

Contamination at the Site resulted from releases at a former Chevron Bulk fuel terminal that operated between 1905 and 1984. The bulk fuel terminal consisted of above-ground fuel storage tanks and associated piping and equipment. The Port purchased the T30 Site from Chevron on January 2, 1985. The fuel terminal was demolished between December 1984 and about November 1985. The Port redeveloped the Site and properties to the north and south into the 34-acre intermodal container terminal. The Port converted T30 into a cruise ship terminal in 1999 and then converted it back to an intermodal container terminal in 2009. The Port does not have plans to change the current site use.

The intermodal terminal is bordered on the north by Jack Perry Memorial Park, on the east by East Marginal Way South, on the south by Terminal 25, and on the west by the East Waterway. The East Waterway is an operable unit of the Harbor Island Superfund Site as administered by the U.S. Environmental Protection Agency (EPA).

T30 was operated as a bulk fuel facility for approximately 80 years before redevelopment into a shipping terminal. Petroleum releases from bulk fuel facility tanks, distribution piping, and operations seeped into and through the vadose zone to the water table where product accumulated to thicknesses of up to 6.5 feet, as measured in wells prior to implementation of previous remedial actions. Compounds partitioned from LNAPL into a groundwater plume that migrated downgradient. No additional upland releases have been documented at the T30 site since removal of the bulk fuel facility and redevelopment of the site into T30 in the mid-1980s (Ecology 2017).

Remedial actions undertaken since the mid-1980’s, including product recovery and excavation, have removed the majority of the LNAPL above residual saturation, in conjunction with natural degradation processes. Free product with measureable thickness is now primarily restricted to the area surrounding MW-59 (Figure 2). Residual or near-residual saturation conditions likely remain within a significant portion of the historical extent of free product. These areas constitute a large mass of immobile LNAPL and the bulk of the contaminant mass (PGG 2016a).

Removal of free product and natural attenuation processes have resulted in a groundwater plume that has been stable or shrinking, as documented in the Remedial Investigation and Feasibility Study (RI/FS), and does not reach the East Waterway above cleanup levels. Groundwater concentrations in wells around the historical extent of free product have decreased significantly, and some wells on the northern and upgradient edges of the former extent of free product have transitioned from having measurable product to concentrations below cleanup levels (e.g. MW-54). The downgradient edge of the dissolved phase plume varies in relation to the remaining LNAPL source: to the south, groundwater is below screening levels within 100 feet of LNAPL. The northern portion of the plume has elevated GRO further downgradient from observed sheen. No wells along the sheet pile wall (MW-87A, MW-86B, MW-85A, and MW-84A) currently have concentrations above cleanup levels (PGG 2016a).

The Port and Ecology entered into an Agreed Order for cleanup at T30 in 1991 which was amended in 2013 to include preparation of the CAP. In July 19, 2017, the Port and Ecology entered into a Consent Decree for site cleanup that includes the preparation of the EDR and the construction, operation, maintenance, and monitoring of the selected cleanup action.

2.1 Selected Remedy

The selected cleanup action for the T30 site includes an Air Sparge/Soil Vapor Extraction (AS/SVE) system, a free product recovery system, and compliance monitoring. The purpose of the AS/SVE system is to reduce contaminant mass in the downgradient portion of the sheen area. The purpose of free product recovery is to reduce free product thickness to a sheen (less than 0.01 feet). The footprint of the cleanup action system is shown on Figure 2.

2.2 Previous Remedial Actions

A summary of the key cleanup milestones at T30 includes:

- Port and Ecology enter into Agreed Order for Remedial Investigation/Feasibly Study (RI/FS) in 1991
- Installation of a product recovery system that removed more than 171,000 gallons of product by the early 1990s
- Excavation and offsite disposal of more than 24,000 cubic yards of petroleum impacted soil
- Construction of site-wide 12- to 16-inch thick asphalt cap
- Oxygen Release Compound (ORC®)injection in MW-42 area
- Installation of more than 100 monitoring and recovery wells
- Completion of the initial draft RI/FS in 1998 and the final RI/FS in 2016
- Installation of sheet pile wall in 2008 and 2009 as part of the cruise to container terminal conversion
- Continuation of monitoring and product recovery during the 2000s.

2.3 Hydrogeology

Two shallow stratigraphic units have been identified at the T30 site: fill and native deposits. Fill was derived at least in part from dredging and can be difficult to physically differentiate from similar native tidal flat and alluvial deposits (GeoEngineers, 1998). Key characteristics of these units include:

- Fill Unit—consists of sand and gravel with varying amounts of silt, wood, bricks, and construction debris; the unit thickens and dips westward toward the East Waterway (GeoEngineers 1998). Fill units identified in the 1998 RI/FS by GeoEngineers were described as “laterally discontinuous” with a lower contact approximately 15 to 20 ft below ground surface (bgs) or the approximate historical mean lower low water tide line. Most of the fill materials tested for grain size distribution were classified as well-sorted sands and less commonly as sandy gravels, silty sand, and silts. During construction of the T30 facility in 1984 and 1985, additional fill for an engineered slope was placed along the shoreline after dredging operations were completed. This fill included sand with a surface layer of rip-rap extending to the base of the East Waterway.
- Native Deposits—consist of non-glacial, fluvial and estuarine, black, fine-to-medium sand with varying amounts of silt. Shell fragments and occasional organic materials were frequently observed in the native deposits.

Native soils and overlying fill comprise a shallow water table aquifer at the T30 site. Average depth to water ranges from 8 to 14 feet across the site. Recharge to the water table aquifer originates as precipitation in uplands and unpaved areas offsite; insignificant recharge originates at the T30 site due to the asphalt cover and the storm water management system.

In the Duwamish Valley, groundwater moves from upland recharge zones downgradient to Duwamish Waterway discharge zones. Groundwater at the T30 site generally flows toward the East Waterway, although discharge to the waterway is strongly influenced by tidal fluctuations and man-made structures. The average hydraulic gradient across the site is 0.0028 ft/ft with a slight increase near the sheet pile wall (Figure 3). Groundwater contours curve slightly northeast at the north end of the sheet pile wall, which is consistent with increased discharge around the end of the sheet pile wall. As tides rise and fall, flow between the East Waterway and the aquifer reverses in a tidal mixing zone that is relatively narrow; however, the zone of tidal influence on groundwater gradients is significantly wider (PGG 2016a).

Hydraulic conductivity of the shallow aquifer at the T30 site has been estimated based on tidal studies and grain size analysis (GeoEngineers 1998). Estimates based on grain size analyses range from 0.02 to 0.1 cm/s (57 to 284 ft/day). Estimates based on tidal studies range from 0.2 to 9 cm/s (567 to 25,500 ft/day) and likely overestimate the hydraulic conductivity of the aquifer given the native and fill lithologies observed at the T30 site. The higher tidal study estimates are typical hydraulic conductivities for clean gravels not for silty sands which are observed in most borings at the site (PGG 2016a).

2.4 Groundwater Exposure Pathways

Possible groundwater exposure pathways are limited to contaminated groundwater discharging to surface water and contaminants in groundwater migrating to indoor air. Human consumption of groundwater at the T30 site is not a complete pathway. Because the T30 site and greater Seattle metropolitan region of King County is within the Seattle Public Utilities (SPU) Water Service Area, drinking water is provided by the utility from municipal sources. According to the 2013 Water System Plan, 100-percent of Seattle's drinking water is provided by the Cedar River and South Fork Tolt River surface water sources. Two well fields in the SeaTac area provide drought and emergency supply (SPU 2012). None of these surface water or groundwater sources is near Terminal 30 (Ecology 2017).

2.5 Groundwater Fate and Transport

Groundwater fate and transport is discussed in detail in the T30 RI/FS. Below is a summary of the discussion from the RI/FS (PGG 2016a). Groundwater in contact with petroleum-impacted soil and LNAPL has produced a dissolved groundwater plume across much of the cleanup area. The dissolved plume is subject to the following major fate and transport phenomena:

- Sorption
- Tidal mixing
- Biodegradation

2.5.1 Sorption

Contaminant mobility in groundwater is related to solubility and sorption to the aquifer matrix. Larger molecules generally have lower solubility and higher partitioning coefficients, which reduces mobility in groundwater relative to contaminant mixtures that consist of smaller molecules. Reduced mobility can be summarized by a "retardation factor". DRO and GRO are mixtures of compounds/molecules of differing characteristics. Formulations vary widely between refineries, age of fuels, and source crude used to produce fuels. BTEX compounds are common components of typical gasoline formulations; diesel fuels are predominantly heavier, with less-volatile compounds such as naphthalene and anthracene and with lower concentrations of BTEX compounds. The BTEX compounds common to GRO have lower retardation factors (less sorption) than the heavier compounds common to DRO (more sorption) indicating relatively higher GRO mobility than DRO mobility in groundwater. This is consistent with the greater extent of GRO and BTEX compounds than DRO in the MW-42/MW-89 area.

PAHs partition strongly to soil particles and have high retardation coefficients. They have low solubility and low mobility in groundwater. Aqueous solubilities for PAHs are much lower than BTEX compounds and soil-water partitioning coefficients are generally much higher than BTEX compounds. Analytical results from unfiltered, filtered, and centrifuged samples collected at MW-58 and MW-86C support a conceptual model in which PAH compounds are predominantly sorbed to soil particles. Concentrations in filtered samples were lower than in unfiltered samples (2016 RI/FS Tables 2-8a and 2-8b). Most PAHs are not likely to migrate significantly due to their strong sorption to soil particles (PGG 2016a).

2.5.2 Tidal Mixing

Tidal mixing occurs only in the nearshore area. High tides result in advection of marine water into the aquifer. At low tide the gradient reverts to generally westward flow. Thus, the average concentration of any groundwater contaminant in this zone is reduced. The amount of mixing varies from a maximum at the marine/aquifer interface, to zero at the landward limit of mixing (see Appendix A; 2012 Tidal Study).

2.5.3 Biodegradation

Biodegradation occurs as microbes in the aquifer metabolize petroleum compounds, thus reducing contaminant mass. Biodegradation of petroleum compounds follows a metabolic pathway in which the contaminant is an electron donor and oxygen, nitrogen, and other compounds act as electron acceptors. Degradation begins with the aerobic metabolic pathway resulting in decreases in dissolved oxygen and oxidation-reduction potential. As oxygen is depleted, metabolism shifts to anaerobic metabolic pathways in which nitrate and sulfate concentrations decrease accompanied by further decreases in oxidation-reduction potential, and increases carbon dioxide and methane.

Data collected by AECOM (ENSR|AECOM, 2008a) demonstrated decreasing dissolved oxygen, nitrate, and sulfate concentrations coupled with elevated methane and carbon dioxide concentrations within and downgradient of the source area that are consistent with active biodegradation in the aquifer. Decreases in sulfate coupled with increases in methane in the former free product area indicate that biodegradation in the source area is sulfate-reducing and methanogenic. Biodegradation rates are commonly expressed as half-lives. A half-life is the time required to reduce the contaminant concentration by half. Biodegradation half-lives were calculated by AECOM on an intra-well basis and did not include estimates of attenuation caused by dispersion and tidal mixing. The biodegradation half-lives varied across the site depending on the constituent and the geochemical conditions (ENSR|AECOM, 2008a). The mean DRO biodegradation half-lives were 5.3 years for all wells and 3.7 years in the zone immediately downgradient of the former extent of free product. Half-lives from intra-well analyses reflect both the dissolved phase degradation and partitioning with the sorbed contaminant mass (PGG 2016a).

2.5.4 Predicted AS/SVE Effectiveness

The current extent of measurable free product in wells and the dissolved groundwater plume are shown in Figure 2. AS/SVE performance can be predicted based on measured concentrations and anticipated AS injection and SVE extraction rates and effectiveness.

An analysis to assess oxygen demand within and downgradient of the AS/SVE system was performed based on TPH soil concentrations. Based on an average TPH soil concentration of 9,700 mg/kg, it was determined that an oxygen demand of 2,300 kg is present within and downgradient of the AS/SVE system (Appendix B). If we further assume that AS results in a groundwater dissolved oxygen concentration of 8 to 9 mg/L, the AS/SVE system will satisfy the oxygen demand within about 9 to 10 years of operation. Operation of the AS/SVE system beyond 10 years is not likely to provide a significant reduction in contaminant mass.

3 Monitoring Plan

Monitoring will include free product thickness measurements and groundwater sampling at wells across the site (Figure 4). Wells are grouped by monitoring purpose as follows:

- Performance Monitoring Wells (Within the AS/SVE System): MW-59, RW-11A, and MW-89 (MW-59 and MW-89 will become Performance Monitoring Wells once free product is no longer accumulating)
- Performance Monitoring Wells (Downgradient of AS/SVE System): MW-36A, RW-9, MW-39A, and MW-42 (MW-39A will become a Performance Monitoring Well once free product is no longer accumulating)
- Interior Monitoring Wells: RW-1, RW-5A, MW-93, and MW-38
- CPOC Wells: MW-45A, MW-46B, MW-58A, MW-86B, and MW-92
- Shoreline Water Quality Monitoring Wells: MW-84A, MW-85A, MW-86B, and MW-87A
- Free Product Gauging: MW-59, RW-12, new recovery wells (RW-101-110), MW-36, MW-39A, MW-89, and MW-93
- Interior Monitoring Wells (Gauging Only): MW-35, MW-36, MW-54, and MW-64

The full suite of Indicator Hazardous Substances (IHSs; Table 1) will be analyzed in CPOC wells. A subset of IHSs will be monitored in Performance Monitoring wells that are indicative of AS/SVE system performance: NWTPH-G, BTEX, and NWTPH-Dx. Water quality samples will not be collected from free product gauging wells.

Table 1 Indicator Hazardous Substances

Constituent (BTEX, SVOC, TPH)	Constituent (PAH)
BTEX Compounds	***PAH Compounds (filtered)***
Benzene	Acenaphthene
Toluene	Acenaphthylene
Ethylbenzene	Anthracene
Xylenes (total)	Benzo[a]anthracene
Semivolatile Organic Compounds	Benzo[a]pyrene
2-Methylnaphthalene	Benzo[b]fluoranthene
Petroleum Hydrocarbons	Benzo[g,h,i]perylene
TPH, gasoline range organics	Benzo[k]fluoranthene
TPH, diesel range organics	Chrysene
TPH, heavy oils	Dibenzo[a,h]anthracene
	Fluoranthene
	Fluorene
	Indeno[1,2,3-cd]pyrene
	Naphthalene
	Phenanthrene
	Pyrene
	Naphthalene

The frequency of groundwater monitoring varies by well group and by compliance monitoring phase (Table 2). Compliance monitoring is divided into three sequential phases:

- Baseline Monitoring- A full round of compliance well gauging and sampling that occurs shortly before start-up of the AS/SVE system and initiation of free product recovery activities.
- Performance Monitoring– Compliance well gauging and sampling that occurs during and for 2 years after cleanup system operation, for both the AS/SVE system and free product recovery, to determine whether rebound occurs or cleanup actions continue to achieve remediation levels.
- Confirmational Monitoring – Long-term compliance well gauging and sampling that occurs once remediation levels and cleanup levels have been achieved in Performance and CPOC Wells, respectively, as discussed in Section 6.

Table 3 illustrates the monitoring schedule by compliance monitoring phase.

Table 2 Compliance Monitoring Frequency and Analytes

Well Network	**Compliance Monitoring Phase**		
	Baseline Sampling	**Performance Monitoring***	**Confirmational Monitoring**
Groundwater Sampling (See Note 1)			
Performance Monitoring Wells – Within (MW-59, RW-11A, MW-89**)**	Single Event (NWTPH-G/BTEX, NWTPH-Dx)	Every 6 Months (NWTPH-G/BTEX, NWTPH-Dx)	None Scheduled
Performance Monitoring Wells – Downgradient (MW-36A, RW-9, MW-39A, MW-42)		Every Year (NWTPH-G/BTEX, NWTPH-Dx)	
Interior Monitoring Wells (MW-38, MW-93, RW-1, RW-5A)	Single Event (NWTPH-G/BTEX, NWTPH-Dx)	Every 2 Years (NWTPH-G/BTEX, NWTPH-Dx)	Every 5 Years (NWTPH-G/BTEX, NWTPH-Dx)
Interior Monitoring Wells - Gauging Only (MW-35, MW-36, MW-54, MW-64)	Single Event (Free Product Gauging)	Every 2 Years (Free Product Gauging)	Every 5 Years (Free Product Gauging)
CPOC Monitoring Wells (MW-45A, MW-46B, MW-58A, MW-86B*, MW-92)**	Single Event (NWTPH-G/BTEX, NWTPH-Dx, PAHs, 2-methylnaphthalene)	Every 2 Years (NWTPH-G/BTEX, NWTPH-Dx, PAHs, 2-methylnaphthalene)	Varies – See Table 3 (NWTPH-G/BTEX, NWTPH-Dx, PAHs, 2-methylnaphthalene)
Shoreline Water Quality Monitoring Wells (MW-84A, MW-85A, MW-86B*, MW-87A)**	Single Event (NWTPH-G/BTEX, NWTPH-Dx, PAHs, 2-methylnaphthalene)	None Scheduled	None Scheduled
Free Product Recovery Gauging (See Note 2)			
Free Product Gauging Wells (MW-59, RW-12, New Recovery wells [RW-101 to 110], MW-36, MW-39A**, MW-89**, MW-93)**	Single Event (Free Product Gauging)	Quarterly (Free Product Gauging)	None Scheduled

Notes:

1. This schedule can be modified based on data collected during system performance, see Section 6.
2. For all monitoring wells, the measurement of free product in a well will trigger free product removal activities. Free product gauging (and removal, if free product is present) will occur quarterly for a minimum of 4 consecutive quarters.

* Performance monitoring will continue for the duration of AS/SVE system operation plus 2 years, at which time confirmational monitoring will be initiated.

** MW-59, MW-39A, and MW-89 will become Performance Monitoring Wells once free product has not been present for 2 consecutive quarters.

***MW-86B is both a CPOC Well and a Shoreline Water Quality Well

Table 3 Compliance Monitoring Schedule

Post AS/SVE Startup Years:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**22**	**27**	**32**
Post AS/SVE Shutdown Years:							**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**17**	**22**	**27**
Confirmational Monitoring Years:									**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**15**	**20**	**25**
	Baseline	**Performance Monitoring Period**							**Confirmational Monitoring Period**												
CPOC Wells	*Once*	*Biannual*							*Annual*					*Biannual*				*Every 5 years*			
MW-45A	X	X		X		X		X	X	X	X	X	X	X		X		X	X	X	X
MW-46B	X	X		X		X		X	X	X	X	X	X	X		X		X	X	X	X
MW-58A	X	X		X		X		X	X	X	X	X	X	X		X		X	X	X	X
MW-86B	X	X		X		X		X	X	X	X	X	X	X		X		X	X	X	X
MW-92	X	X		X		X		X	X	X	X	X	X	X		X		X	X	X	X
Performance Wells																					
Within	*Once*	*Semiannual*							None												
MW-59	X	XX	XX	XX	XX	XX	XX	XX													
MW-89	X	XX	XX	XX	XX	XX	XX	XX													
RW-11A	X	XX	XX	XX	XX	XX	XX	XX													
Downgradient	*Once*	*Annual*							None												
MW-36A	X	X	X	X	X	X	X	X													
MW-39A	X	X	X	X	X	X	X	X													
MW-42	X	X	X	X	X	X	X	X													
RW-9	X	X	X	X	X	X	X	X													
Interior Wells	*Once*	*Biannual*							*Every 5 years*												
MW-38	X	X		X		X		X					X					X	X	X	X
MW-93	X	X		X		X		X					X					X	X	X	X
RW-1	X	X		X		X		X					X					X	X	X	X
RW-5A	X	X		X		X		X					X					X	X	X	X

Notes

The monitoring frequency for the Shoreline water quality monitoring wells and free product gauging wells are not shown on this table.

3.1 Performance Groundwater Monitoring

Performance Monitoring wells are located within and downgradient of the AS/SVE system radius of influence and will be used to track system effectiveness.

Concentrations within and downgradient of the AS/SVE system are expected to decline as contaminant mass is reduced within the AS/SVE treatment area. Samples will be analyzed for NWTPH-G/BTEX and NWTPH-Dx. Performance Monitoring wells will be sampled at the frequencies indicated in Table 2. Performance monitoring will continue for the duration of AS/SVE system operation plus 2 years, at which time confirmational monitoring will be initiated.

Performance monitoring wells include the following:

- Performance Monitoring Wells (within the AS/SVE System) - MW-59, RW-11A, and MW-89 (MW-59 and MW-89 will become Performance Monitoring Wells once free product has not been present for 4 consecutive quarters)
- Performance Monitoring Wells (downgradient of AS/SVE System) – MW-36A, RW-9, MW-39A, and MW-42 (MW-39A will become a Performance Monitoring Well once free product has not been present for 4 consecutive quarters)

3.2 Interior Groundwater Monitoring

Interior Monitoring wells are located upgradient of the AS/SVE system within the portion of the site with sheen but with no measurable product thickness. Interior monitoring wells will be used to track long-term reductions in contaminant mass that are not associated with operation of the AS/SVE system. Samples will be analyzed for NWTPH-G/BTEX and NWTPH-Dx. Interior Monitoring wells will be sampled at the frequencies indicated in Table 2 during performance and confirmational monitoring phases of the project. Interior Monitoring Wells include: MW-38, MW-93, RW-1, and RW-5A.

Select interior monitoring wells within the sheen area will be gauged for free product accumulation during monitoring. These wells include: MW-35, MW-36, MW-54, and MW-64. If product is detected in these wells, the product will be removed during the next scheduled product removal event at the site.

3.3 CPOC Groundwater Monitoring

Groundwater monitoring at the CPOC will be used to assess concentrations of site IHSs at the CPOC wells relative to cleanup levels. Samples will be analyzed for the IHSs listed in Table 1. The CPOC monitoring wells will be sampled at the frequencies indicated in Table 2 during performance and confirmational monitoring phases of the project. CPOC Wells include: MW-45A, MW-46B, MW-58A, MW-86B, and MW-92.

3.4 Shoreline Water Quality Monitoring

Groundwater monitoring at the shoreline water quality wells will be used to assess concentrations of site IHSs at the shoreline wells relative to cleanup levels. Samples will be analyzed for the IHSs listed in Table 1. The shoreline water quality monitoring wells will be sampled at the frequencies indicated in Table 2 and may be sampled during additional sampling events based on results from the CPOC wells (discussed in Section 6.5). Shoreline Water Quality Monitoring Wells include: MW-84A, MW-85A, MW-86B and MW-87A.

3.5 Free Product Gauging

Free product thickness will be measured at MW-59, MW-39A, MW-89, and MW-93 during groundwater compliance monitoring events and at MW-59, RW-12, free product removal wells (RW-101 through RW-110), MW-36, MW-39A, MW-89, MW-93, and any additional free product wells at the beginning of free product recovery events. MW-59, MW-39A, and MW-89 will become Performance Monitoring Wells once free product has not been present for 4 consecutive quarters. At the beginning of cleanup activities, free product removal will occur monthly until free product no longer accumulates in recovery wells. The frequency will be reduced to bimonthly or quarterly, as appropriate.

3.6 Monitoring Well Network Maintenance

Wells will be inspected on a regular interval and maintenance or replacement will be performed on an as-needed basis. Problems that require immediate attention will be reported to the Port’s project manager so as to remedy the condition prior to the next sampling event. If a significant problem, such as a broken wellhead, bent casing, or other damage that compromises a well is discovered, it may be necessary to remedy the problem as soon as possible and/or before sampling. A problem with the well integrity may require a modification of the sampling schedule or some other change in the sampling program. All decisions regarding such modifications will be reported immediately by the field personnel to the Port’s project manager. The Port’s project manager will be responsible for maintaining technical liaison with Ecology regarding such issues.

Modifications to the monitoring network will be documented in the groundwater monitoring reports described in Section 7. Examples of changes to the well monitoring network could include changes in wells used for monitoring, well replacement, well modification, or well abandonment.

3.6.1 Inspection and Maintenance

Monitoring wells in the network will be inspected by the sampling team during routine monitoring to assess their integrity. The inspection will include a visual inspection of the well to determine if the well has been damaged or tampered with. The well inspection verifies the physical condition of the well at the ground surface, the protective monument, and the internal well casing. All wells, including product recovery, CPOC, Performance and Interior Monitoring wells will be inspected during routine sampling and gauging.

Total well depths within the groundwater sampling network (CPOC, Performance, and Interior Monitoring wells) will be measured once per year to evaluate the well integrity. Product Recovery wells will be inspected once every 4 years to evaluate the integrity of the well. If more than 1 foot of sediment has built up in the bottom of a well, the well will be redeveloped and the sediment removed. Well redevelopment will include documenting the starting and final total depth of the well, the initial depth to water, the number of gallons of water removed from the well, and the method used to remove sediment and surge and/or purge the well.

Monitoring wells will also be inspected for damage after any major physical event that may affect the wells, such as an earthquake or heavy construction in the vicinity of a well. Problems discovered during the inspection will be recorded on field forms and a well maintenance form, which will be provided by the field personnel to the Project Manager.

All sampling equipment used for groundwater monitoring will be maintained regularly by the sampling team members according to the appropriate equipment standard operation procedures (SOP) or the manufacturer's equipment manuals.

3.6.2 **Monitoring Well Replacement**

If any monitoring well in the network must be replaced, the Port will notify Ecology prior to replacement. The replacement will be completed upon approval by Ecology and prior to the next scheduled groundwater sampling event, if possible. If it is agreed that the well has become unsuitable for groundwater sample collection, the Port will propose the location of a replacement well, if considered necessary, consistent with the needs of the groundwater monitoring program. The location of a replacement well may or may not be near the previous well location. A monitoring well construction form will be completed for the new well and a copy will be submitted to Ecology.

Wells will be decommissioned in accordance with WAC 173-160-460 (Abandonment of Resource Protection Wells). The Port’s drilling contractor will file the appropriate notification of well abandonment with Ecology.

Field personnel will observe the drilling and construction of all new or replacement monitoring wells. A detailed drilling borehole log will be prepared to document geologic observations, as-built well construction details, Ecology well ID, and drilling method. Borehole logs will be included in the following annual monitoring report (Section 7.2.2).

4 Sampling and Analysis Plan

This section summarizes the field procedures for the groundwater sampling and free product recovery. See Appendix C for copies of well logs, Appendix D for Standard Operating Procedures and field forms, and Section 5 for the Quality Assurance Project Plan (QAPP).

4.1 Groundwater Sampling Methods

Groundwater samples will be collected from CPOC, Performance, and Interior monitoring wells (Figure 4) using low-flow sampling techniques. Samples will be submitted for laboratory analysis of the parameters outlined in Section 3.

A subset of wells at T30 are sufficiently tidally influenced that they require sampling at specific times to ensure that tidal influence on groundwater chemistry is minimized. Best-practice includes sampling at the tidal lag times to ensure a representative sample. Purging will begin at an appropriate time prior to the target lag time for sampling. The T30 Tidal Study summarizes tidal lags and tidal efficiencies for wells on site and should be referenced if sampling of additional wells not specifically addressed in this CMP is required. The complete Tidal Study is included as Appendix A for reference. Below is a summary tidal lag times[1]:

- CPOC Well MW-58A will be sampled between 70 and 130 minutes after low-low tide
- CPOC Well MW-86B will be sampled between 130 and 190 minutes after low-low tide
- Performance Monitoring Well MW-89 will be sampled between 130 and 190 minutes after low-low tide
- Shoreline Water Quality Monitoring Wells (MW-84A, MW-85A, MW-86B, MW-87A) will be sampled between 130 and 190 minutes after low-low tide
- All other CPOC, Performance, and Interior wells have limited tidal influence and do not require coordinating sampling time with tidal lag.

The following tasks will be performed at each well:

- Measure and record static water level (distance from top of casing) to the nearest 0.01 foot using an electric well sounder. If free product is present, the free product thickness will be measured as described in Section 4.2 and the well will not be sampled.
- Use the EPA Low-Flow Groundwater Sampling Procedure (EPA, 2010b). This procedure includes several steps and can be summarized as follows. The

---

[1] Low-low tide is as measured at NOAA Tide Station ID: 9447130.

groundwater sample tubing inlet should be maintained near the mid-point of the saturated well screen interval. For wells with significant tidal influence the sample tubing inlet should be placed at least 2 feet from the bottom of the well. Water levels should be monitored before and during purging to ensure that tubing placement is accurate[2]. Once sampling tubing is inserted, first, purge groundwater at a low rate (~100 to 200 mL/min). Second, monitor the discharge water for temperature, pH, and specific conductance at least three times during the purging period. Third, measure the purge volume using a calibrated bucket. Fourth, record purge water volume, time, and field parameter values in the field notes.

- Depth to water will be measured during purging at all wells to ensure that purging does not cause greater than 1 foot of drawdown. The amount of drawdown may be estimated by field staff at tidally-influenced wells where water levels are changing independent of purge rate.
- Sampling may begin after three consecutive field parameter measurements (temperature, specific conductance, and pH) measured at not less than a 2 minute interval are stable. Continue purging water until three consecutive stable measurements are recorded. Sampling may be conducted without stabilization if the parameter trends are reasonably attributed to in-aquifer variability such as tidal flux.
- Collect samples of water for laboratory analysis in a manner that minimizes volatilization of constituents. Hands and clothing will be clean when handling sampling equipment and during sampling. Clean, disposable, nitrile (or equivalent) gloves will be worn when filling bottles for analyses. Gloves will be changed when dirty and between samples. All water samples will be collected from the pump discharge lines directly into the appropriate sample containers. Samples submitted for dissolved PAH analyses will be field filtered using a 0.45-micron in-line disposable filter.

Collect samples in the following manner:

- VOCs and TPH-gasoline: For each sample, fill 40-ml vials preserved with hydrochloric acid, or according to laboratory specifications. Slowly fill each vial until all air is removed and sample water bulges slightly over the top of the vial. Wet cap with sample water and screw onto top of vial. Invert vial and tap with finger. The properly filled vial has NO visible air bubbles.
- Other Parameters: There is no headspace or filtering concerns related to the other water quality parameters. Fill the laboratory prepared sample bottles almost to the top, taking care not to overfill.

---

[2] If dedicated tubing is used in monitoring wells, then the tubing length should be cut such that the tubing end is at the correct position when connected to a pump or equivalent sampling setup for purging.

- Filtered groundwater samples will be collected for polynuclear aromatic hydrocarbon (PAH) analysis. Filtered sample will be collected using a disposable 0.45-micron filter. Water will be purged through the filter for at least 2 minutes prior to filling sample containers.
- Record sample identification data on each sample container, in the field notes, and on the chain-of-custody. Sample identification will be the same as the well name/number and the sample collection date.

Field indicator parameters will be measured approximately every 2 to 5 minutes during purging. Field parameters will include pH, specific conductance, temperature, turbidity, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Measurements will be recorded to the following standards:

- pH to ±0.01 units;
- Specific conductance to ±1 microSiemens;
- Temperature to ±0.1oC;
- Turbidity to ±1 units;
- DO to ±0.1 milligrams per liter (mg/L); and
- ORP to ±1millivolts (mV).

Samples will not be collected until these parameters have stabilized for three consecutive readings to the following criteria:

- pH to ±0.1 pH unit;
- Specific conductance to ±5 percent; and
- Temperature to ±3 percent unless ambient conditions affect temperature readings.

Attempts to stabilize turbidity, DO, and ORP measurements should be made, but will not be used to determine stability. As noted above, tidally influenced wells may have ambient trends and stability for sampling purposes may be made by field staff based on estimated trends. Alternately, if field parameters do not stabilize after 3 to 5 well casing volumes have been purged, a sample will be collected. Well purging data will be recorded on a Groundwater Sampling Form.

Field instruments will be calibrated using known, standard solutions, at the start of each sampling day and if readings appear to be in error.

4.2 Free Product Gauging Methods

Product thickness will be measured with an interface probe. The interface probe will be lowered slowly until the upper surface of product can be measured and recorded in field notes. Then, the probe will then be slowly lowered until it is at least 5 cm below the lower product contact surface with water and then pulled back slowly until the lower product surface is measured by the interface probe. The measurement process will then be repeated a second time and measurements checked for consistency. This protocol is used to prevent over estimating product thickness due to drag down of the lower product surface. A clear plastic bailer will be used to measure product thickness if a reliable measurement cannot be obtained with the interface probe.

4.3 Sampling and Monitoring Equipment

Field equipment and supplies include sampling equipment (e.g., interface probe, sampling pumps, water quality meters, bailers, and field filters), decontamination supplies, sample containers, coolers, log books and forms, personal protection equipment, and personal gear. Protective wear (e.g., hard hats, gloves) are described in the Health and Safety Plan. Sample containers, coolers, and packaging material will be supplied by the analytical laboratory. All sampling containers will be certified clean by the laboratory.

Equipment used for free product gauging will consist of an electronic oil/water interface probe for detection of free product and water, and includes two types of responses: one for detection of free product and the other for detection of water. This detector typically consists of a permanently marked coaxial cable or plastic-coated flat wire with 0.01-foot calibrations, a detection probe, and electronic controls contained in a spool or reel.

4.4 Decontamination

To minimize sample cross-contamination to the extent practical, disposable equipment will be used for groundwater sampling. Disposable equipment will include gloves, filters, and sampling tubing. New, disposable, polyethylene tubing will be used to draw water from each monitoring well. Dedicated tubing may be considered where little to no contamination is present or where low level organic testing (i.e. PAHs) is not being performed. Equipment that comes into contact with groundwater, such as water level meters, shall be decontaminated after each use and between sampling stations. The following decontamination steps will be performed on equipment prior to use at each station:

- Wash with Liqui-nox^{TM} or equivalent detergent
- Double rinse with distilled/deionized water
- Final rinse with distilled/deionized water.

If residual petroleum sheen remains on the sampling equipment or is difficult to remove using the standard decontaminations procedures above, a hexane, isopropyl alcohol, or methanol rinse may be added, followed by a final rinse with distilled/deionized water. Where required, equipment blanks will be collected by pouring distilled water over the equipment and collecting a set of the same sample containers as those used for the environmental samples the equipment is used to collect (Section 5.3).

4.5 Sampling Containers

Sample container requirements and storage conditions are provided in Table 4. Samples analyzed for TPH-gasoline and BTEX will require chemical preservation, which will be present in the laboratory-supplied containers. All sample containers will have screw-type lids so that they are adequately sealed. Lids of the glass containers will have Teflon^{TM} inserts to prevent sample reaction with the plastic lid and to improve the quality of the seal. Commercially available, pre-cleaned jars will be used and the laboratory will maintain a record of certification from the suppliers. The container shipment documentation will record batch numbers for the bottles. With this documentation, containers can be traced to the supplier and bottle rinse blank results can be reviewed.

Sampling containers will be filled to minimize head space, and will be appropriately labeled and stored prior to shipment or delivery to the laboratory. Samples must be packed to prevent damage to the sample containers and labeled to allow sample identification. All samples must be packaged so that they do not leak, break, vaporize or cause cross-contamination of other samples. Each individual sample must be properly labeled and identified. When refrigeration is required for sample preservation, samples must be kept cool, by means of ice packs or double-bagged ice in coolers, during the time between collection and final packaging.

Table 4 Analytical Methods and Sample Handling Details

Analyses	Analytical Method	Water Sample Container	Preservation	Max Holding Time
Total Petroleum Hydrocarbons (TPH) - Gasoline Range	NWTPH-G	2 x 40 mL VOA vial	Cool, 4°C, HCL, pH <2	14 days
TPH - Diesel Range and Oil Range	NWTPH-Dx	1 Liter Amber	Cool, 4°C If add HCL, pH <2	7 days 14 days
Volatile Organic Compounds (VOCs) - BTEX only	EPA 8260	2 x 40 mL VOA vial	Cool, 4°C, HCL, pH <2	14 days
SVOC – 2-Methylnaphthalene and PAHs (filtered)	EPA 8270	2 x 500 mL Amber	Cool, 4°C	7 days

Sample container type, preservation, or quantity may be adjusted to meet laboratory analytical requirements, or updates in EPA analytical methods. Additional container volume required for quality assurance purposes will be as required by the laboratory.

4.6 Field Logs

All field activities and observations will be noted on weatherproof paper at the time they occur. The field logs will be compiled in a binder in the chronological order they were completed. Information will include personnel, date, time, station designation, sampler, types and number of samples collected, photographs taken, weather conditions, health and safety meetings conducted (tailgate meeting), field measurements, and general observations. Any changes that occur at the site (e.g., personnel, responsibilities, deviations from the CMP) and the reasons for these changes will be documented in the field log. The field log will also identify onsite visitors observing the sampling. The Site is an actively used property, therefore only those specifically visiting/observing sampling activities will be documented. The Field Manager is responsible for ensuring that the field logs are correct.

All field activities and observations will be noted during fieldwork. The descriptions will be clearly written with enough detail so that participants can reconstruct events later, if necessary. Requirements for entries include:

- Field logs will be compiled in chronological order in a 3-ring binder, with the date and observer clearly marked on all field forms and note sheets.
- Entries will be made legibly with black (or dark) waterproof ink or pencil.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself).
- Each consecutive day's first entry will be made on a new, blank page.
- The date and time, based on a 24-hour (military) clock (e.g., 0900 for 9 a.m. and 2100 for 9 p.m.), will appear on each page.
- When the field activity is complete, the field binder will be physically entered into the project file and the pages will be scanned to a PDF file (or equivalent electronic format) and saved in the electronic project library. Scanning of sheets may also occur after each day’s field activities.
- The person recording the information must initial and date each sheet. If more than one individual makes entries on the same sheet, each recorder must initial and date each entry. The bottom of the page must be signed and dated by the individual who makes the last entry.
- The Field Manager, after reading the day’s entries, also must sign and date the last page of each daily entry.
- Corrections will be made by drawing a single line through the original entry allowing the original entry to be read. The corrected entry will be written alongside the original. Corrections will be initialed, dated, and explained.

4.7 Chain-of-Custody Procedures

All samples must be clearly identified immediately upon collection. Each sample container label will list:

- Client and project name
- A unique sample description/sample ID
- Sample collection date and time.

Additionally, the container’s label may include:

- Sampler's name or initials
- Preservative, if applicable

- Analyses to be performed.

Chain-of-custody procedures will be used to document sample possession from the time of collection, through analysis, to disposal. Chain-of-custody forms will document transfers of sample custody. A sample is considered to be under custody if it is in one's possession, view, or in a designated secure area. One set of chain-of-custody forms will be used per laboratory shipment. The chain-of-custody record will include, at a minimum, the following information:

- Client and project name
- Sample collector's name
- Sampler’s company mailing address and telephone number
- Designated recipient of data (name, email, and telephone number)
- Analytical laboratory's name and city
- Description of each sample (i.e., unique identifier and matrix)
- Date and time of collection
- Quantity of each sample or number of containers
- Type of analysis required
- Any unique features of analysis, such as lower reporting limits
- Any requests to hold/archive samples
- Requested turn-around times
- Date and method of shipment.

When transferring custody, both the staff relinquishing custody of samples and the staff receiving custody of samples will sign, date, and note the time on the form. All samples will be stored appropriately by the laboratory. Samples may be delivered directly to the lab or transferred by courier following the custody protocols described above.

4.8 Investigation Derived Waste

Investigation derived waste (IDW) will be properly contained after each sampling event, and disposed of according to local, state, and federal laws. Purge water, non-dedicated disposable tubing, and used personal protective equipment (PPE) will be contained onsite in drums for subsequent disposal by the Port under its waste handing program.

The following procedures will be used for the investigation residuals, including groundwater sampling purge water and decontamination water:

- Purge water and decontamination water generated during the investigation activities will be placed in 55-gallon drums and stored on site. The drums will be managed as satellite accumulation drums and stored in the appropriate area within the equipment pad fenced area, or the on-site Port Environmental Shed, until they have been filled; and
- Disposable clothing and equipment will be placed in plastic bags and disposed of as solid waste.

5 Quality Assurance Project Plan

The QAPP describes the measures undertaken so that the data collected during the project are acceptable for their intended use(s) and includes the elements from Ecology's QAPP guidance document and EPA guidance (Ecology 2004, EPA 2001, 2002, 2006).

All measurements will be made to yield accurate and precise results representative of the media and conditions measured. Chemical analyses will be performed in accordance with the requirements of the analytical methods. All sample results will be calculated and reported in consistent units to allow comparison of the sample data with regulatory criteria and federal, state, and local databases. QAPP objectives for precision, accuracy, and completeness have been established for each measurement variable, where possible, and are discussed below.

5.1 Sampling Process Design

The overall data quality objective for this project is the collection of representative data of known and acceptable quality. Parameters related to precision, accuracy or bias, representativeness, completeness, and comparability (PARCC) will be used to assess the quality of data.

5.1.1 Precision

Precision is a measure of how closely one result matches another result expected to have the same value. Field precision will be assessed by collecting one duplicate sample for every ten field samples of each media. Field precision is determined by the relative percent difference (RPD) between a sample and it's duplicate. However, results from the analysis of a duplicate sample also test laboratory precision. Therefore, the RPD between the sample and the field replicate provides an indication of both the field and laboratory precision. The tolerance limit for percent differences between field duplicates will be ± 35 percent for groundwater. If the RPDs exceed these limits, a replicate sample may be run to verify laboratory precision. If any RPD exceedance is linked to field sampling, the Field Manager will recheck field sampling procedures and identify the problem. Resampling and analysis may be required.

Laboratory precision can be measured through the evaluation of laboratory control samples/duplicates (LCS/LCSD). The laboratory will perform the analysis of one set of LCS/LCSD samples for every 20 samples. Laboratory precision will be evaluated by the RPD for each analyte between LCS/LCSD samples.

$$\text{RPD} = \frac{\text{ABS(R1-R2)}}{\text{(R1+R2)/2}} \text{ X } 100$$

Where:
ABS = absolute value
R1 = Sample result
R2 = Duplicate sample result

The tolerance limit for percent differences between laboratory duplicates will be ± 20 percent for groundwater samples. If the precision values are outside this limit, the laboratory will recheck the calculations and/or identify the problem. Reanalysis may be required.

5.1.2 **Accuracy**

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Accuracy may be expressed as a percentage of the true or reference value for reference material or as spike recovery from matrix spike/matrix spike duplicate (MS/MSD) samples. The RPD between the MS and MSD is used to evaluate laboratory precision. The following equations are used to express accuracy:

- For reference materials:
    - Percent of true value = (measured value/true value) x 100
- For spiked samples:
    - Percent recovery = ([SQ – NQ]/S) x 100

      SQ = quantity of spike or surrogate found in sample
      NQ = quantity found in native (unspiked) sample
      S = quantity of spike or surrogate added to native sample

The performance of the method will be monitored using surrogate compounds or elements. Surrogate standards are added to all samples, method blanks, matrix spikes, and calibration standards.

Laboratory method reporting limits (MRL) are listed in Table 5. All RLs are below cleanup levels and RELs; otherwise cleanup levels or RELs derived for the project were set to the practical quantitation limit, which is identical to the MRL for this project.

Table 5 Laboratory Method Reporting Limits

Analyte	Method Reporting Limit
SVOC – 2-Methylnaphthalene and PAHs (µg/L)	0.01
Volatile Organic Compounds (VOCs) - BTEX only (µg/L)	0.2 – 2
TPH - Diesel Range and Oil Range (mg/L)	0.1
Total Petroleum Hydrocarbons (TPH) - Gasoline Range (mg/L)	0.2

5.1.3 Representativeness

Representativeness is the degree to which data from the project accurately represent a particular characteristic of the environmental matrix which is being tested. Representativeness of samples is achieved by adherence to standard field sampling protocols and standard laboratory protocols. Representativeness is achieved through following of the sampling plan design, sampling techniques, and sample handling protocols.

5.1.4 Comparability

Comparability is the qualitative similarity of one dataset to another (i.e., the extent to which different datasets can be combined for use). Comparability will be addressed through the use of field and laboratory methods that are consistent with methods and procedures recommended by Ecology and that are commonly used for groundwater studies.

5.1.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

Completeness =
(number of valid measurements/total number of data points planned) x 100

The data quality objective (DQO) for completeness for all analytes is 95%. Data that have been qualified as estimated (J qualified) will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness. Results will be considered valid if all the precision and accuracy targets are met. Resampling or re-analysis of remaining sample aliquots may be required if the completeness DQO is not met.

5.2 Laboratory Quality Control

Laboratory QC procedures will be evaluated to provide supplementary information regarding overall quality of the data, performance of instruments and measurement systems, and sample-specific matrix effects.

QC samples and procedures are specified in each method protocol. All QC requirements will be completed by the laboratory as described in the protocols, including the following (as applicable to each analysis):

- Instrument tuning
- Initial calibration
- Initial calibration verification
- Continuing calibration
- Calibration or instrument blanks
- Method blanks
- LCS/LCSD
- Internal standards
- Surrogate spikes
- Serial dilutions
- MS/MSD.

Only laboratories accredited in accordance with WAC 173-50, Accreditation of Environmental Laboratories, will be used for this project. EPA Contract Laboratory Program (CLP) QA/QC procedures or similar efforts will be used for the analyses. Internal quality control procedures are used to produce consistently high-quality data. A routine QC protocol is an essential part of the analytical process. The minimum requirements for each analytical run are described here. Additional description of laboratory QA/QC procedures can be found in the laboratory’s QA manual. A project narrative detailing analytical results must accompany all data packages submitted by the laboratory.

Preparation batches have a maximum of 20 field samples of the same matrix. QA/QC samples processed with each batch are:

- **One method blank**. The method blank is used to assess the preparation batch for possible contamination during the preparation and processing steps. It is processed along with and under the same conditions as the environmental samples. Concentrations of compounds detected in the blank will be compared to the samples. Any concentration of common laboratory contaminants (i.e., phthalates, acetone, methylene chloride, or 2-butanone) in a sample lower than 10 times that found in the blank will be considered a laboratory contaminant and will be so qualified. For other contaminants, any compounds detected at concentrations lower than five times that found in the blank will be considered laboratory contamination (EPA 2008). Values reported for the method blanks are expected to be below the MDLs for all analytes, except the common laboratory contaminants. Deviations from this must be explained in the laboratory project narrative(s).

- **One LCS**. The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps.
- **One MS**. Matrix specific QA/QC samples indicate the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. The information from these controls is sample/matrix specific and is not normally used to determine the validity of the entire batch.
- **At least one duplicate**. Duplicates are replicate aliquots of the same sample taken through the entire analytical procedure. The results from this analysis indicate the precision of the results for the specific sample using the selected method. One duplicate sample is analyzed with each preparation batch. If sufficient sample is provided, this will be a MSD. If not, a LCSD will be analyzed.
- **Initial and continuing calibration:** A calibration standard will be analyzed each time an instrument is calibrated. The instruments used to perform the analyses will be calibrated, and the calibrations will be verified as required by EPA methodologies. For example, a standard five-point initial calibration will be utilized to determine the linearity of response with the gas chromatograph/electron capture detection. Once calibrated, the system must be verified every 12 hours. All relative response factors, as specified by the analytical method, must be greater than or equal to 0.05. All relative standard deviations, as specified by the analytical method, must be less than or equal to 30 percent for the initial calibration and less than or equal to 25 percent for the continuing calibration.
- **Surrogate evaluations:** Surrogate recovery is a QC measure used in organics analyses. Surrogates are compounds added to every sample at the initiation of preparation to monitor the success of the sample preparation on an individual sample basis (accuracy). Although some methods have established surrogate recovery acceptance criteria that are part of the method or contract compliance, for the most part, acceptable surrogate recoveries need to be determined by the laboratory. Recoveries of surrogates will be calculated for all samples, blanks, and QC samples. Acceptance limits will be listed for each surrogate and sample type and will be compared against the actual result by the data validator.
- **Laboratory management review:** The Laboratory Project Manager will review all analytical results prior to final external distribution (preliminary results will be reported before this review). If the QA Officer finds that the data meet project quality requirements, the data will be released as “final” information. Data which are not acceptable will be held until the problems are resolved, or the data will be flagged appropriately.

5.3 Field Quality Control

QA/QC samples will be collected during all sampling activities. Field duplicate and matrix spike/matrix spike duplicate samples will be collected as follows:

- Field duplicate samples will use the same naming system as the environmental samples do that they are submitted "blind" to the laboratory. Field duplicates are useful in identifying problems with sample collection or sample processing. One duplicate sample will be collected for every 10 field samples of the same matrix. Each field duplicate will be analyzed for the same parameters as the samples to evaluate heterogeneity attributable to sample handling.
- One matrix spike/matrix spike duplicate sample (MS/MSD) will be collected for every 20 field samples. Extra sample containers (the same as those for the environmental sample) collected for MS/MSD analyses will be noted in field notes and on chain-of-custody forms submitted to the analytical laboratory. Extra sample bottles for MS/MSD will be labeled with a "-MS/MSD" suffix for clarity in sample processing.

Rinsate and equipment blanks will not be collected for groundwater samples because samples will be collected using either disposable or dedicated sample tubing, which prevents cross-contamination. If equipment blanks are collected, they will be collected consistent with Section 4.4 of the CMP.

5.4 Instrument and Equipment Testing, Inspection, and Maintenance

The primary objective of an instrument/equipment testing, inspection, and maintenance program is to aid in the timely and effective completion of a measurement effort by minimizing the downtime due to component failure.

Testing, inspection, and maintenance will be carried out on all field and laboratory equipment in accordance with manufacturer's recommendations and professional judgment. Hand-held field monitors will be used to monitor groundwater for field parameters. They will be calibrated and maintained according to the manufacturer's recommendations.

Analytical laboratory equipment preventative testing, inspection, and maintenance will be addressed in the laboratory QA manual, which will be kept on file at the contracted laboratory.

As appropriate, schedules and records of calibration and maintenance of field equipment will be maintained in the field notebook. Equipment that is out of calibration or is malfunctioning will be removed from operation until it is recalibrated or repaired.

5.5 Instrument and Equipment Calibration and Frequency

Field equipment and laboratory instrumentation used for monitoring and sample analysis will be subject to the following calibration requirements:

- **Identification**. Either the manufacturer's serial number or the calibration system identification number will be used to uniquely identify equipment. This identification, along with a label indicating when the next calibration is due, will be attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference.
- **Standards**. Equipment will be calibrated, whenever possible, against reference standards having known valid relationships to nationally recognized standards (e.g., National Institute of Standards and Technology) or accepted values of natural physical constraints. If national standards do not exist, the basis for calibration will be described and documented.
- **Frequency.** Equipment will be calibrated at prescribed intervals and/or prior to use. Frequency will be based on the type of equipment, inherent stability, manufacturers' recommendations, intended use, and observation of equipment readings over the course of the field work. All sensitive equipment to be used in the field or laboratory will be calibrated or checked prior to use.
- **Records**. Calibration records (certifications, logs, etc.) will be maintained for all measuring and test equipment used.

If field or laboratory equipment is found to be out of calibration, the validity of previous measurements will be investigated, and/or corrective action will be implemented. The Field Manager or the Laboratory QA Officer, respectively, will lead the evaluation process, which will be document in the field forms or laboratory log book, respectively.

All laboratory calibration requirements must be met before sample analysis may begin. The laboratory will follow the calibration procedures dictated by the analytical methods to be performed. If calibration non-conformances are noted, samples will be reanalyzed under compliant calibration conditions within method-specified hold times.

5.6 Inspection and Acceptance of Supplies and Consumables

The Field Manager will be responsible for material procurement and control. The Field Manager will verify upon receipt that materials meet the required specifications and that, as applicable, material or standard certification documents are provided, maintained, and properly stored with the project files. The Field Manager will also verify that material storage is properly maintained and that contamination of materials is not allowed.

The laboratory must document and follow procedures related to:

- Checking purity standards, reagent grade water, and other chemicals relative to intended use
- Preparing and storing chemicals
- Handling disposable glassware (including appropriate grade).

The Field Manager will be responsible for procuring and transporting the appropriate sample containers, equipment, and consumables (e.g., soap) to the Site. The containers will be pre-cleaned and certified by lot. If needed, reagents provided will be of the appropriate grade for the analysis. Records of these certifications and grades of material will be maintained on file at the laboratory.

6 Data Evaluation

Compliance monitoring data will be evaluated consistent with the protocols outlined in this Section. Historical free product gauging and groundwater quality data are tabulated in Appendix E for reference.

6.1 Cleanup and Remediation Levels

Groundwater cleanup and remediation levels (RELs) are presented in Table 6. The marine surface water criteria are applicable for groundwater at the T30 site because groundwater discharges to the East Waterway. Surface water criteria are not established for diesel-, heavy oil-, and gasoline range organics, and total xylenes. Therefore, MTCA Method A groundwater criteria were selected for those parameters. For cPAHs, the toxic equivalent concentration (TEQ) will be calculated for comparison with the cleanup level consistent with WAC 173-340-708(8)(e). The TEQ will be calculated using the toxicity equivalency factors (TEFs) for individual cPAH compounds provided in MTCA (Table 708-2; WAC 173-340-900).

RELs were developed in the CAP for a subset of COCs that are indicative of TPH abundance, including: benzene, toluene, ethylbenzene, xylenes (BTEX); diesel range organics; and gasoline range organics. RELs are used to demonstrate reduction in petroleum compound contaminant mass in the sheen area. In this context, RELs are a concentration reduction target for operation of the AS/SVE system and are not a maximum concentration for compliance at performance monitoring wells. RELs in Table 6 are the maximum of either:

- 75% of the estimated solubility limit or
- twice the cleanup level

Measurable thickness of free product in monitoring wells will be considered an exceedance of WAC 173-340-747(10) regardless of groundwater concentrations in samples collected from the well. A measurable thickness is 0.01-feet, the practical measurement limit with an interface probe. The presence of sheen or thicknesses less than 0.01-feet will not be considered an exceedance of the free product criteria.

Table 6 Groundwater Cleanup and Remediation Levels

Constituent	GW Cleanup Levels (ug/L)	GW REL (ug/L)
BTEX Compounds		
Benzene	23	47
Toluene	15,000	30,000
Ethylbenzene	2,100	4,200
Xylenes (total)	1,000	2,000
Semivoliatile Organic Compounds		
2-Methylnaphthalene	NV	NV
PAH Compounds		
Acenaphthene	643	NV
Acenaphthylene	NV	NV
Anthracene	25,900	NV
Benzo[a]anthracene (TEF=0.1)	See cPAH	NV
Benzo[a]pyrene (TEF=1)	See cPAH	NV
Benzo[b]fluoranthene (TEF=0.1)	See cPAH	NV
Benzo[g,h,i]perylene	NV	NV
Benzo[k]fluoranthene (TEF=0.1)	See cPAH	NV
Chrysene (TEF=0.01)	See cPAH	NV
cPAH TEQ	0.018	NV
Dibenzo[a,h]anthracene (TEF=0.1)	See cPAH	NV
Fluoranthene	90	NV
Fluorene	3,460	NV
Indeno[1,2,3-cd]pyrene (TEF=0.1)	See cPAH	NV
Naphthalene	4,940	NV
Phenanthrene	NV	NV
Pyrene	2,590	NV
Naphthalene	4,940	NV
Petroleum Hydrocarbons		
Tph: gasoline range organics, no detectable benzene*	1,000	2,085
Tph: gasoline range organics, benzene present*	800	NV
Tph, diesel range organics	500	2,085
Tph, heavy oils	500	NV

Notes:
NV = indicates that no value is available.
REL = Remediation Level
TEF: Toxicity Equivalency Factor. Values from WAC 173-340-900 Table 708-2.

6.2 Groundwater Points of Compliance

The standard MTCA groundwater point of compliance is groundwater throughout the site. For the T30 site, a conditional point of compliance (CPOC) for groundwater is selected to be located as close as practical to the source of the petroleum sheen area and free product area. Monitoring wells MW-45A, MW-46B, MW-58A, MW-86B, and MW-92 (Figure 4), located between the sheen and free product areas and surface water receptors, were selected as CPOC monitoring wells.

6.3 Free Product Recovery Termination

Free product recovery events will occur monthly at the beginning of cleanup activities. Recovery at a well will be terminated when product thickness has been reduced to less than a measurable thickness (0.01-feet) for a period of one year of quarterly measurements. This recovery termination criterion will result in sequential removal of recovery wells from recovery events as the area with measurable free product shrinks. Wells RW-101 through RW-110 will be left in place for 1 year after the last well meets the termination criteria, after which they will be decommissioned consistent with WAC 173-160.

6.4 Performance Well Data Analysis

Data collected from the 7 Performance Monitoring Wells will be evaluated and used to make decisions regarding AS/SVE system operation as shown in the flow chart (Figure 5). As stated in the CAP, the overall goal of the AS/SVE system is to reduce contaminant mass in the sheen area at and downgradient of the sparge wells. The AS/SVE system is not intended to reduce concentrations upgradient of the AS/SVE system.

The Port intends to initially operate the AS/SVE system for a period of 3 to 5 years continuously, with the exception of shut downs for routine maintenance or prior to sampling wells within the AS radius of influence. This decision is based on the continuous duty nature of the equipment and the corrosion that will occur when the blowers are not in use.

The AS/SVE system will be operated until Performance Monitoring Wells within and downgradient of the AS/SVE system (RW-9, RW-11A, MW-42, MW-39A, MW-36A, MW-59, and MW-89) achieve remediation levels or if the AS/SVE system is no longer significantly removing contaminant mass[3], consistent with the CAP.

The AS/SVE system will be restarted if Performance Monitoring Wells do not achieve remediation levels. Performance monitoring will continue for 2 years after shutdown of the AS/SVE system to assess if any substantial rebound occurs, at which time confirmational monitoring will be initiated if remediation levels are still met or the AS/SVE system is no longer significantly removing contaminant mass.

6.5 CPOC Well Data Analysis

Data collected from CPOC wells will be evaluated and used to make decisions regarding continued monitoring and the potential need for contingent actions as shown in the flow

---

[3] The statement “the AS/SVE system is no longer significantly removing contaminant mass” has not been defined. This standard will need to be negotiated, if necessary, at a future time. This could involve analysis of vapor extraction concentrations, groundwater dissolved oxygen concentrations, performance well groundwater concentrations, or other similar measure.

chart (Figure 6). The CPOC was selected to be as close to the source of the dissolved constituents as practicable per WAC 173-340-720(8)(c).

As indicated in Figure 6, an exceedance of a cleanup level at a CPOC well will trigger the following incremental monitoring activities:

- The sampling frequency of the CPOC well with an exceedance will be increased to quarterly for up to 2 years if concentrations persist above cleanup levels (8 quarters)
- Plume stability will be assessed consistent with Ecology guidance (Ecology 2005) after the 8 quarters of data are collected
- Sampling of the 2 nearest Shoreline Water Quality Wells will be triggered if the plume is identified as expanding, except for MW-86B because it is both a CPOC Well and Shoreline Water Quality Well

6.6 Contingent Actions

This section describes consistent protocols to be used to determine if implementation of a contingent action is warranted,.

For all compliance monitoring wells, the measurement of free product in a well will trigger free product removal activities. Free product gauging (and removal, if free product is measured) will occur quarterly for a minimum of 4 consecutive quarters. Where the well is tidally influenced, free product removal will occur at the point in the tidal cycle consistent with when free product was observed. The preferred method of free product removal is using a vacuum pump or truck consistent with protocols used for the identified free product recovery wells.

For CPOC wells, the consistent protocol for determining if a contingent action is warranted is illustrated in Figure 6. The incremental monitoring identified in the flow chart was discussed in Section 6.5. A contingent action will be triggered once a cleanup level has been exceeded in a Shoreline Water Quality Well based on results averaged over a minimum of 4 consecutive quarters consistent with WAC 173-340-720(9)(c)(v).

Since the ultimate point of compliance is the point of groundwater discharge to surface water, initial contingent actions may include the following evaluations:

- Steady-state attenuation modelling between the Shoreline Water Quality Well and the point of discharge to surface water
- Assessment of attenuation between the Shoreline Water Quality Well and the point of discharge to surface water using dye tests, or similar
- Groundwater sampling at the mudline

Once a contingent cleanup action is triggered, it is anticipated that the cleanup actions will focus on enhancing biodegradation of dissolved contamination.

All contingent actions will be determined on a location-specific and data-specific basis as approved by Ecology.

7 Schedule and Reporting

7.1 Schedule

The groundwater monitoring frequencies are provided on Tables 2 and 3. The schedule will be based on the performance of the AS/SVE system and wells achieving cleanup levels or remediation levels, as appropriate. Free product will be gauged on a quarterly basis until termination criteria are achieved. Schedule revisions will be documented in quarterly status reports and annual groundwater monitoring reports.

7.2 Reporting

7.2.1 Quarterly Progress Reports

Progress reports will be prepared on a quarterly basis, in accordance with the requirements of the Consent Decree, and submitted to Ecology via email no later than the 30th day of the month following each quarterly reporting period. Each progress report will include the following:

- All work conducted pursuant to the Consent Decree during the last quarterly period;
- Occurrence of any problems, how problems were rectified, deviations from the work plans, and an explanation of all deviations;
- Projected work to occur in the upcoming three months;
- Summaries of significant findings, changes in personnel, summaries of significant contacts with all federal, state, local community, and public interest groups; and
- Monitoring data that was received during the quarter and has been QA/QC reviewed.

7.2.2 Annual Reporting

In addition to the quarterly progress reports, an annual AS/SVE system operation and groundwater monitoring report will be prepared and submitted to Ecology. The annual report will include, at a minimum:

- An overview of current cleanup status, identifying significant results and data trends;
- Tabulated concentrations of IHSs and water table elevation data from the previous year’s sample events. Tables will note groundwater cleanup levels;
- Tabulated results of the free product recovery events;
- As appropriate, time series plots of: water levels (hydrographs), IHS groundwater concentrations at CPOC and performance wells, and free product thicknesses.
- Copies of all laboratory analytical data sheets, chain of custody forms, and field activity logs;

- A narrative discussion of data validation and a description of all data qualified or rejected;
- Copies of borehole log and well construction details for any work performed during the reporting period; and,
- Updated monitoring schedule for the next year.

7.2.3 **Five-Year Review Report**

After 5 years of system operation, an evaluation report will be prepared that will include a summary of the five preceding annual reports and discussions about longer term trends in the groundwater data. The CMP will be reviewed and updated by addendum (with Ecology review), if changes to the monitoring program are appropriate.

8 References

CRETE 2018. Engineering Design Report. December 2018.

Ecology, 1991. In the Matter of Remedial Action by: Port of Seattle Agreed Order: Terminal 30. Effective Date: August 30, 1991.

Ecology, 2005. Guidance on Remediation of Petroleum-Contaminated Ground Water By Natural Attenuation. Publication No. 05-09-091 (Version 1.0). July.

Ecology, 2013. First Amendment to Agreed Order: Terminal 30. Port of Seattle. Effective Date: October 23, 2013.

Ecology, 2017. Consent Decree and Cleanup Action Plan. July 19, 2017.

ENSR|AECOM, 2008. Supplemental Data Report, Revision 2. Prepared for Port of Seattle Terminal 30 by ENSR., Seattle, Washington. June.

ENSR|AECOM, 2010. Terminal 30 Cargo Terminal Construction Completion Report. Prepared for Port of Seattle Terminal 30 by AECOM. Seattle, Washington. January 2010.

GeoEngineers, Inc., 1998. Terminal 30 Final Report Remedial Investigation/ Feasibility Study. Prepared for the Port of Seattle. December.

Pacific Groundwater Group, 2013a. Terminal 30 Monitoring Well Installation and Data Gaps Sampling. November 6, 2013.

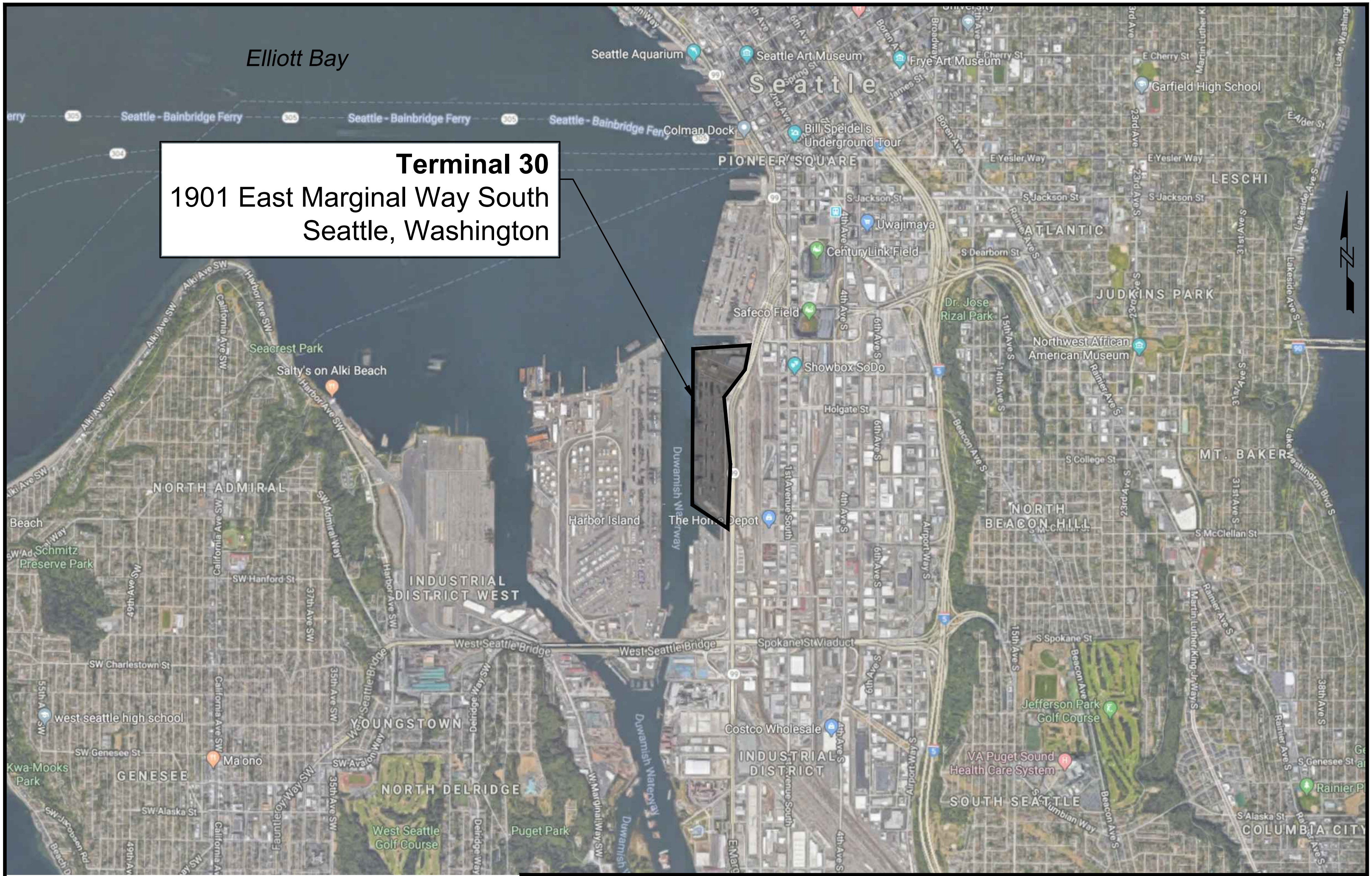
Pacific Groundwater Group, 2016a. Terminal 30 Revised 2013 Remedial Investigation /Feasibility Study. January 11, 2016.

Pacific Groundwater Group, 2016b. Port of Seattle Terminal 30 Interim Monitoring Plan. Draft. February 9, 2016.

Ecology, 2017. Port of Seattle Terminal 30 Cleanup Action Plan. July 19, 2017.

Figures

File: E:\Project\clients\Crete\T30\T30_001.dwg Layout: FIG 1.1 User: sangw Plotted: Nov 18, 2017 - 7:08am Xref's:



CRETE
CONSULTING, INC.

1500 0 3000
Approx Scale in Feet

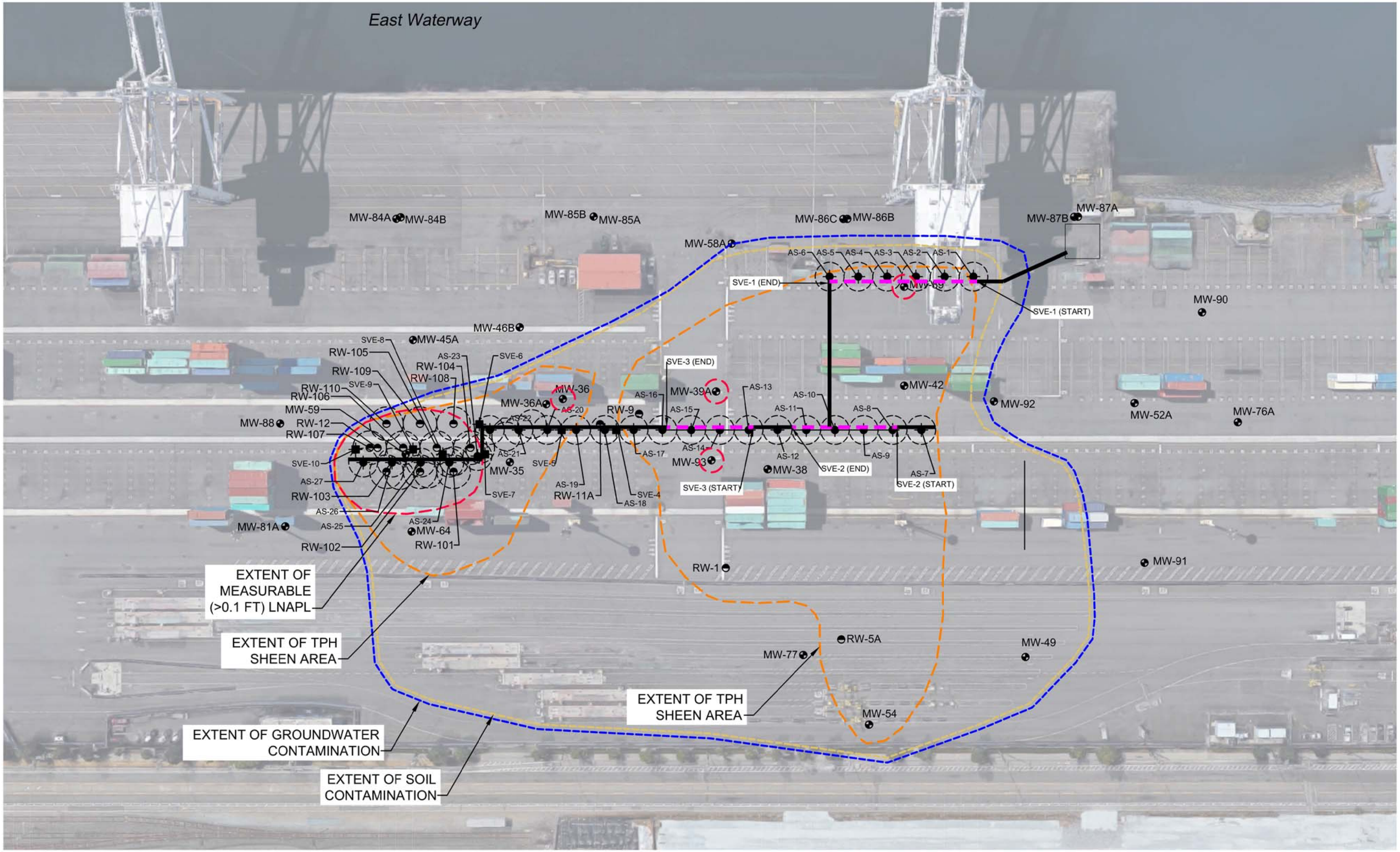
Engineering Design Report
Terminal 30 Cleanup Action

Site Location

DATE: 11/18/2017

DRWN: bts

Figure 1



CRETE
CONSULTING, INC.

N

50 0 100
Approx Scale in Feet

LEGEND

⯁	AS WELL
■	SVE WELL (VERTICAL)
●	MONITORING WELL
◒	PRODUCT RECOVERY WELL

Compliance Monitoring Plan
Terminal 30 Cleanup Action

Extent of Impacts and Location of Cleanup Action

DATE: 12/2/2017
DRWN: BTS

Figure 2

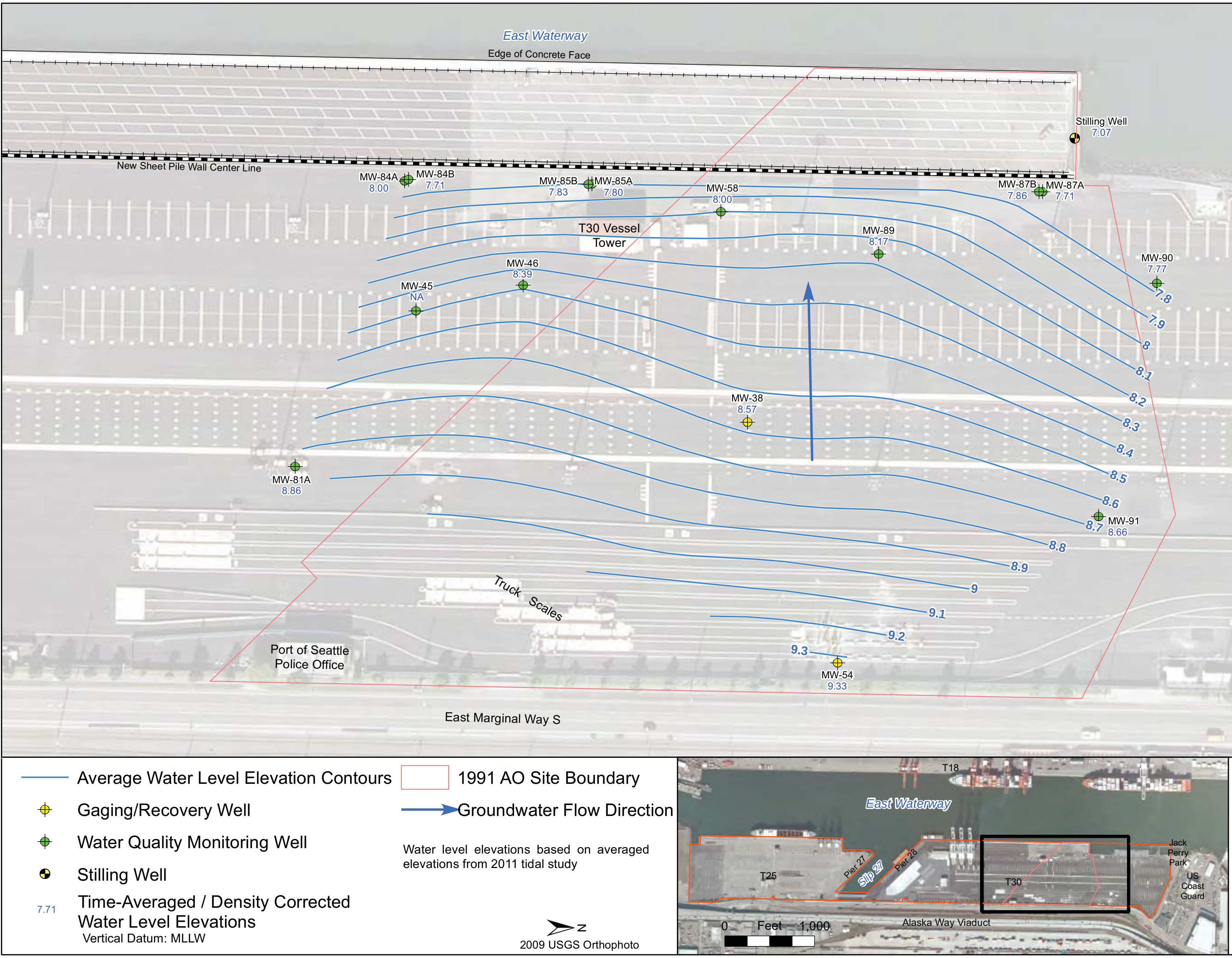
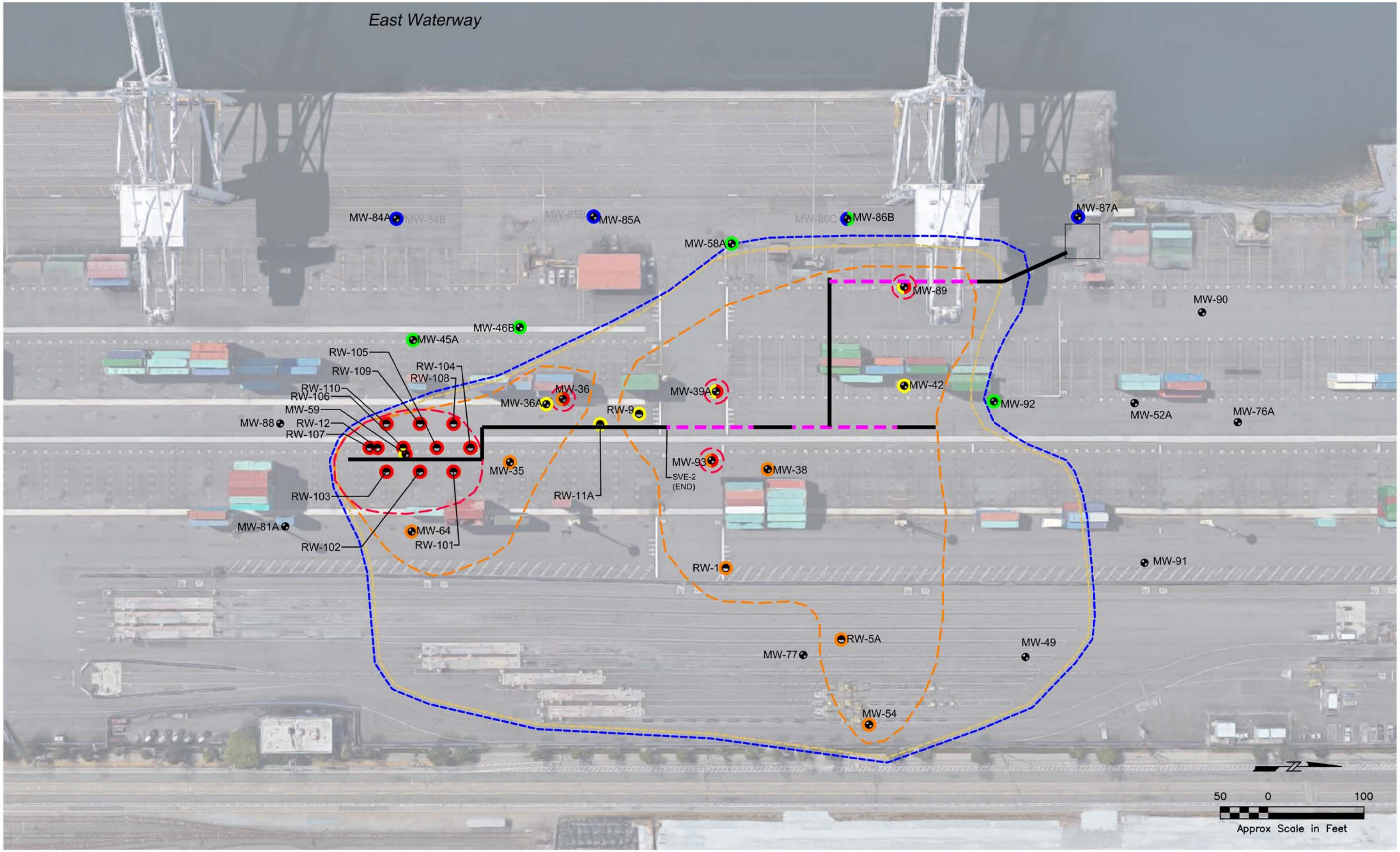


Figure 3
Groundwater
Potentiometric Surface
Source: From 2012 Tidal Study.
Figure prepared by Pacific Groundwater Group.



LEGEND

- ● MONITORING WELL
- ◒ PRODUCT RECOVERY WELL
- ○ PERFORMANCE MONITORING WELL
- ○ INTERIOR MONITORING WELL
- ○ CPOC MONITORING WELL
- ○ SHORELINE MONITORING WELL
- ○ FREE PRODUCT GAUGING WELL

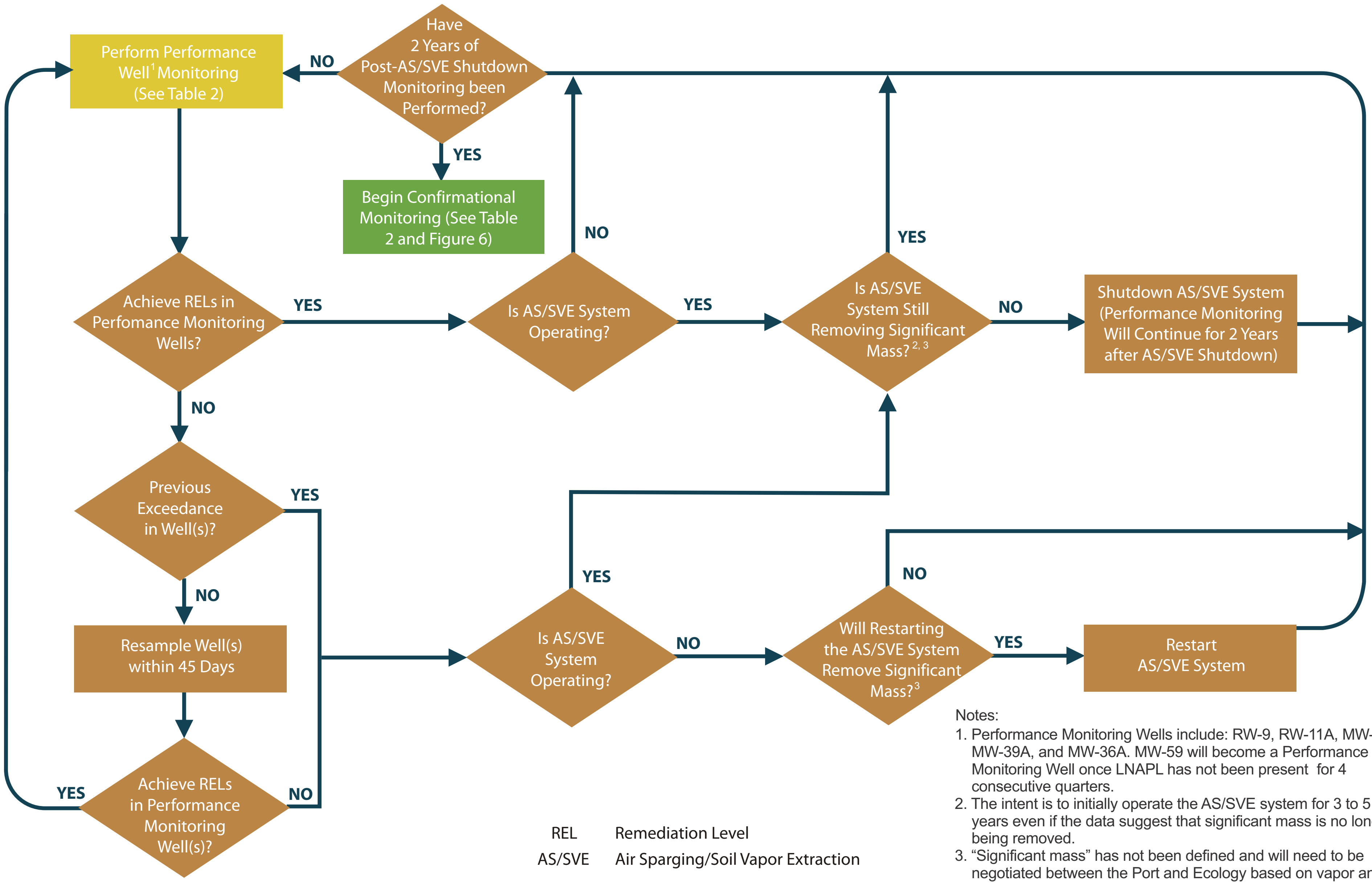
CRETE
CONSULTING, INC.

Compliance Monitoring Plan
Terminal 30 Cleanup Action

Compliance Monitoring Network

DATE: 12/2/2017 DRWN: BTS

Figure 4



REL	Remediation Level
AS/SVE	Air Sparging/Soil Vapor Extraction

Notes:

1. Performance Monitoring Wells include: RW-9, RW-11A, MW-42, MW-39A, and MW-36A. MW-59 will become a Performance Monitoring Well once LNAPL has not been present for 4 consecutive quarters.
2. The intent is to initially operate the AS/SVE system for 3 to 5 years even if the data suggest that significant mass is no longer being removed.
3. "Significant mass" has not been defined and will need to be negotiated between the Port and Ecology based on vapor and groundwater data.

CRETE
CONSULTING, INC.

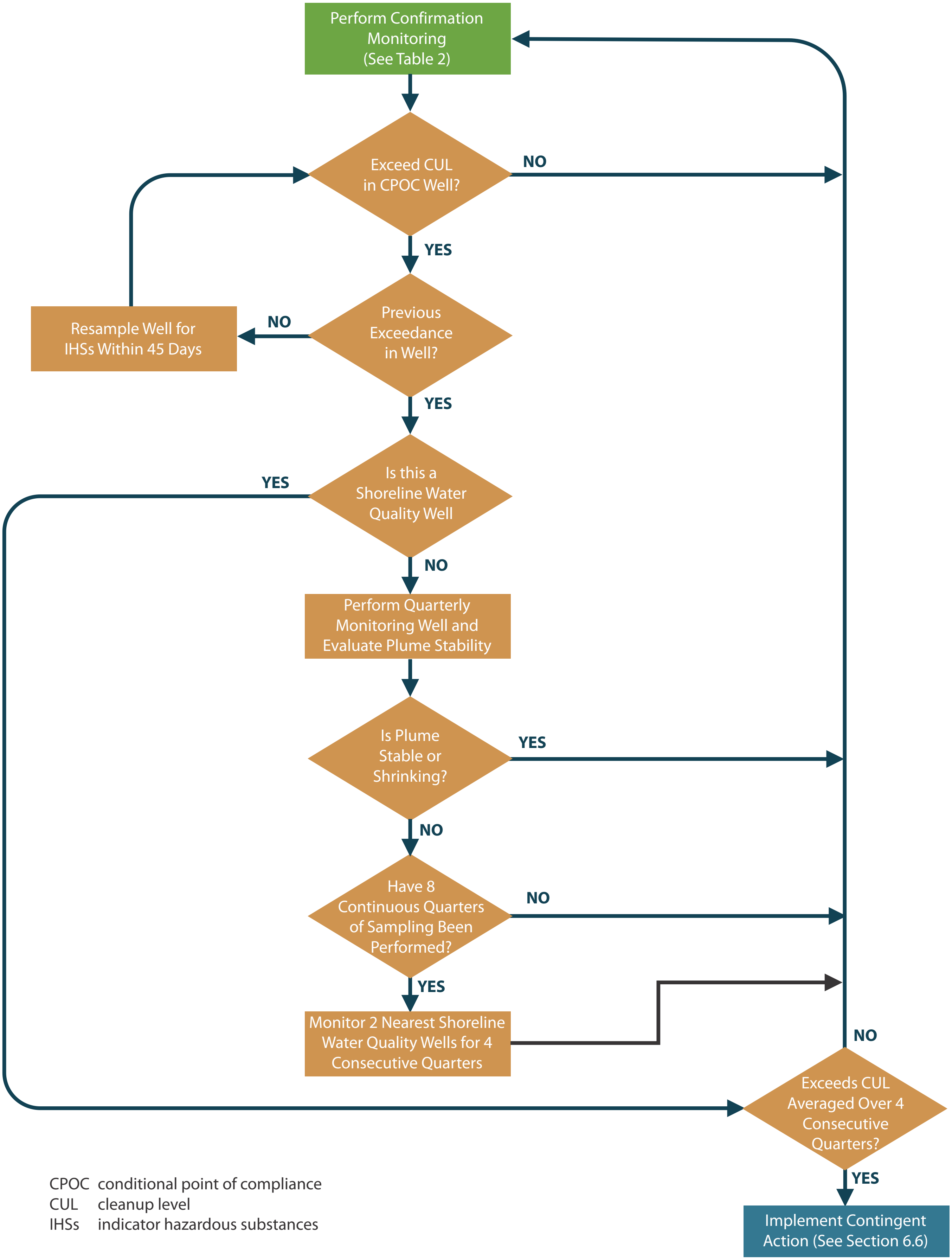
PORT OF SEATTLE
TERMINAL 30 GROUNDWATER
COMPLIANCE MONITORING PLAN

PERFORMANCE WELL MONITORING WELL AND AS/SVE OPERATION DECISION MATRIX

DATE: 11/28/2018 | **DRWN: bts**

FIGURE 5

File: G:\Clients\CRETE\Figure 5\Well Monitoring and SE/SVE Operation Decision Matrix



CPOC	conditional point of compliance
CUL	cleanup level
IHSs	indicator hazardous substances

File: G:\Clients\CRETE\Figure 6\Confirmation Monitoring and Contingent Action Decision Matrix

CRETE
CONSULTING, INC.

PORT OF TACOMA
TERMINAL 30 GROUNDWATER
COMPLIANCE MONITORING PLAN

CONFIRMATIONAL MONITORING AND CONTINGENT ACTION DECISION MATRIX

DATE:11/28/2018 | **DRWN: bts**

FIGURE 6

Appendix A 2012 Tidal Study

Technical Memorandum

To: Sunny Becker, Department of Ecology

Cc: Jerome Cruz, Department of Ecology

From: Glen Wallace, Ph.D., and Pony Ellingson, Pacific Groundwater Group

Re: Tidal Study Results

Date: February 1, 2012

This appendix to the Terminal 30 Remedial Investigation/Feasibility Study (RI/FS) describes water-level measurements at the Port of Seattle's Terminal 30 (T-30) obtained and analyzed to assess groundwater flow direction and gradient across the site including flow near the sheetpile wall. The sheetpile wall was installed subsequent to earlier water level studies. At the T-30 site, tidal action in the East Waterway induces fluctuations in groundwater elevations in nearshore areas. In these areas of fluctuating groundwater, water-level "snapshots" cannot be used to accurately characterize time-averaged (net) flow direction and gradient. For this study, water-level measurements collected over a 95-hour period[1] were used to calculate mean flow direction and gradient.

The purpose of this study was to test the 2008 site conceptual model and the sufficiency of the current well network for compliance monitoring purposes now that the sheetpile wall is installed. Key findings include:

- Average water level elevations in the deeper wells of well-pairs near the sheetpile wall are higher than elevations in the shallower wells by 0.03 to 0.29 feet, indicating slight net upward groundwater flow at a time-averaged head gradient ranging from 0.0012 to 0.0145.
- Tidal variation is generally less, and decreases more quickly with increased distance east of the shore compared to the pre-wall condition.
- Net movement of shallow groundwater from the contaminant source area is likely similar to or slower than prior to sheetpile wall construction. A pathline trends west from the source area then around the north end of the sheetpile wall. Some lateral flow to the south may also occur but is less than the northerly component. Lateral flow through the wall appears likely[2]. Contrary to the prior conceptual model, vertical downward flow near the wall is not indicated; however, vertical downward flow outside the areas monitored with well pairs for this study is not ruled out. The RI/FS and monitoring plan will be reviewed in light of this additional data.

---

[1] The tidal study was originally intended to span 72-hours. Transducers were in wells for longer due to scheduling around SSA operations.

[2] PGG observed significant leakage through a sheetpile wall excavated in the Port of Tacoma.

The work was performed using generally accepted hydrogeologic practices at this time and in this vicinity, for exclusive application to the Port of Seattle Terminal 30 site. This statement is in lieu of other warranties, express or implied.

BACKGROUND

Two water-level studies were completed during the initial T-30 Remedial Investigation/Feasibility Study (GeoEngineers, 1998). Both studies occurred before the sheetpile wall was installed in the winters of 2007-2008 and 2008-2009 (two phases). The first study occurred over a 36-hour period in May 1993 and included water-level measurements at 18 monitoring wells every 15-minutes using pressure transducers. The second study occurred over a 40-hour period in January 1994 at 14 monitoring wells using the same methodology. These data were reportedly re-analyzed and incorporated into a tidal mixing model (AECOM, 2008). AECOM indicates that the findings of the mixing model remain valid following construction of the sheetpile wall. AECOM reports that the sheetpile wall will reduce, but not eliminate tidal fluctuations upgradient of the wall, but that groundwater flow direction and gradient will remain the same (AECOM, 2008; page 6-2) and that dissolved and free-phase transport would not change significantly. Water-level observations recorded during the installation of the sheetpile wall reportedly confirmed their conclusions.

DATA COLLECTION

Water-level measurements were collected at 11 water table monitoring wells, 3 deep zone nearshore monitoring wells, and one marine water stilling well for an 95-hour period (Figure 1 and Table 1). Wells were equipped with pressure transducers and programmed to record measurements at synchronized15-minute intervals. Monitoring wells for this study were selected using the following criteria:

- completed in shallow aquifer with well screen spanning the water table
- wells are distributed along the sheetpile wall and across the site
- wells do not contain LNAPL
- wells (or their replacement) were used in one or both of the previous studies and provided usable data for those studies

A marine stilling well was installed at the north end of the concrete apron to record tidal fluctuations in the East Waterway. The stilling well was constructed of 1-inch metal conduit suspended from the concrete apron and extending to below the expected low-low tide during the study period (Figure 2). A 3-foot length of rebar was attached to the bottom of the conduit to anchor the base of the stilling well against currents and prop wash while leaving an open interval for water level equilibration.

Transducers were suspended using stainless steel cable secured to the well plug in monitoring wells; a PVC cap was used at the stilling well. Hand water-level measurements were recorded at the start and end of the measurement period, and at any time the well was accessed during the water level monitoring period[3]. The elevation of the stilling well measuring point was included in the survey of selected monitoring wells conducted by the Port of Seattle survey crew in December 2011. A Solinst Barologger was deployed in the on-site equipment shed to record barometric pressure changes during the test period. All loggers were set to record on a synchronized 15-minute time interval.

WATER-LEVEL DATA ANALYSIS

Transducer data was corrected for water density variation using existing specific conductivity data, and corrected for barometric pressure changes using the data from the barometric logger. Hand water-level measurements were collected at the installation and removal of each transducer within five minutes of the transducer measurement interval, and within 1 minute at strongly tidally influenced wells close to the sheetpile wall. Manual water level measurements were used to calculate the transducer depths in the wells at the start and end of test, and to correct for instrument drift, which was negligible. Transducer data was used to calculate mean water levels and to investigate the range of tidal influence. Water level hydrographs are shown in Figures 3 and 4.

Mean water level elevations were calculated using the Serfes method over a 4-day interval (Serfes, 1991). The Serfes method uses moving averages to produce a filtered mean water-level elevation; water-table mean elevations are contoured in Figure 1. Groundwater flow is generally east to west with gradients increasing in the near-shore region. Curvature in water level contours suggests a northerly component near the north end of the sheetpile wall. Horizontal gradient is calculated between the 9.3 and 8.3 foot elevation contour at 0.0026 ft/ft, which is at the low end of the range calculated in previous tidal studies (0.0025 and 0.0035 ft/ft).

Water-level elevations in water table and deep near-shore well pairs indicate that time-averaged heads in the deeper wells are greater than those in the shallow wells. Although the net vertical gradient was upward, ranging from 0.0145 to 0.0012, it varied through the tidal cycle (Table 1; Figures 3 and 5). Vertical gradients are upwards during high tide and downwards at low tides with good correlation between vertical gradient and tide stage. The upward gradient in near-shore well pairs along the sheetpile wall likely reflects a classic discharge zone at the East Waterway (Figure 2). The upward vertical gradient in nearshore wells suggests that shallow groundwater near the wall does not flow downward and discharge beneath the sheetpile wall.

Tidal efficiency and time lag were estimated by curve fitting tide and well water level elevations to the tide cycle between low-low tide on November 4, 2011 to high tide approximately 7 hours later (Table 1). Tidal efficiency is calculated as the ratio of water-level elevation change in monitoring wells to that of the stilling well. Tidal efficiencies were generally higher closer to the East Waterway and ranged from less than 1% at MW-

---

[3] Wells MW-58, MW-85A, MW-87A, and MW-87B were accessed for redevelopment 4-days into the monitoring period.

91 in the eastern portion of the site up to 56% in MW-87B along the sheetpile wall (Figure 6). Well pairs along the sheetpile wall showed greater efficiencies in the deeper well completion (51 to 56%) than the shallow completion (11% to 22%).

The time lag is calculated as the difference in time between high or low tides at the stilling well and corresponding peaks and troughs in each monitoring well. Time lag increased with distance from the waterway ranging from 30 minutes at MW-84A to more than 3 hours; time lag was not estimated for wells with tidal efficiencies less than 5% where peaks could not be identified with confidence against background variation. Well pairs along the sheetpile wall again showed a consistent relationship with longer time lags in shallow wells than the deeper wells.

Water level profiles are plotted along a composite west to east transect at high-high tide, falling tide, low-low tide and the following rising tide (Figure 6). No head data are available seaward of the sheetpile wall so water level elevations from the stilling well are plotted at the sheetpile wall; this simplification increases the plotted gradients between the sheetpile and adjacent well pairs.

Groundwater flow directions and gradients shift in nearshore wells from generally westerly flow to easterly flow during tidal cycles (Figures 7a and 7b). Groundwater flow direction and gradient was calculated from sets of three water table wells at the north (MW-87A, MW-89, MW-90) and south (MW-84B[4], MW-85A, MW-46) using density-corrected transducer data. Flow at the north well cluster shifts from west-north-west over most of the tidal cycle to almost due east at high-high tide and then back (Figure 7a). Similarly, flow near MW-84B shifts from a nearly westerly flow to almost due north at high-high tide before returning to westerly flow (Figure 7b). Gradients calculated from the well clusters indicate that gradients calculated during flow reversals are generally less than a third of the magnitude of gradients calculated during flow to the west. The lower magnitude of the flow gradient coupled with the relatively short portion of the tidal cycle in which flow is reversed indicates that the tidal flow reversals are a small component of the net groundwater flow path (Figure 8).

REFERENCES

AECOM, 2008. Final Supplemental Data Report, Revision 2, Terminal 30, Port of Seattle. Consultant's report prepared for the Port of Seattle. May 2008.

GeoEngineers, Inc., 1998. Terminal 30 Final Report Remedial Investigation/ Feasibility Study. Consultant's report prepared for the Port of Seattle. December 1998.

Serfes, M.E.,1991. Determining the Mean Hydraulic Gradient of Ground Water Affected by Tidal Fluctuations. Groundwater, Vol. 29, No. 4, July-August 1991, pgs 549 to 555.

---

[4] MW-84B is the shallow well in this pair.

TABLES AND FIGURES

Attachments:

Well Hydrographs

tidestudyappendix_v3.doc
JE1005.02

Table 1. Tidal Efficiency and Time Lag

Port of Seattle Terminal 30

Location	Well Completion	Uncorrected Mean Water Level Elevation (ft MLLW)	Tidal Lag (minutes)	Tidal Efficiency	Distance East of Sheetpile Wall (ft)	Screen Top (ft bgs)	Screen Bottom (ft bgs)	November 2011 EC (umhos/cm)	April 2011 EC (umhos/cm)	Density Corrected Mean Water Level Elevation (ft)	Well Pair Vertical Gradient (ft/ft)
MW-38 [1]	Water Table	8.57	nr	nr	281	nr	12.25	--	500	**8.57**	--
MW-46	Water Table	8.38	nr	<1 %	135	8.5	17.5	--	1,960	**8.39**	--
MW-54 [1]	Water Table	9.32	nr	nr	537	4	29	--	500	**9.33**	--
MW-58	Water Table	7.99	90	20%	56	5	30	846	900	**8.00**	--
MW-81A	Water Table	8.85	180	1%	339	5	20	--	900	**8.86**	--
MW-84A	Deep Zone	7.99	30	53%	29	30	40	1,040	961	**8.00**	0.0145
MW-84B	Water Table	7.71	70	22%	29	5	20	983	1,180	**7.71**	
MW-85A	Water Table	7.78	160	12%	29	5	20	6,370	4,890	**7.80**	0.0012
MW-85B	Deep Zone	7.75	35	52%	29	30	40	3,700	5,310	**7.83**	
MW-87A	Water Table	7.7	160	20%	29	5	20	4,051	2,460	**7.71**	0.0076
MW-87B	Deep Zone	7.85	30	56%	29	30	40	797	869	**7.86**	
MW-89	Water Table	8.16	150	6%	99	5	20	--	3,450	**8.17**	--
MW-90	Water Table	7.76	115	12%	121	5	20	--	1,410	**7.77**	--
MW-91	Water Table	8.66	nr	< 1%	373	5	20	--	1,020	**8.66**	--
Stilling Well	--	6.85	0	100%	--	30	30	--	30,000	**7.07**	--

[1] Specific Conductivity (EC) values are estimated at 500 umhos/cm. Sensitivity testing between 100 and 1000 umhos indicated uncertainty of 0.01 ft or less.

"nr" indicates that the value is not available from existing data.

MW-45 was inaccessible due to shipping container placement, and was not included in the tidal study.

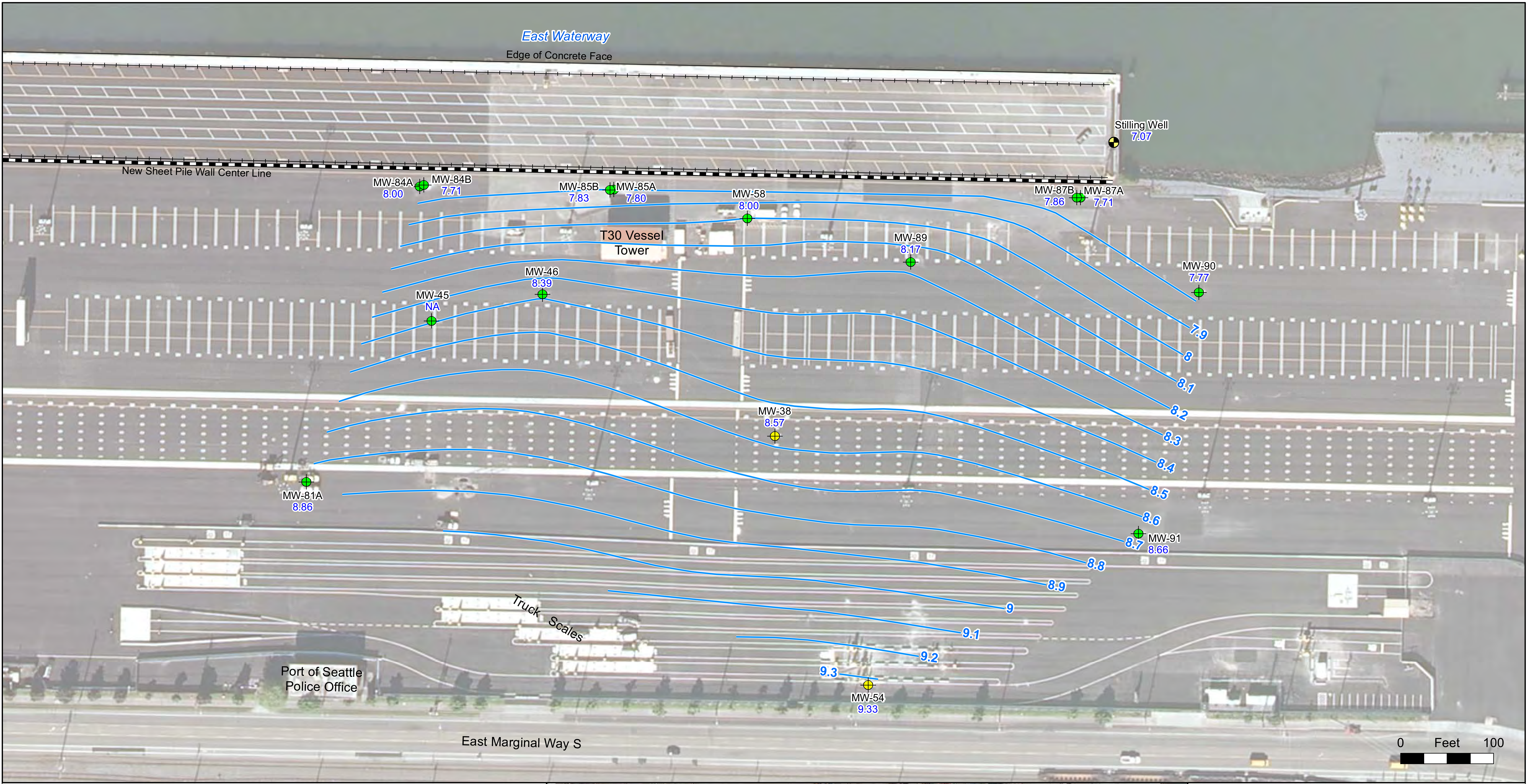
Tidal efficiency too low at MW-91 to estimate tide lag.

A transducer error at MW-54 prevented calculation of time lag and tidal efficiency.

Positive vertical gradients indicate upward head gradient; gradient calculated assuming 20 foot vertical separation between head measurements.

Water level density correction is the difference in height of a column of freshwater relative to the measured water level/density in well.

Density was estimated from specific conductivity data.



K:\PONY\T30\GIS\mxds\WaterLevelElevations.mxd

Average Water Level Elevation Contours

Gaging/Recovery Well

Water Quality Monitoring Well

Stilling Well

7.71 Time-Averaged / Density Corrected
Water Level Elevations
Vertical Datum: MLLW

N

2009 USGS Orthophoto

See Table 1 for Well Completion Information

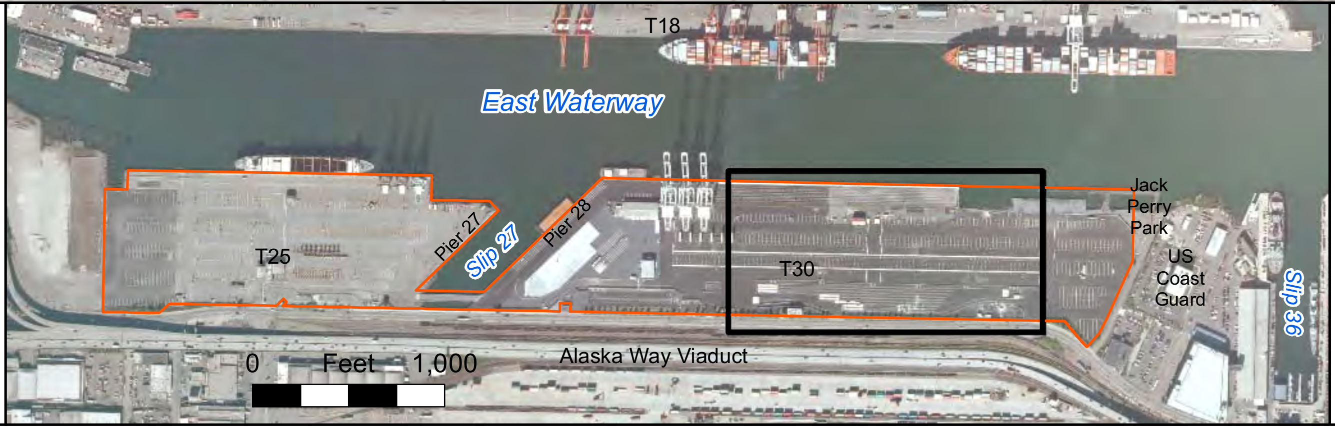
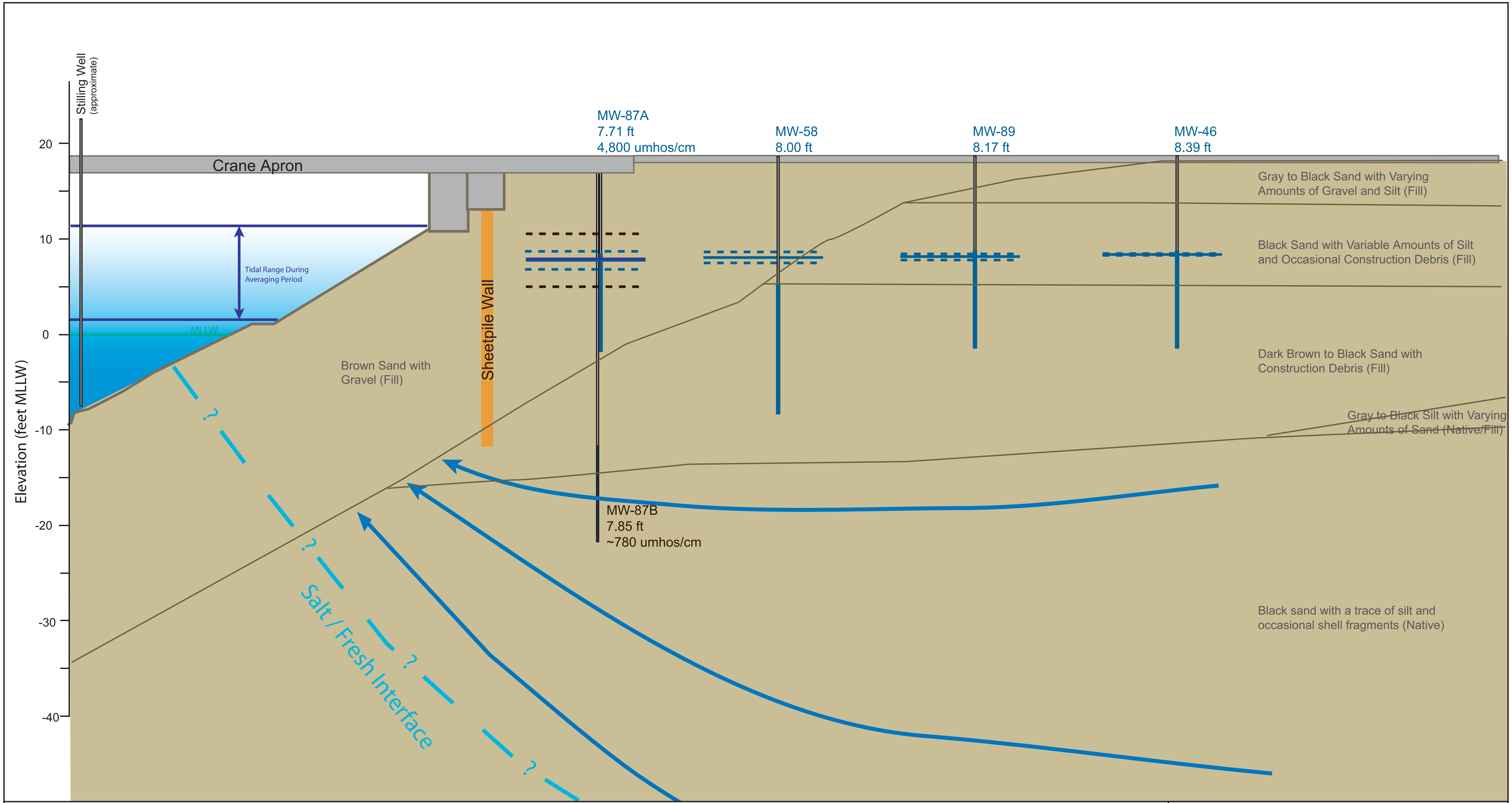


Figure 1

Site Map and
Average Water Level Elevations

Terminal 30
Port of Seattle
JE1005

PgG



Notes:

No Vertical Exaggeration.

Geology modified from GeoEngineers (1998) Figure 6.5.

Dashed lines at each well indicate maximum and minimum water level during 2011 tidal study.

Solid lines at each well indicate average water level during 2011 tidal study.

Features such as pilings and cranes omitted for clarity.

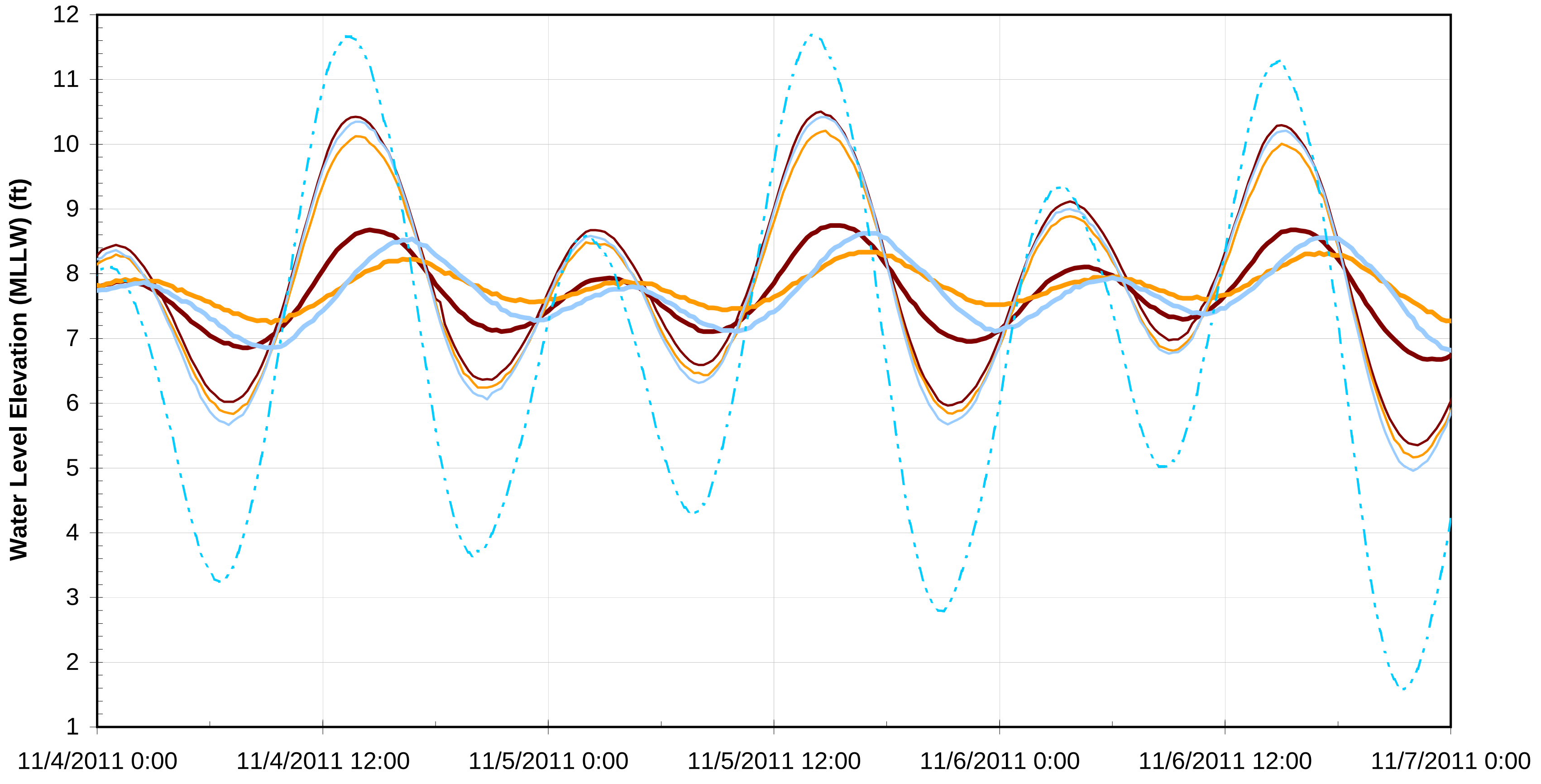
MLLW stands for Mean Low Low Water.

← Conceptualized Deep Groundwater Flow Path

Figure 2. Schematic Cross Section

Port of Seattle Terminal 30

PgG 25 years

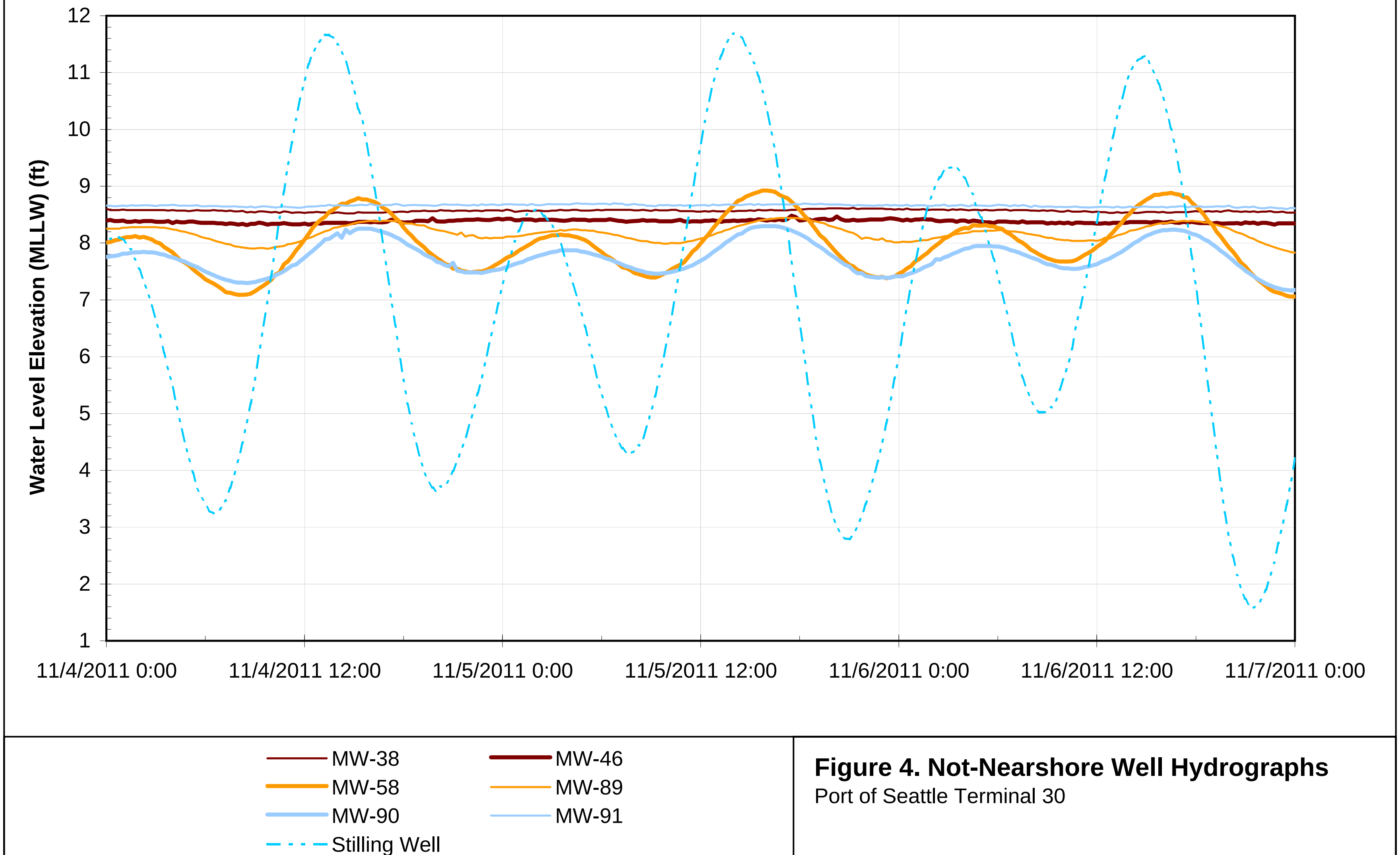


Well Depths:
MW-84A : 40
MW-84B : 20
MW-85A : 20
MW-85B : 40
MW-87A : 20
MW-87B : 40
Thin Line= 40 ft

Water level elevations corrected for density. Thick lines are shallow well completions.

Figure 3. Nearshore Well Pair Hydrographs

Port of Seattle Terminal 30

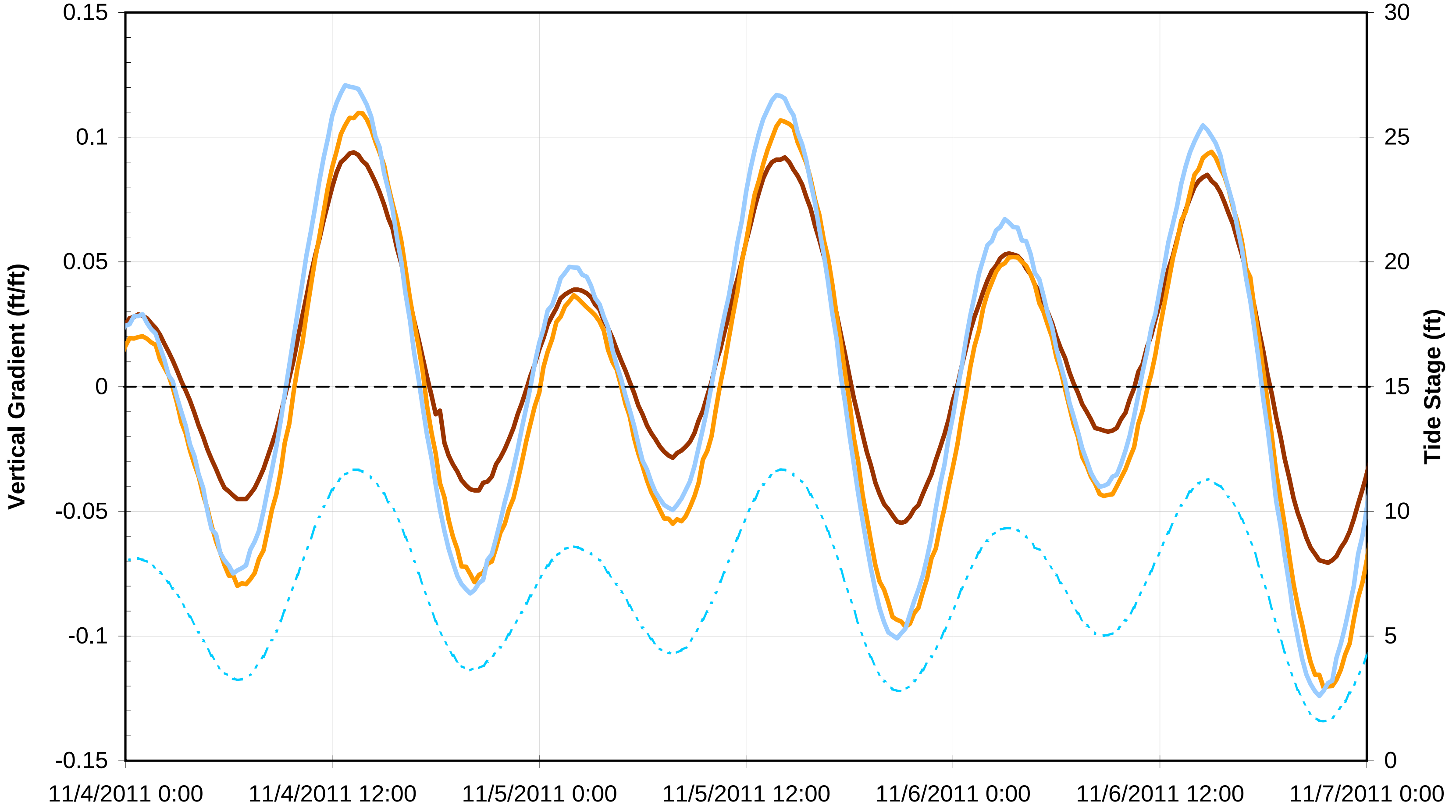


Water level elevations corrected for density.

Figure 4. Not-Nearshore Well Hydrographs

Port of Seattle Terminal 30

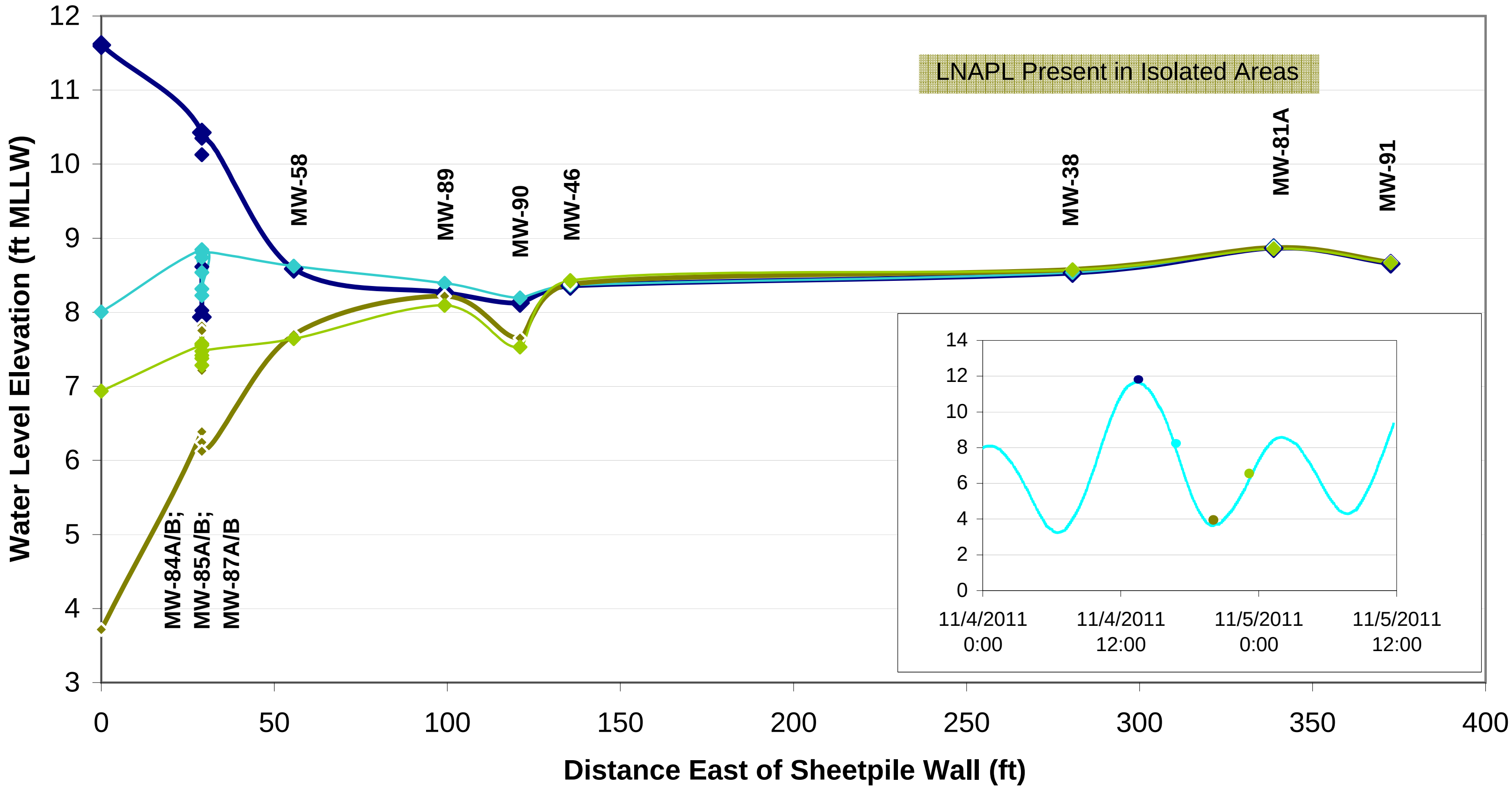
PGG 25 years



Positive values indicate upward gradient. Vertical gradient calculated as deep minus shallow density-corrected water level over assumed 20ft separation based on well construction. Tide stage shown for reference.

Figure 5. Nearshore Well Pair Vertical Gradient

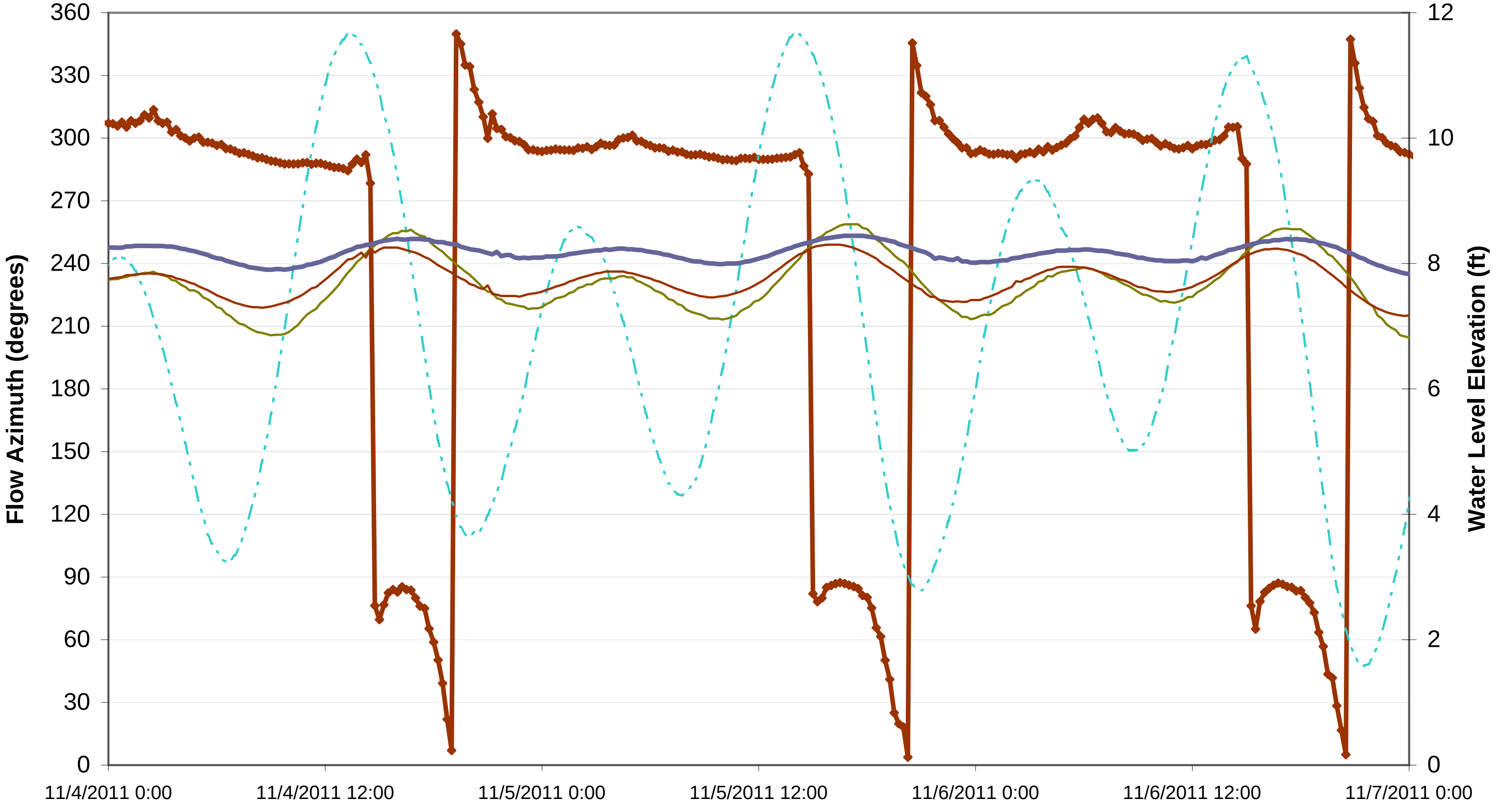
Port of Seattle Terminal 30



Water level elevations corrected for density. Stilling Well tide stage plotted at sheetpile wall; actual distance varies over tidal cycle. Scatter in water levels at near-sheetpile well pairs due to head differential between shallow and deep wells. Apparent mounding/depression at MW-81A and MW-90 due to north-south water level variation (see Figure 1).

Figure 6. Water Level Profiles Over a Tidal Cycle

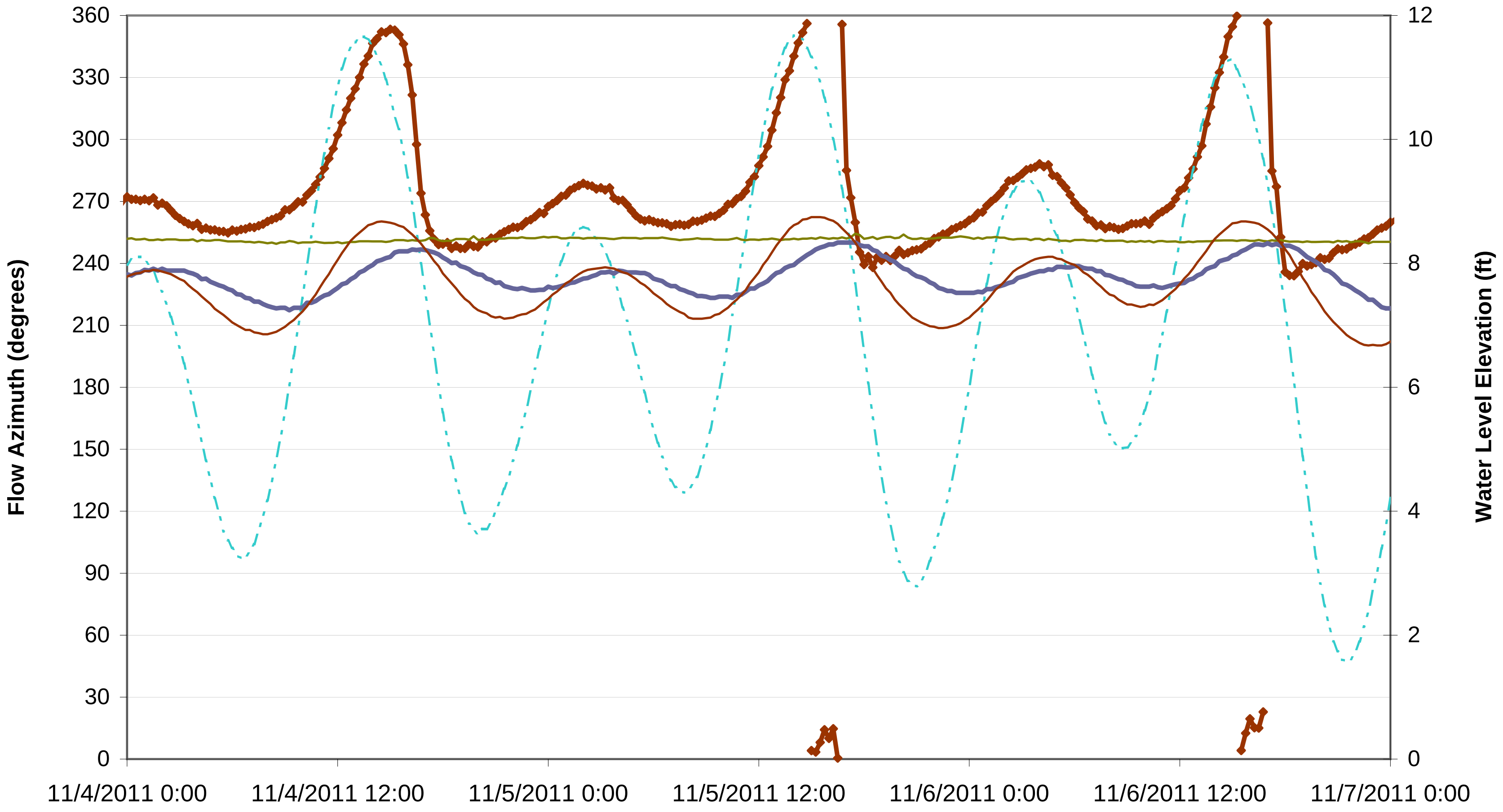
Port of Seattle Terminal 30



Water level elevations corrected for density. Flow directon calculated from MW-87A, MW-89 and MW-90.
Average flow azimuth 302 degrees (32 degrees north

Figure 7a. Groundwater Flow Direction at North End of Sheetpile Wall

Port of Seattle Terminal 30



Water level elevations corrected for density. Flow directon calculated from MW-46, MW-84B and MW-85A. Average flow azimuth 261 degrees (9 degrees south of due west).

Figure 7b. Groundwater Flow Direction at MW-84B, MW-85A, MW-46

Port of Seattle Terminal 30

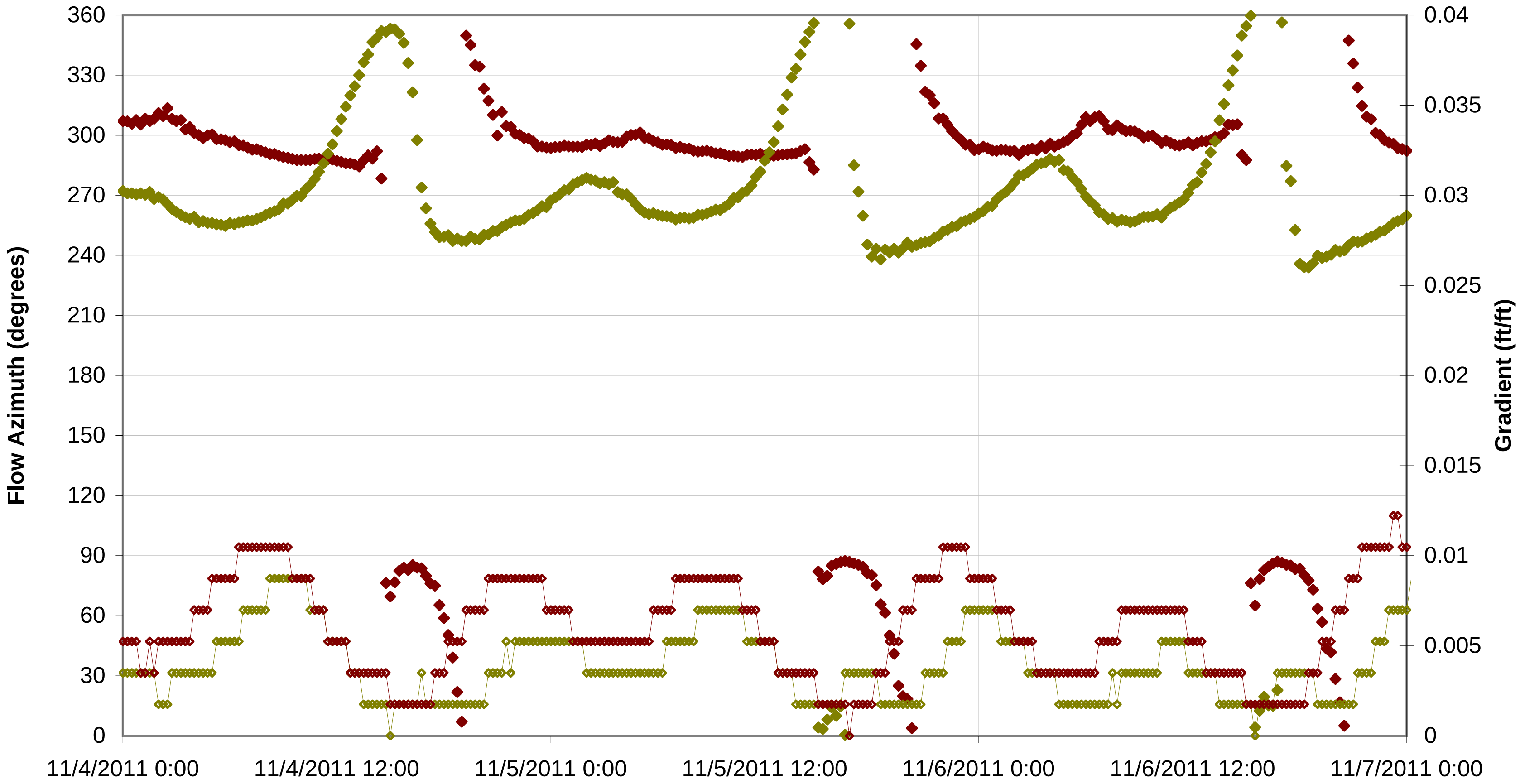
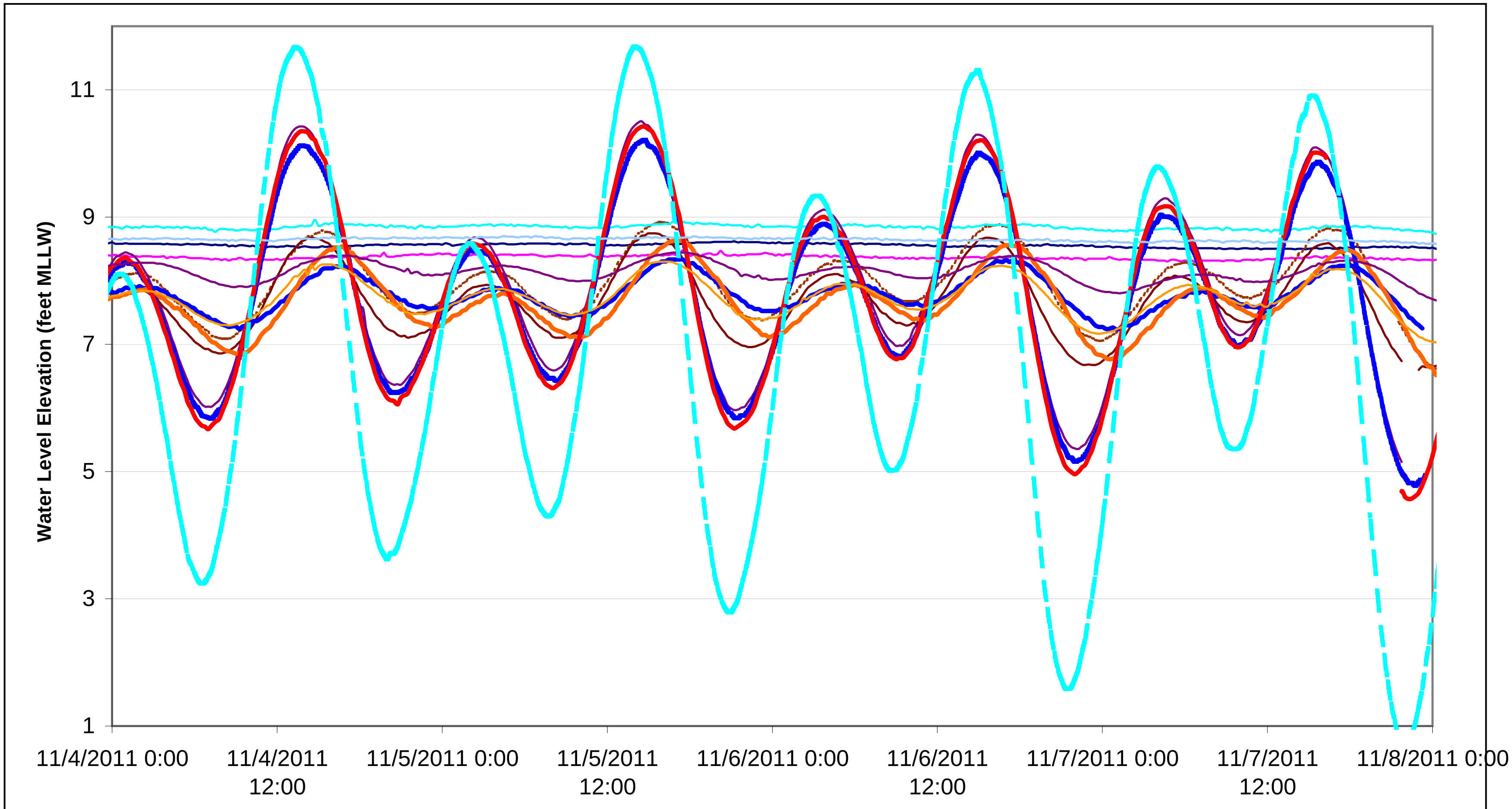


Figure 8. Groundwater Flow Direction and Gradient

Port of Seattle Terminal 30



Density Corrected Hydrographs

Port of Seattle Terminal 30

Appendix B Calculations to Predict AS/SVE Performance

Table 1: Estimated time to Satisfy TPH Biodegradation Oxygen Demand Within and Downgradient of the AS/SVE System

Port of Seattle - Terminal 30 Cleanup Design

1. Average TPH Downgradient and within of AS/AVE system:

Width	1	foot	
Max Length	200	feet	
Saturated Thickness	8	feet	
Avg TPH-G	4350	mg/kg	from RI/FS Table 2-7 MW-78/78A and MW-79/79A data
Avg TPH-D	5350	mg/kg	
Dry Bulk Density	1.5	Kg/L	MTCA default
	1500	kg/m3	
Soil Mass	67962.9	kg	
TPH-G Mass	295.6	kg	
TPH-Dx Mass	363.6	kg	

2. TPH Oxygen Demand

TPH-G O2 Demand	3.5	kg O2/kg TPH
TPH-Dx O2 Demand	3.5	kg O2/kg TPH
Total O2 Demand	2307.341	kg O2

3. Groundwater Flow

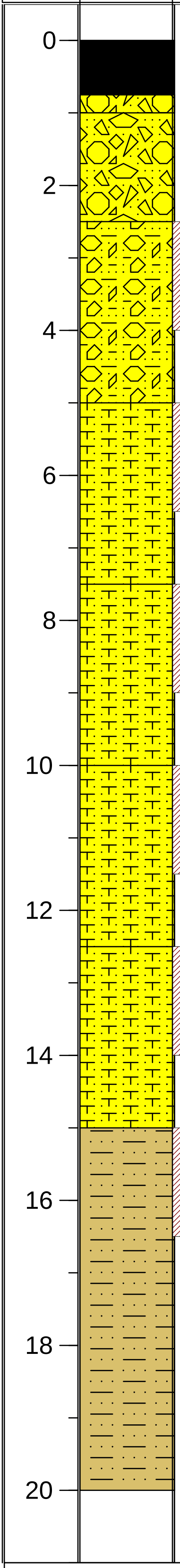
K	0.04	cm/s	Range is 0.02 to 0.1 cm/s based on grain size analyses
K	113.4	ft/d	
i	0.0028	ft/ft	
Porosity	0.3		
Velocity	1.06	ft/day	
	386.3	ft/year	
Pore Volume	480	ft3	
Pore Volumes/Year	1.93		
GW Per Year	927.0425	ft3/year	
	28.07997	m3/year	
	28079.97	L/year	

Table 1: Estimated time to Satisfy TPH Biodegradation Oxygen Demand Within and Downgradient of the AS/SVE System

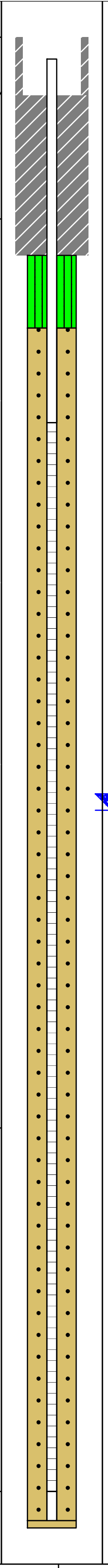
Port of Seattle - Terminal 30 Cleanup Design

4. Oxygen Provided Per Year	Range of DO from 8-9 mg/L	
DO in groundwater	8	mg/L
DO/year	224639.7	mg/year
	224.6397	kg/year
Time to O2 Demand	10.27	years
DO in groundwater	8.5	mg/L
DO/year	238679.7	mg/year
	238.6797	kg/year
Time to O2 Demand	9.67	years
DO in groundwater	9	mg/L
DO/year	252719.7	mg/year
	252.7197	kg/year
Time to O2 Demand	9.13	years

Appendix C Compliance Well Borehole Logs and Monitoring Well Construction Details



Samples			
Sample ID	Blow Counts	Description	Well Construction
		Asphalt	Sherwood high-traffic flush-mount monument set in concrete
		GRAVEL fill	Cement
	13 13 11	Dry, gray,silty SAND fill; gravel and 1/2-inch rocks present; no petroleum odor	Hydrated bentonite seal 2-inch flush-thread pvc casing with o-rings at joints
	9 10 10	Dry, gray, silty SAND; no petroleum odor	
	4 4 6	Moist, gray, silty, coarse-to-fine SAND; organic wood debris; faint petroleum odor	10-inch borehole SWL 10.63 ft 10/16/16
S MW-36A-S-10	6 7 6	Wet, gray, silty SAND; sheen on core; petroleum odor	10/20 Colorado Silica sand pack
	4 5 6	Wet, gray, brown silty SAND; faint petroleum odor	0.010-slot, 2-inch diameter, flush-threaded pvc screen 5.3 to 20.4 feet bgs
	4 5 5	Wet, gray/brown, sandy-to-clayey SILT	
			Threaded Cap Bottom of hole at 20.5 ft

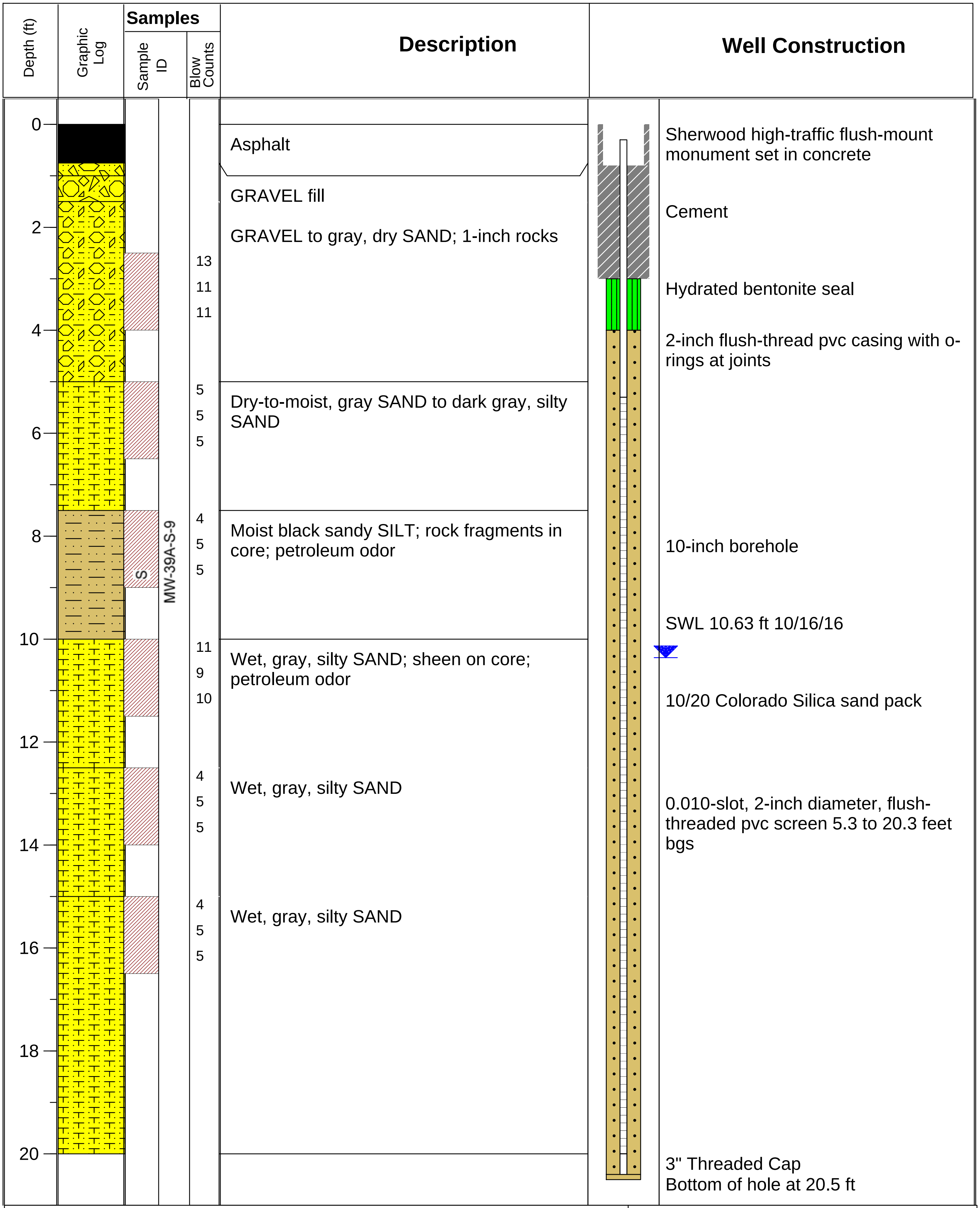


Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: T24N R04E S07; NE1/4
Horizontal Loc.: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Koshlan Mayer-Blackwell

Drilling Firm: Cascade Drilling
Drilling Method: Hollow Stem Auger
Well Tag ID: BKA 415
DTW: 10.63 ft
MP Elevation: Not Surveyed
Datum: N/A
Date: 10/15/16

Figure
Boring Log and As-Built
MW-36A

Terminal 30
Well Replacement
JE1005.09



Sample ID	Blow Counts	Description
		Asphalt
		GRAVEL fill
	13 11 11	GRAVEL to gray, dry SAND; 1-inch rocks
	5 5 5	Dry-to-moist, gray SAND to dark gray, silty SAND
S MW-39A-S-9	4 5 5	Moist black sandy SILT; rock fragments in core; petroleum odor
	11 9 10	Wet, gray, silty SAND; sheen on core; petroleum odor
	4 5 5	Wet, gray, silty SAND
	4 5 5	Wet, gray, silty SAND

Well Construction

Sherwood high-traffic flush-mount monument set in concrete

Cement

Hydrated bentonite seal

2-inch flush-thread pvc casing with o-rings at joints

10-inch borehole

SWL 10.63 ft 10/16/16

10/20 Colorado Silica sand pack

0.010-slot, 2-inch diameter, flush-threaded pvc screen 5.3 to 20.3 feet bgs

3" Threaded Cap
Bottom of hole at 20.5 ft

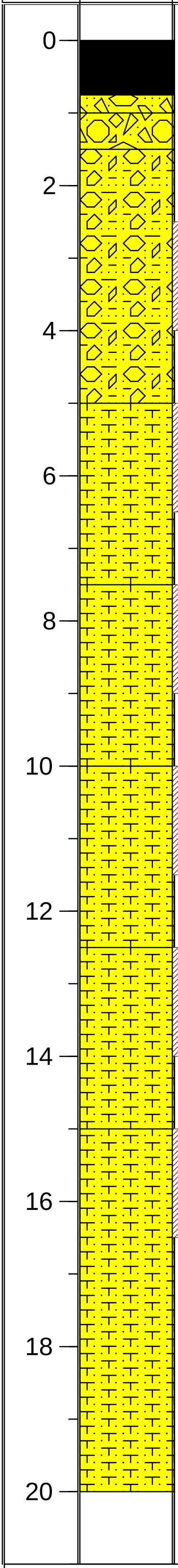
Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: NE-6 -24-4
Horizontal Loc.: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Koshlan Mayer-Blackwell

Drilling Firm: Cascade Drilling
Drilling Method: Hollow Stem Auger
Well Tag ID: BKA 414
DTW: 10.36 ft
MP Elevation: Not Surveyed
Datum: N/A
Date: 10/15/17

Figure
Boring Log and As-Built
MW-39A

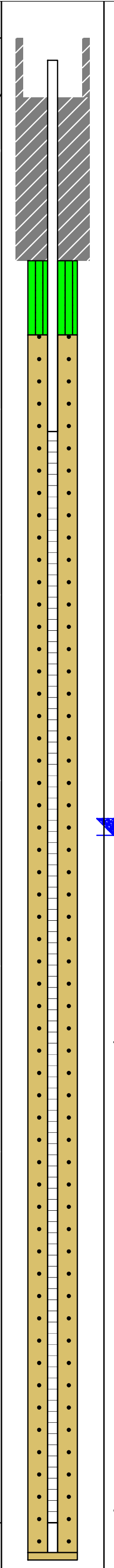
Terminal 30
Well Replacement
JE1005.09

PgG



Samples: Sample ID	Samples: Blow Counts	Description
		Asphalt
		GRAVEL fill
	13 13 15	Damp, silty, fine SAND and gravel; faint petroleum odor
	4 2 3	Damp, fine, dark brown SAND
S MW-93-S-8	4 4 3	Moist-to-wet, dark brown, silty SAND; wet section contains petroleum product; strong petroleum odor
	4 4 3	Wet, dark brown, silty SAND; petroleum sheen visible on core; petroleum odor
	5 6 6	Wet, dark brown, silty SAND; faint petroleum odor
	4 4 3	Wet, dark, brown silty SAND

Well Construction



Sherwood high-traffic flush-mount monument set in concrete

Cement

Hydrated bentonite seal

2-inch flush-thread pvc casing with o-rings at joints

10-inch borehole

SWL 10.74 ft 11/15/17

10/20 Colorado Silica sand pack

0.010-slot, 2-inch diameter, flush-threaded PVC screen 5.3 to 20.3 feet bgs

Threaded Cap

Bottom of hole at 20.5 ft

Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: NE-6 -24-4
Horizontal Loc.: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Koshlan Mayer-Blackwell

Drilling Firm: Cascade Drilling
Drilling Method: Hollow Stem Auger
Well Tag ID: BKA 413
DTW: 10.74 ft
MP Elevation: Not Surveyed
Datum: N/A
Date: 10/15/17

Figure
Boring Log and As-Built
MW-93

Terminal 30
Well Replacement
JE1005.09

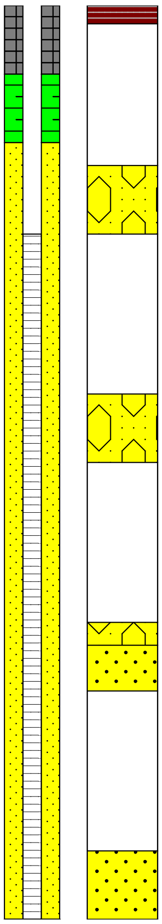
PgG

ENSR | AECOM

Boring/Well Log

Well #: MW-89
Sheet 1 of 1

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **217003.9259** Easting: **1268079.618**	Ground Elevation: **18.13'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **17.91'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/22/08 0755**	Casing ID: **2"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/22/08 0830**	Boring ID: **6"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample						
Type & Number	**Depth Range**	**% Rec**	**Depth (ft.)**	**Soil and Rock Description** Classification Scheme: **USCS/ASTM**	**Elevation (ft.)**	**Comments & Samples**
			0	(0.0-0.4) ASPHALT		Flush mount monument Concrete from 0.0-1.5 ft-bgs
				(0.4-3.5) Not Sampled	15	Bentonite chip seal from 1.5-3.0 ft-bgs
SPT -1	**3.5-5**	**53**		(3.5-5.0) SW: WELL GRADED SAND WITH GRAVEL, gray, fine to coarse, angular to sub rounded, medium dense, dry. 35% angular to sub angular, fine gravel. Slight hydrocarbon-like odor. No visible contamination.		
			5	(5.0-8.5) Not Sampled		2-inch Sch. 40 PVC riser from 0.0-5.0 ft-bgs
SPT -2	**8.5-10**	**73**		(8.5-10.0) SW: WELL GRADED SAND, dark gray, fine to coarse, sub angular, very loose, moist. Trace fine gravel. Very strong hydrocarbon-like odor. Dark staining on grains and on spoon.	10	0.010-inch slot 2-inch Sch. 40 PVC screen from 5-20 ft-bgs
			10	(10.0-13.5) Not Sampled		Silica sand from 3.0-20.15 ft-bgs
		▽		(13.5-14.0) SW: WELL GRADED SAND, fine to coarse, angular to sub angular, loose, wet. few white and red grains. Strong odor and heavy rainbow sheen.	5	
SPT -3	**13.5-15**	**100**		(14.0-15.0) SP: POORLY GRADED SAND, black, fine, loose, wet. Strong odor and heavy rainbow sheen.		
			15	(15.0-18.5) Not Sampled	0	2-inch Sch. 40 PVC end cap from 20.0-20.15 ft-bgs
SPT -4	**18.5-20**	**40**		(18.5-20.0) SP: POORLY GRADED SAND, black, fine, loose, wet. Moderate hydrocarbon-like odor, slight rainbow sheen.		
			20			

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule **Amb. - Ambient Air**

HSA - Hollow Stem Auger

Surveyed in NAD 83

ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

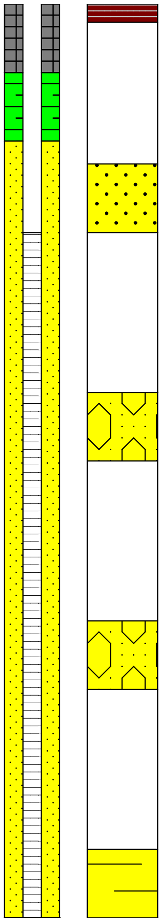
Date	Time	Depth (ft.)
4/22/08	**0815**	**13'**

ENSR | AECOM

Boring/Well Log

Well #: MW-87A
Sheet 1 of 1

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **217186.7537** Easting: **1268010.277**	Ground Elevation: **18.24'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **17.98'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/22/08 1000**	Casing ID: **2"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/22/08 1040**	Boring ID: **6"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample: Type & Number	Sample: Depth Range	Sample: % Rec	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
			0	(0.0-0.4) ASPHALT		Flush mount monument Concrete from 0.0-1.5 ft-bgs
				(0.4-3.5) Not Sampled	15	Bentonite chip seal from 1.5-3.0 ft-bgs
SPT -1	**3.5-5**	**35**		(3.5-5.0) SP: POORLY GRADED SAND, brown, medium, sub rounded, loose, moist. 20% fine, sub rounded gravel, up to 1/2" thick. Slight hydrocarbon-like odor. No visible contamination.		
			5	(5.0-8.5) Not Sampled		2-inch Sch. 40 PVC riser from 0.0-5.0 ft-bgs 0.010-inch slot 2-inch Sch. 40 PVC screen from 5-20 ft-bgs
SPT -2	**8.5-10**	**20**		(8.5-10.0) SW: WELL GRADED SAND, brown, fine to coarse, rounded, loose, moist. Trace silt and fine gravel. No odor or visible contamination.	10	
		▽	10	(10.0-13.5) Not Sampled		Silica sand from 3.0-20.15 ft-bgs
SPT -3	**13.5-15**	**33**		(13.5-15.0) SW: WELL GRADED SAND, brown, fine to medium, rounded, very loose, wet. Trace fine gravel and coarse sand. No odor or visible contamination.	5	
			15	(15.0-18.5) Not Sampled	0	2-inch Sch. 40 PVC end cap from 20.0-20.15 ft-bgs
SPT -4	**18.5-20**	**-**	20	(18.5-20.0) ML: SILT, dark brownish gray, soft, wet. No odor or visible contamination.		

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule
Amb. - Ambient Air
HSA - Hollow Stem Auger
Surveyed in NAD 83
ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

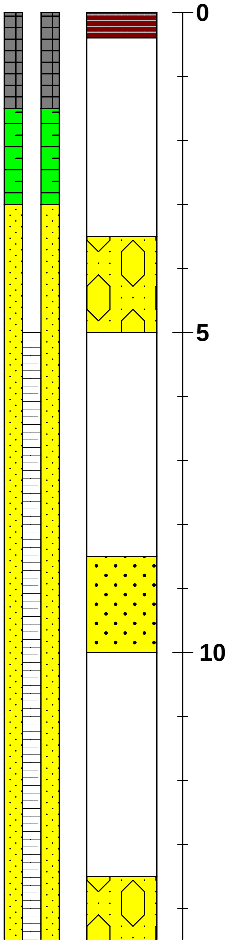
Groundwater

Date	Time	Depth (ft.)
4/22/08	**1020**	**11'**

Boring/Well Log

Well #: MW-86B
Sheet 1 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216946.1461** Easting: **1268007.758**	Ground Elevation: **18.46'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.28'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/22/08 1140**	Casing ID: **2"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/22/08 1215**	Boring ID: **6"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample: Type & Number	Sample: Depth Range	Sample: % Rec	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)
			0	(0.0-0.4) ASPHALT	
				(0.4-3.5) Not Sampled	15
SPT -1	**3.5-5**	**86**		(3.5-5.0) SW: WELL GRADED SAND, brown, fine to coarse, medium dense, sub rounded, moist. 20% rounded, fine gravel, up to 1/2" in diameter. No odor or visible contamination.	
			5	(5.0-8.5) Not Sampled	10
SPT -2	**8.5-10**	**53**		(8.5-10.0) SP: POORLY GRADED SAND, brown, medium, loose, sub rounded, moist. 30% coarse sand. Trace fine gravel. No odor or visible contamination.	
			10	(10.0-13.5) Not Sampled	5
SPT -3	**13.5-15**	**33**		(13.5-15.0) SW: WELL GRADED SAND, grayish brown, fine to coarse, loose, sub rounded, wet. 10% sub angular to sub rounded, fine gravel. No odor or visible contamination.	

Comments & Samples

Flush mount monument Concrete from 0.0-1.5 ft-bgs

Bentonite chip seal from 1.5-3.0 ft-bgs

2-inch Sch. 40 PVC riser from 0.0-5.0 ft-bgs

0.010-inch slot 2-inch Sch. 40 PVC screen from 5-20 ft-bgs

Silica sand from 3.0-20.15 ft-bgs

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule **Amb. - Ambient Air**

HSA - Hollow Stem Auger

Surveyed in NAD 83

ft-bgs - feet below ground surfce

Sample Type

N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

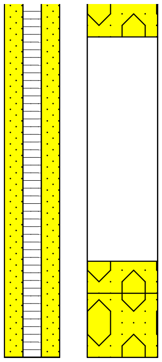
Groundwater

Date	Time	Depth (ft.)
4/22/08	**1200**	**12'**

Boring/Well Log

Well #: MW-86B
Sheet 2 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216946.1461** Easting: **1268007.758**	Ground Elevation: **18.46'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.28'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/22/08 1140**	Casing ID: **2"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/22/08 1215**	Boring ID: **6"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample			Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
Type & Number	Depth Range	% Rec				
			15	(15.0-18.5) Not Sampled		2-inch Sch. 40 PVC end cap from 20.0-20.15 ft-bgs
SPT -4	**18.5-20**	**66**		(18.5-19.0) SW: WELL GRADED SAND, brown, fine to coarse, medium dense, sub angular, wet.	0	
			20	(19.0-20.0) SW: WELL GRADED SAND, gray, fine to medium, medium dense, wet. Trace coarse sand. Slight hydrocarbon-like odor and sheen.		

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule
Amb. - Ambient Air
HSA - Hollow Stem Auger
Surveyed in NAD 83
ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

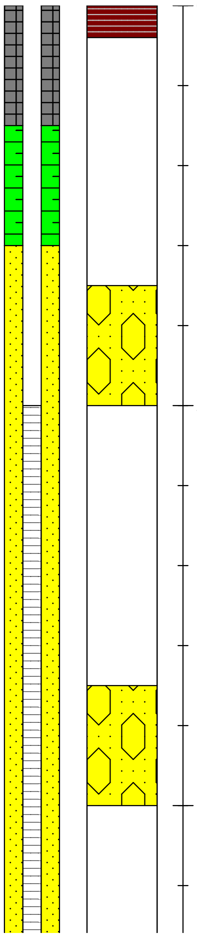
Groundwater

Date	Time	Depth (ft.)
4/22/08	**1200**	**12'**

Boring/Well Log

Well #: MW-85A
Sheet 1 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216682.4566** Easting: **1268002.195**	Ground Elevation: **18.34'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.09'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/24/08 1514**	Casing ID: **2"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/24/08 1545**	Boring ID: **6"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
					0	(0.0-0.4) ASPHALT		Flush mount monument Concrete from 0.0-1.5 ft-bgs
						(0.4-3.5) Not Sampled		Bentonite chip seal from 1.5-3.0 ft-bgs
SPT -1	**3.5-5**	**0.4**				(3.5-5.0) SW: WELL GRADED SAND, brown, fine to coarse, sub rounded, medium dense, moist. 15% sub rounded to sub angular gravel up to 1.5" in diameter. No odor or visible contamination.	15	
					5	(5.0-8.5) Not Sampled		2-inch Sch. 40 PVC riser from 0.0-5.0 ft-bgs 0.010-inch slot 2-inch Sch. 40 PVC screen from 5-20 ft-bgs
SPT -2	**8.5-10**	**33**				(8.5-10.0) SW: WELL GRADED SAND, brown, fine to coarse, sub rounded, medium dense, moist. 10% angular gravel, up to 1" in diameter. No odor or visible contamination.	10	
					10	(10.0-13.5) Not Sampled		Silica sand from 3.0-20.15 ft-bgs

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule **Amb. - Ambient Air**
HSA - Hollow Stem Auger
Surveyed in NAD 83
ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

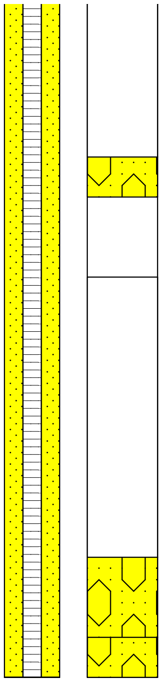
Groundwater

Date	Time	Depth (ft.)
4/24/08	**0530**	**12'**

Boring/Well Log

Well #: MW-85A
Sheet 2 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216682.4566** Easting: **1268002.195**	Ground Elevation: **18.34'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.09'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/24/08 1514**	Casing ID: **2"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/24/08 1545**	Boring ID: **6"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample: Type & Number	Sample: Depth Range	Sample: % Rec	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
SPT -3	**13.5-15**	**20**		(13.5-15.0) SW: WELL GRADED SAND, fine to coarse, medium dense, sub angular to sub rounded, wet. 3" diameter cobble at 15'. No odor or visible contamination.	5	
			15	(15.0-18.5) Not Sampled		
					0	2-inch Sch. 40 PVC end cap from 20.0-20.15 ft-bgs
SPT -4	**18.5-20**	**80**		(18.5-19.5) SW: WELL GRADED SAND, brownish gray, fine to coarse, medium dense, sub angular to sub rounded, wet. No odor or visible contamination.		
			20	(19.5-20.0) SW: WELL GRADED SAND, dark gray, medium to coarse, medium dense, wet. Trace, fine, sub angular to sub rounded gravel. Slight hydrocarbon-like odor. No visible contamination.		

Remarks and Datum Used:

Sch. - Schedule **Amb. - Ambient Air**

HSA - Hollow Stem Auger

Surveyed in NAD 83

ft-bgs - feet below ground surfce

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type

N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
4/24/08	**0530**	**12'**

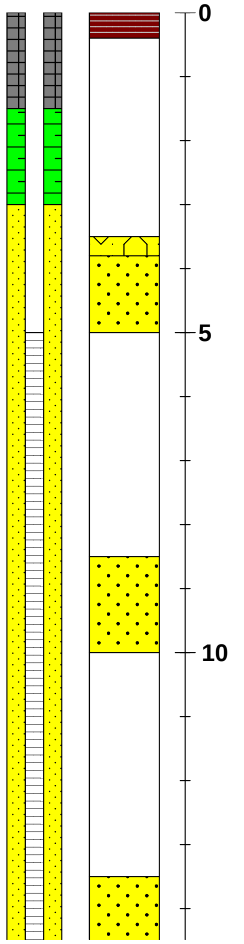
Boring/Well Log

Well #: RW-11A
Sheet 1 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216683.9365** Easting: **1268216.993**	Ground Elevation: **18.55'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.02'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/24/08 0802**	Casing ID: **4"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/24/08 0843**	Boring ID: **8"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**

Sample			
Type & Number	**Depth Range**	**% Rec**	**Depth (ft.)**
SPT -1	**3.5-5**	**100**	
SPT -2	**8.5-10**	**100**	
SPT -3	**13.5-15**	**66**	

Well Completion Log | **Graphic** | **Depth (ft.)**



Soil and Rock Description

Classification Scheme: **USCS/ASTM**

(0.0-0.4) ASPHHALT

(0.4-3.5) Not Sampled

(3.5-3.8) SW: WELL GRADED SAND, brown, fine to coarse, medium dense, angular, dry. 10% fine gravel, sub angular to angular. Monderate odor, no visible contamination.

(3.8-5.0) SP: POORLY GRADED SAND, gray, fine, medium dense, moist. Trace silt and wood chips. Slight odor, no visible contamination.

(5.0-8.5) Not Sampled

(8.5-10.0) SP: POORLY GRADED SAND, dark gray, fine, loose, moist. Stron odor, slight sheen on rainwater in spoon.

(10.0-13.5) Not Sampled

(13.5-15.0) SP: POORLY GRADED SAND, gray, fine, loose, wet. Some white and orange grains. Strong odor, rainbow sheen on water.

Elevation (ft.): 15, 10, 5

Comments & Samples

Flush mount monument Concrete from 0.0-1.5 ft-bgs

Bentonite chip seal from 1.5-3.0 ft-bgs

4-inch Sch. 40 PVC riser from 0.0-5.0 ft-bgs

0.010-inch slot 4-inch Sch. 40 PVC screen from 5-20 ft-bgs

Silica sand from 3.0-20.15 ft-bgs

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule **Amb. - Ambient Air**

HSA - Hollow Stem Auger

Surveyed in NAD 83

ft-bgs - feet below ground surfce

Sample Type

N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

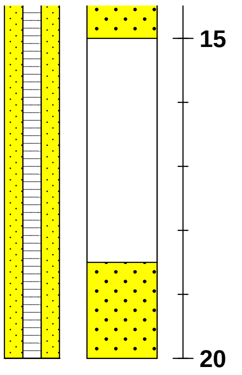
Date	Time	Depth (ft.)
4/25/08	**1415**	**12.5**

ENSR | AECOM

Boring/Well Log

Well #: RW-11A
Sheet 2 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216683.9365** Easting: **1268216.993**	Ground Elevation: **18.55'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.02'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/24/08 0802**	Casing ID: **4"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/24/08 0843**	Boring ID: **8"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
					15	(15.0-18.5) Not Sampled	0	4-inch Sch. 40 PVC end cap from 20.0-20.15 ft-bgs
SPT -4	**18.5-20**	**33**			20	(18.5-20.0) SP: POORLY GRADED SAND, gray, fine, sub angular, wet. Strong odor, moderate rainbow sheen.		

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule **Amb. - Ambient Air**

HSA - Hollow Stem Auger

Surveyed in NAD 83

ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

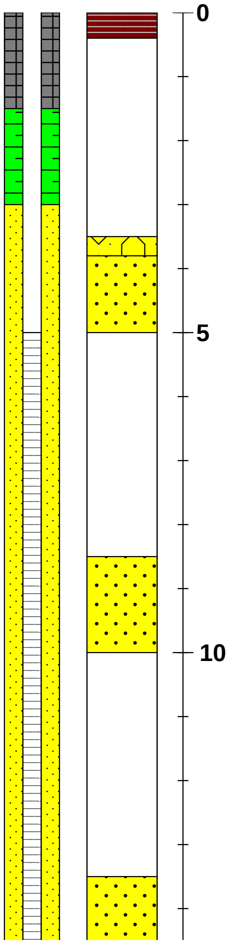
Date	Time	Depth (ft.)
4/25/08	**1415**	**12.5**

ENSR | AECOM

Boring/Well Log

Well #: RW-11A
Sheet 1 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216683.9365** Easting: **1268216.993**	Ground Elevation: **18.55'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.02'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/24/08 0802**	Casing ID: **4"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/24/08 0843**	Boring ID: **8"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample			Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
Type & Number	Depth Range	% Rec			
			(0.0-0.4) ASPHHALT		Flush mount monument Concrete from 0.0-1.5 ft-bgs
			(0.4-3.5) Not Sampled		
SPT -1	**3.5-5**	**100**	(3.5-3.8) SW: WELL GRADED SAND, brown, fine to coarse, medium dense, angular, dry. 10% fine gravel, sub angular to angular. Monderate odor, no visible contamination.	15	Bentonite chip seal from 1.5-3.0 ft-bgs
			(3.8-5.0) SP: POORLY GRADED SAND, gray, fine, medium dense, moist. Trace silt and wood chips. Slight odor, no visible contamination.		
			(5.0-8.5) Not Sampled		4-inch Sch. 40 PVC riser from 0.0-5.0 ft-bgs 0.010-inch slot 4-inch Sch. 40 PVC screen from 5-20 ft-bgs
SPT -2	**8.5-10**	**100**	(8.5-10.0) SP: POORLY GRADED SAND, dark gray, fine, loose, moist. Stron odor, slight sheen on rainwater in spoon.	10	
		▽	(10.0-13.5) Not Sampled		Silica sand from 3.0-20.15 ft-bgs
SPT -3	**13.5-15**	**66**	(13.5-15.0) SP: POORLY GRADED SAND, gray, fine, loose, wet. Some white and orange grains. Strong odor, rainbow sheen on water.	5	

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule **Amb. - Ambient Air**
HSA - Hollow Stem Auger
Surveyed in NAD 83
ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

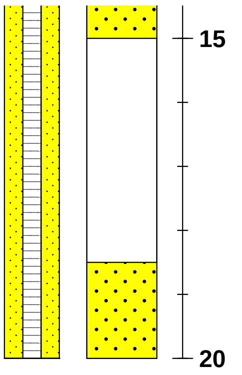
Date	Time	Depth (ft.)
4/25/08	**1415**	**12.5**

ENSR | AECOM

Boring/Well Log

Well #: RW-11A
Sheet 2 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216683.9365** Easting: **1268216.993**	Ground Elevation: **18.55'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.02'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/24/08 0802**	Casing ID: **4"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/24/08 0843**	Boring ID: **8"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**



Sample			Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
Type & Number	Depth Range	% Rec						
					15	(15.0-18.5) Not Sampled	0	4-inch Sch. 40 PVC end cap from 20.0-20.15 ft-bgs
SPT -4	**18.5-20**	**33**			20	(18.5-20.0) SP: POORLY GRADED SAND, gray, fine, sub angular, wet. Strong odor, moderate rainbow sheen.		

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule **Amb. - Ambient Air**
HSA - Hollow Stem Auger
Surveyed in NAD 83
ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
4/25/08	**1415**	**12.5**

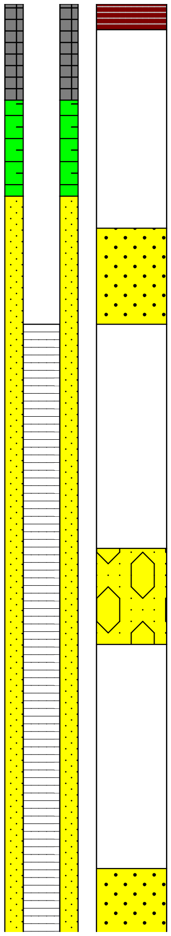
ENSR | AECOM

Boring/Well Log

Well #: RW-5A
Sheet 1 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216931.1214** Easting: **1268445.78**	Ground Elevation: **18.46'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.07'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/25/08 1351**	Casing ID: **4"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/25/08 1430**	Boring ID: **8"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)
			0	(0.0-0.4) ASPHALT	
				(0.4-3.5) Not Sampled	15
SPT -1	**3.5-5**	**40**		(3.5-5.0) SP: POORLY GRADED SAND, brownish gray, loose, sub angular, moist. 15% medium to coarse sand. Trace fine gravel. Strong hydrocarbon-like odor, No visible contamination.	
			5	(5.0-8.5) Not Sampled	10
SPT -2	**8.5-10**	**33**		(8.5-10.0) SW: WELL GRADED SAND, gray, fine to coarse, medium dense, sub angular, dry. 10% angular, fine, gravel. No odor or visible contamination.	
			10	(10.0-13.5) Not Sampled	
SPT -3	**13.5-15**	**40**		(13.5-14.5) SP: POORLY GRADED SAND, dark gray, fine, medium dense, wet. Trace shell fragments. Strong hydrocarbon-like odor. Slight sheen on water in spoon.	5



Comments & Samples

Flush mount monument Concrete from 0.0-1.5 ft-bgs

Bentonite chip seal from 1.5-3.0 ft-bgs

4-inch Sch. 40 PVC riser from 0.0-5.0 ft-bgs

0.010-inch slot 4-inch Sch. 40 PVC screen from 5-20 ft-bgs

Silica sand from 3.0-20.15 ft-bgs

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule
Amb. - Ambient Air
HSA - Hollow Stem Auger
Surveyed in NAD 83
ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

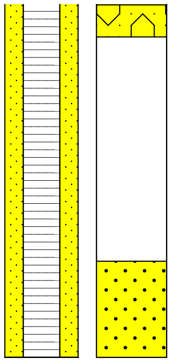
Date	Time	Depth (ft.)
4/25/08	**1415**	**12.5'**

ENSR | AECOM

Boring/Well Log

Well #: RW-5A
Sheet 2 of 2

Project: **Terminal 30**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-014-600**	Northing: **216931.1214** Easting: **1268445.78**	Ground Elevation: **18.46'**
Location: **Seattle, WA**	Drill Rig Type: **Mobile B-59**	MP Elevation: **18.07'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20'**
Start Date & Time: **4/25/08 1351**	Casing ID: **4"**	Filter Pack: **10-20 Silica Sand**
Finish Date & Time: **4/25/08 1430**	Boring ID: **8"**	Seal: **Bentonite Chips**
Contractor: **Boart Longyear**	Bit Type: **Carbide Tooth Auger Head**	Grout: **-**
Operator: **John Bennett**	Logged By: **C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-20 ft-bgs**

Sample			**Well Completion Log**	**Graphic**	**Depth (ft.)**	**Soil and Rock Description** Classification Scheme: **USCS/ASTM**	**Elevation (ft.)**	**Comments & Samples**
Type & Number	**Depth Range**	**% Rec**						
					**15**	(14.5-15.0) SW: WELL GRADED SAND, dark gray, fine to coarse, medium dense, sub angular, wet. Trace fine gravel up to 1/2" in diameter. Moderate hydrocarbon-like odor. Slight sheen on water.		
						(15.0-18.5) Not Sampled	0	4-inch Sch. 40 PVC end cap from 20.0-20.15 ft-bgs
SPT -4	**18.5-20**	**100**			**20**	(18.5-20) SP: POORLY GRADED SAND, dark gray, fine, loose, wet. Trace shell fragments. 1/4" lense of wood chips at 19.5'. Strong odor, decreasing toward 20'. No visible contamination.		

Remarks and Datum Used:

ENSR
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sch. - Schedule
Amb. - Ambient Air
HSA - Hollow Stem Auger
Surveyed in NAD 83
ft-bgs - feet below ground surfce

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
4/25/08	**1415**	**12.5'**

DRAFT

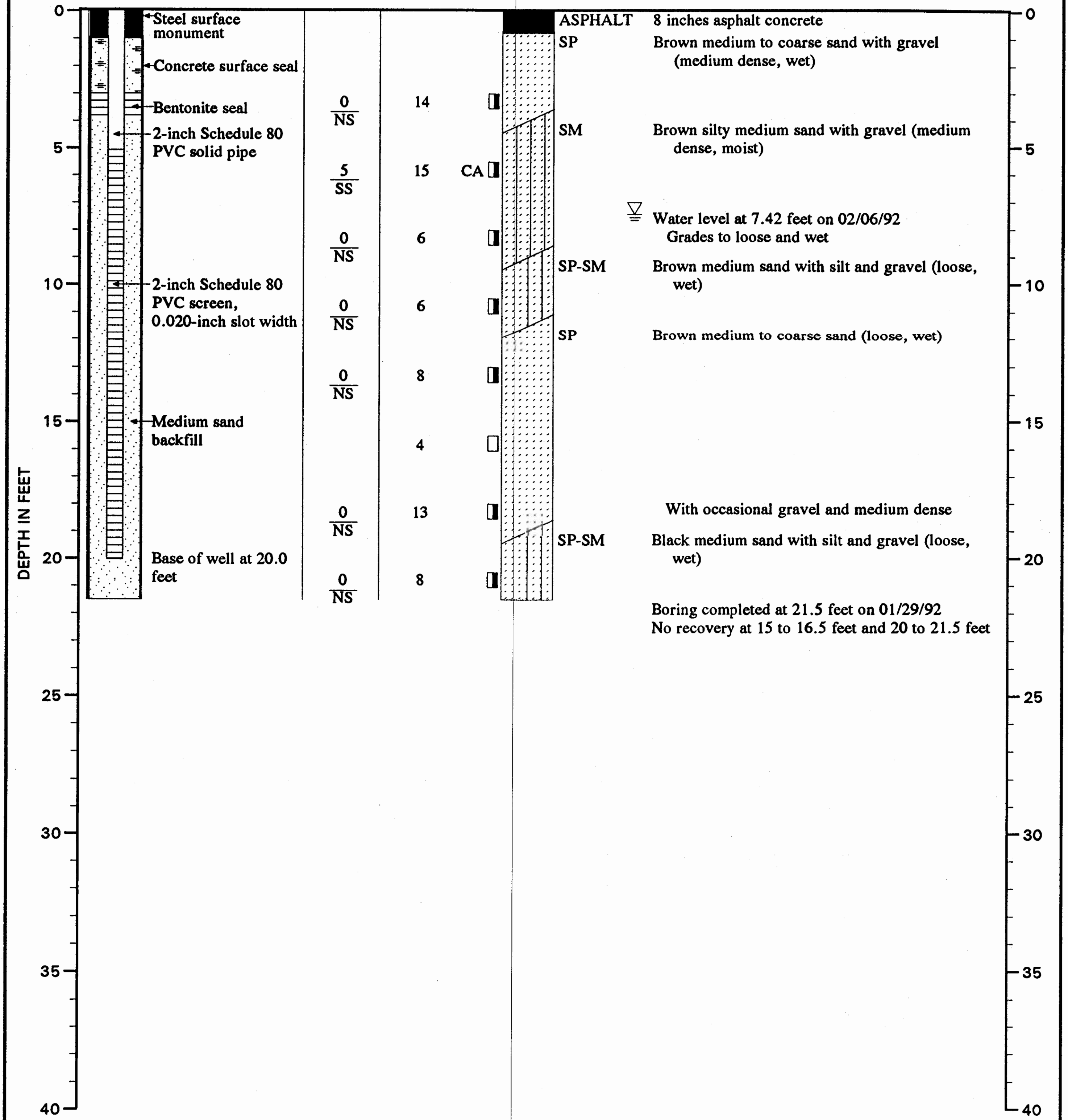
MONITORING WELL MW-84

WELL SCHEMATIC

Casing Elevation (ft.): 18.22
Casing Stickup (ft.): -0.31

DESCRIPTION

Surface Elevation (ft.): 18.53



Vapor Conc.(ppm) / Sheen	Blow Count	Samples	Group Symbol	Description
			ASPHALT	8 inches asphalt concrete
			SP	Brown medium to coarse sand with gravel (medium dense, wet)
0 / NS	14			
			SM	Brown silty medium sand with gravel (medium dense, moist)
5 / SS	15	CA		
				Water level at 7.42 feet on 02/06/92 Grades to loose and wet
0 / NS	6			
			SP-SM	Brown medium sand with silt and gravel (loose, wet)
0 / NS	6			
			SP	Brown medium to coarse sand (loose, wet)
0 / NS	8			
	4			
				With occasional gravel and medium dense
0 / NS	13			
			SP-SM	Black medium sand with silt and gravel (loose, wet)
0 / NS	8			

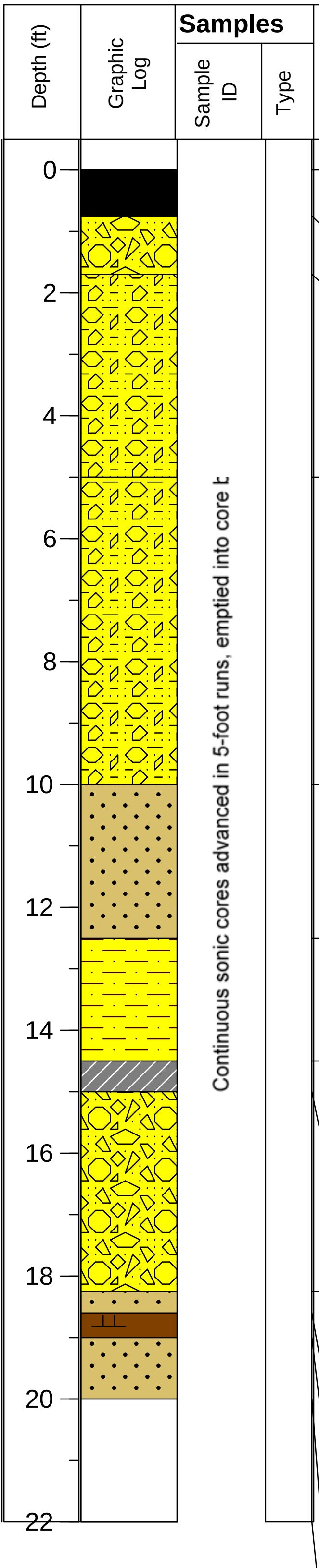
Boring completed at 21.5 feet on 01/29/92
No recovery at 15 to 16.5 feet and 20 to 21.5 feet

Note: See Figure A- 2 for explanation of symbols

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-14



Continuous sonic cores advanced in 5-foot runs, emptied into core t

Description

Asphalt in 2-lifts

Packed angular GRAVEL fill

Brown, damp, gravelly SAND; soil observed during hand-clearing with no sonic recovery

Gray, moist, medium sandy GRAVEL; trace brick fragments; no petroleum staining or odor noted

Mottled brown and gray, moist to wet gravelly, silty SAND; poorly graded; hard drilling at and below 10 feet bgs

Gray, wet, medium-coarse GRAVEL

Concrete; unclear from recovered material if cobble or cast-in-place slab

Gray, wet, fine-medium GRAVEL; rounded 0.75-inch minus; soft drilling; no petroleum odor or staining noted

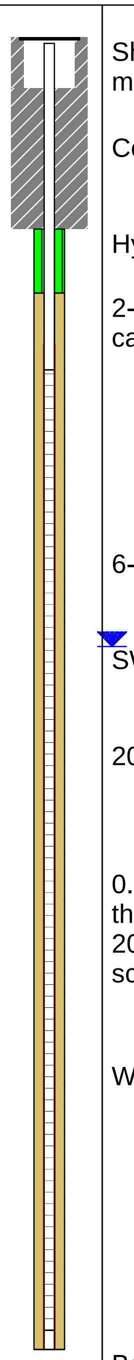
Dark gray-brown, wet, silty SAND; trace marine shells

Wood, single piece of plank or log/branch

Brown, wet SAND; fine 5-10 mm thick layering suggesting native material. No petroleum odor or staining noted

No core recovery this interval; drilling advanced to control and allow for heave

Well Construction



Sherwood high-traffic flush-mount monument set in concrete

Cement

Hydrated bentonite seal

2-inch flush-thread stainless steel casing with o-rings at joints

6-inch borehole

SWL 9.52 ft below MP 11/7/16

20/40 Colorado Silica sand pack

0.010-slot, 2-inch diameter, flush-threaded stainless steel screen 5.1 to 20.1 feet bgs with 20/40 pre-pack screen

Well developed by surging and bailing

Bottom of hole at 22 ft; heave to 20.5

Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: T24N R04E S07; NE1/4
Horizontal Loc.: N 216490.82 ft, E 1268124.8 ft
Consulting Firm: Pacific Groundwater Group
Logged by: Glen Wallace

Drilling Firm: Cascade Drilling
Drilling Method: Sonic
Well Tag ID: BJH-204
DTW: 9.52 ft bmp
MP Elevation: 16.52 ft
Datum: NAVD 88
Date: 11/7/16

Figure
Boring Log and As-Built MW-45A

Terminal 30
Well Replacement
JE1005.09

PGG

Depth (ft)

Graphic Log

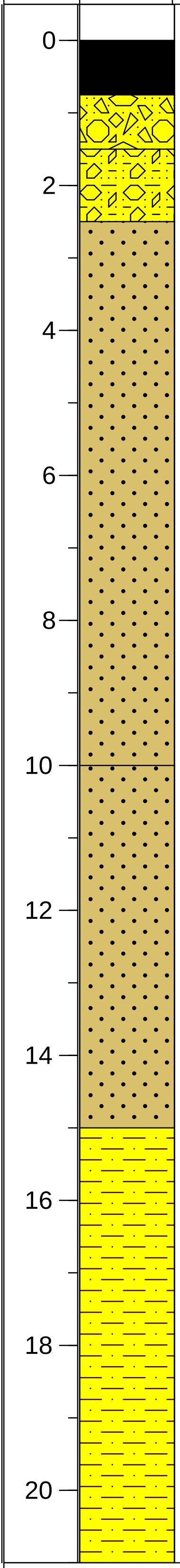
Samples

Sample ID

Type

Description

Well Construction



Continuous sonic cores advanced in 5-foot runs, emptied into core bags

Asphalt in 2-lifts

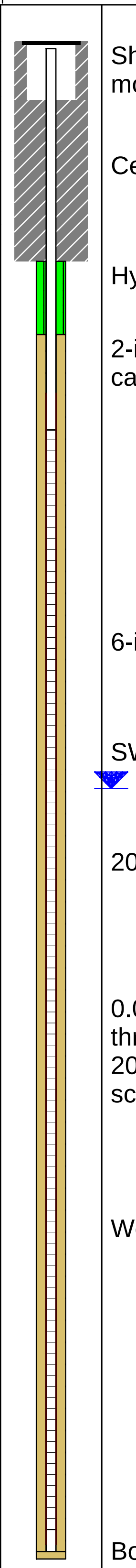
Packed angular GRAVEL fill

Brown, damp, gravelly SAND

Black, damp, fine gravelly SAND; trace woody debris; gravel is 1.5-inch minus, rounded; unit coarsens downward; no petroleum staining or odor noted

Dark gray, wet, fine silty SAND; very slight petroleum odor, with no visible staining

Gray, wet, sandy SILT with abundant wood; woody debris is up to 1-inch diameter branches interbedded with silty/sandy intervals; no petroleum staining or odor noted



Sherwood high-traffic flush-mount monument set in concrete

Cement

Hydrated bentonite seal

2-inch flush-thread stainless steel casing with o-rings at joints

6-inch borehole

SWL 10.19 ft below MP 11/4/16

20/40 Colorado Silica sand pack

0.010-slot, 2-inch diameter, flush-threaded stainless steel screen 5.3 to 20.3 feet bgs with 20/40 pre-pack screen

Well developed by surging and bailing

Bottom of hole at 21 ft; heave to 20.7

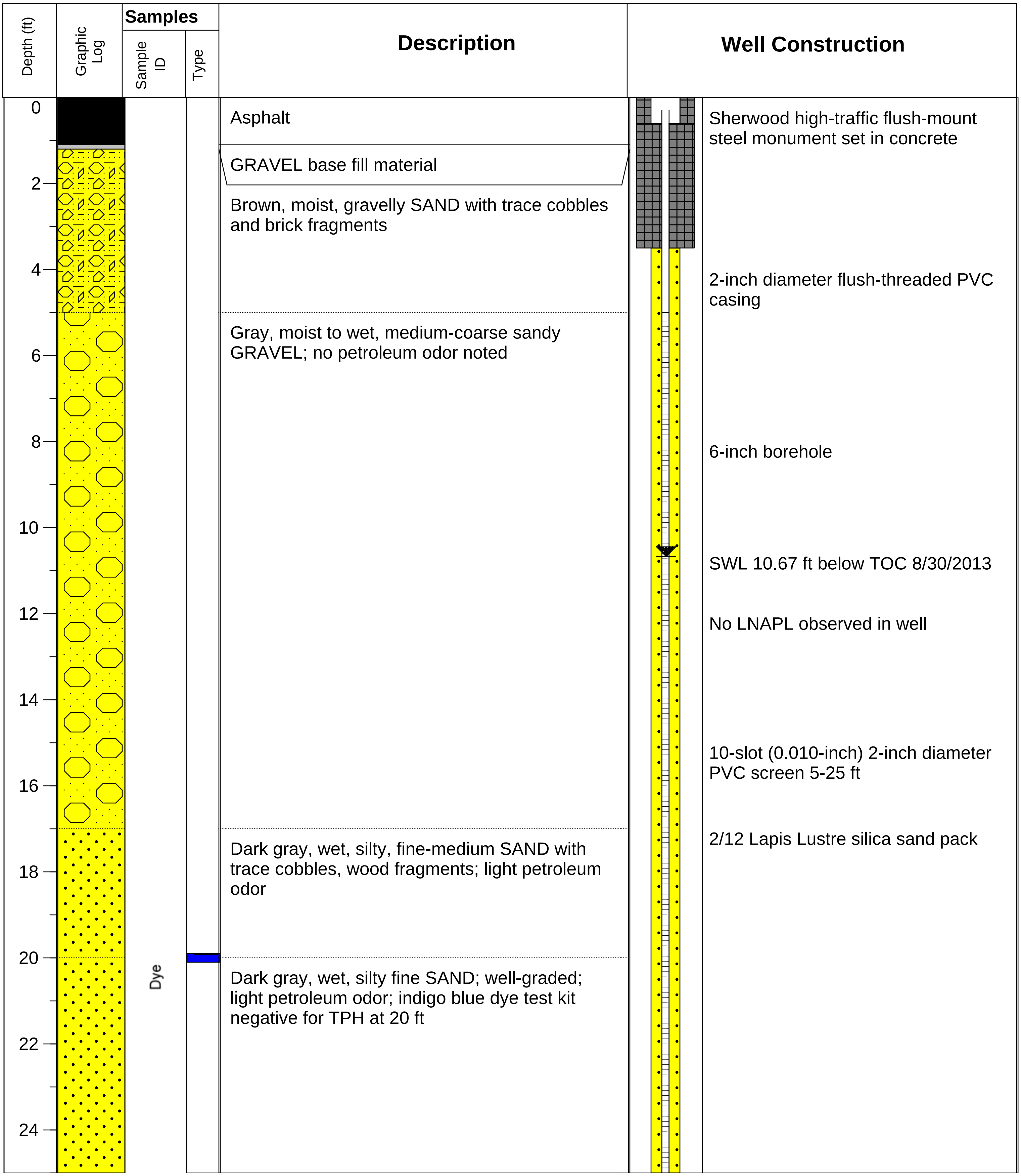
Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: T24N R04E S07; NE1/4
Horizontal Loc.: N 216602.9 ft, E 1268114.9 ft
Consulting Firm: Pacific Groundwater Group
Logged by: Glen Wallace

Drilling Firm: Cascade Drilling
Drilling Method: Sonic
Well Tag ID: BJH-205
DTW: 10.19 ft bmp
MP Elevation: 16.07 ft
Datum: NAVD 88
Date: 11/4/16

Figure
Boring Log and As-Built
MW-46B

Terminal 30
Well Replacement
JE1005.09

PgG



Description

Asphalt

GRAVEL base fill material

Brown, moist, gravelly SAND with trace cobbles and brick fragments

Gray, moist to wet, medium-coarse sandy GRAVEL; no petroleum odor noted

Dark gray, wet, silty, fine-medium SAND with trace cobbles, wood fragments; light petroleum odor

Dark gray, wet, silty fine SAND; well-graded; light petroleum odor; indigo blue dye test kit negative for TPH at 20 ft

Well Construction

Sherwood high-traffic flush-mount steel monument set in concrete

2-inch diameter flush-threaded PVC casing

6-inch borehole

SWL 10.67 ft below TOC 8/30/2013

No LNAPL observed in well

10-slot (0.010-inch) 2-inch diameter PVC screen 5-25 ft

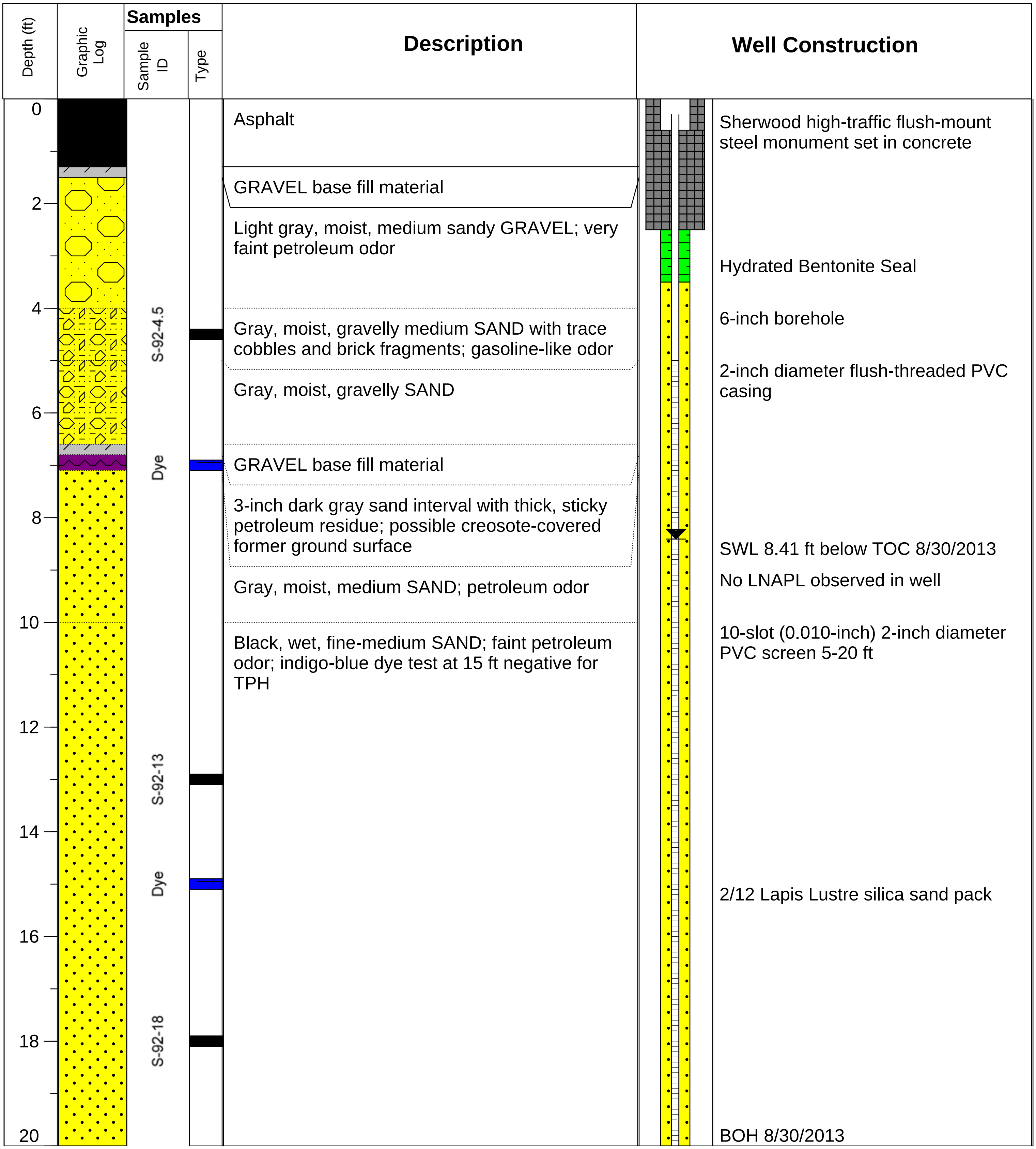
2/12 Lapis Lustre silica sand pack

Address: 1901 E Marginal Way
City, State: Seattle, WA
Tax Parcel ID: 7666207830
Location (TRS): T24N R04E S07; SW1/4 of NE1/4
Lat/Long: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Glen Wallace

Drilling Firm: Cascade Drilling
Drilling Method: Sonic
Ecology ID: BIC-765
DTW: 10.67
MP Elevation: Not Surveyed
V. Datum: Not Surveyed
Completed Date: 8/29/2013

Figure 2
MW-58A Boring Log and As-Built

Port of Seattle Terminal 30
Data Gaps
JE1005



Asphalt

GRAVEL base fill material

Light gray, moist, medium sandy GRAVEL; very faint petroleum odor

Gray, moist, gravelly medium SAND with trace cobbles and brick fragments; gasoline-like odor

Gray, moist, gravelly SAND

GRAVEL base fill material

3-inch dark gray sand interval with thick, sticky petroleum residue; possible creosote-covered former ground surface

Gray, moist, medium SAND; petroleum odor

Black, wet, fine-medium SAND; faint petroleum odor; indigo-blue dye test at 15 ft negative for TPH

Sherwood high-traffic flush-mount steel monument set in concrete

Hydrated Bentonite Seal

6-inch borehole

2-inch diameter flush-threaded PVC casing

SWL 8.41 ft below TOC 8/30/2013

No LNAPL observed in well

10-slot (0.010-inch) 2-inch diameter PVC screen 5-20 ft

2/12 Lapis Lustre silica sand pack

BOH 8/30/2013

Address: 1901 E Marginal Way
City, State: Seattle, WA
Tax Parcel ID: 7666207830
Location (TRS): T24N R04E S07; SW1/4 of NE1/4
Lat/Long: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Glen Wallace

Drilling Firm: Cascade Drilling
Drilling Method: Sonic
Ecology ID: BIC-766
DTW: 8.41
MP Elevation: Not Surveyed
V. Datum: Not Surveyed
Completed Date: 8/30/2013

Figure 3
MW-92 Boring Log and As-Built

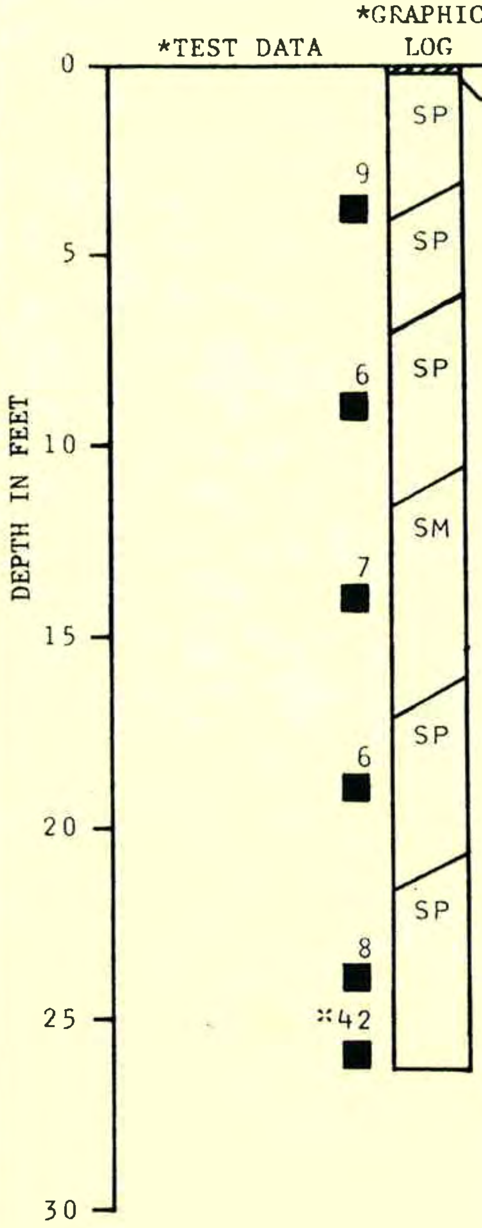
Port of Seattle Terminal 30
Data Gaps
JE1005

PgG

DRAFT

MONITOR WELL NO. 12

CASING RIM ELEVATION: 6.96 FEET



DESCRIPTION

ASPHALTIC CONCRETE AND GRAY CRUSHED ROCK

GRAY FINE TO MEDIUM SAND WITH A TRACE OF GRAVEL AND MODERATE PRODUCT ODOR (LOOSE, MOIST)

BLACK FINE SAND WITH A TRACE OF SILT AND MODERATE PRODUCT ODOR (LOOSE, MOIST)

BLACK FINE SAND WITH A TRACE OF SILT AND STRONG PRODUCT ODOR (VERY LOOSE, MOIST)

GRAY SILTY FINE SAND WITH LENSES OF SANDY SILT (LOOSE, WET)

BLACK FINE SAND (LOOSE, WET)

BLACK FINE TO MEDIUM SAND WITH A TRACE OF SHELL FRAGMENTS (LOOSE, WET)

BORING COMPLETED AT 26 FEET ON 3/6/84

4-INCH PVC MONITOR WELL INSTALLED TO A DEPTH OF 23 FEET. SLOTTED INTERVAL EXTENDS FROM 2½ TO 22½ FEET.

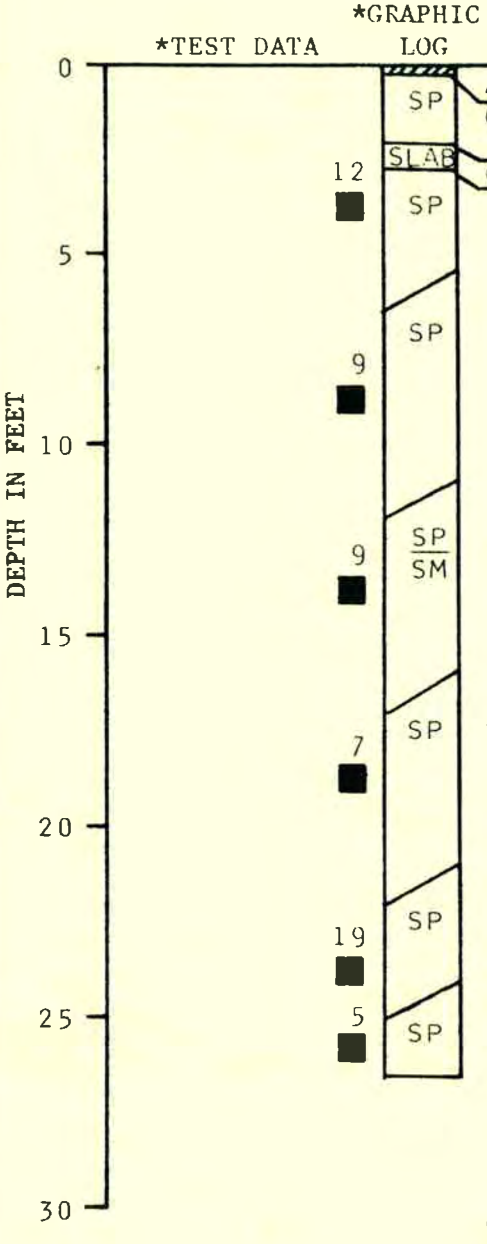
*BLOW COUNT NOT REPRESENTATIVE OF SOIL CONDITIONS DUE TO SAND HEAVING INTO AUGER

*SEE KEY FOR EXPLANATION OF SYMBOLS

GeoEngineers Inc. | LOG OF EXPLORATION

MONITOR WELL NO. 13

CASING RIM ELEVATION: 6.78 FEET



DESCRIPTION

ASPHALTIC CONCRETE AND CRUSHED ROCK

GRAY FINE TO MEDIUM SAND WITH A TRACE OF GRAVEL (LOOSE, MOIST)

CONCRETE SLAB

BLACK FINE SAND WITH A TRACE OF SILT INCLUSIONS AND RED BRICK FRAGMENTS AND MODERATE PRODUCT ODOR (LOOSE, MOIST)

BLACK FINE SAND AND STRONG PRODUCT ODOR (LOOSE, MOIST)

BLACK FINE SAND AND SILTY FINE SAND WITH A TRACE OF SILT INCLUSIONS (LOOSE, WET)

BLACK FINE TO MEDIUM SAND (LOOSE, WET)

BLACK FINE TO MEDIUM SAND WITH A TRACE OF SHELL FRAGMENTS (MEDIUM DENSE, WET)

BLACK FINE TO MEDIUM SAND WITH A TRACE OF SILT INCLUSIONS, SHELL FRAGMENTS AND ORGANIC MATTER (LOOSE, WET)

BORING COMPLETED AT 26½ FEET ON 3/7/84

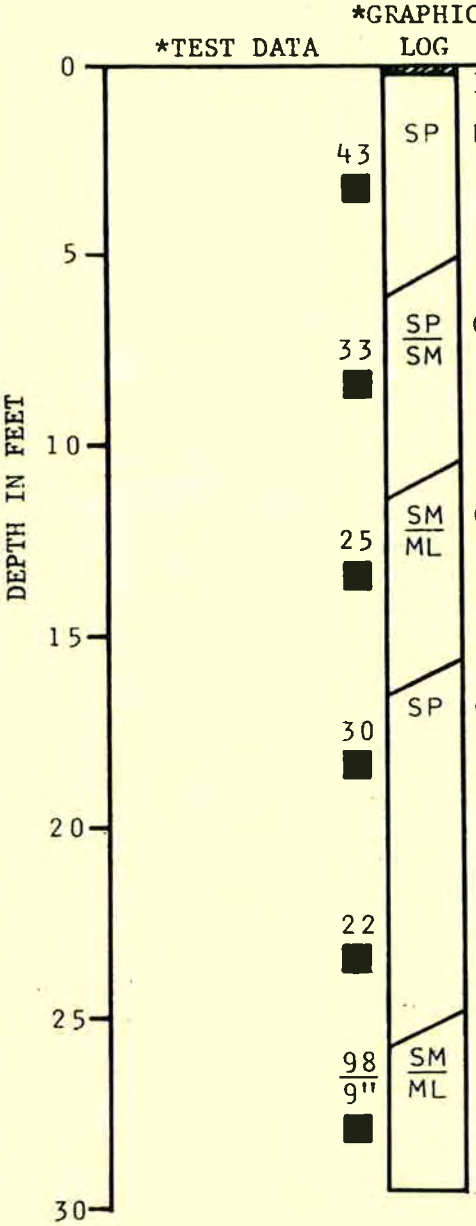
4-INCH PVC MONITOR WELL INSTALLED TO A DEPTH OF 26 FEET. SLOTTED INTERVAL EXTENDS FROM 5½ TO 25½ FEET.

*SEE KEY FOR EXPLANATION OF SYMBOLS

FIGURE 2

MONITOR WELL NO. 15

CASING RIM ELEVATION: 6.56 FEET



DESCRIPTION

3 INCHES ASPALTIC CONCRETE

BROWN FINE TO MEDIUM SAND WITH A TRACE OF SILT (MEDIUM DENSE, MOIST) (FILL)

GRAY FINE SAND WITH SOME SILT AND MODERATE PRODUCT ODOR (MEDIUM DENSE, MOIST)

STRONG PRODUCT ODOR AT 10 FEET

GRAY SILTY FINE TO MEDIUM SAND WITH GRAY SANDY SILT LAYERS (MEDIUM DENSE, WET)

GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT (MEDIUM DENSE, WET)

GRAY SILTY FINE TO MEDIUM SAND WITH GRAY SILT LAYERS (DENSE, WET)

BORING COMPLETED AT 28½ FEET ON 5/10/84

4-INCH PVC MONITOR WELL INSTALLED TO 25 FEET. SLOTTED INTERVAL EXTENDS FROM 5 TO 25 FEET.

*SEE KEY FOR EXPLANATION OF SYMBOLS

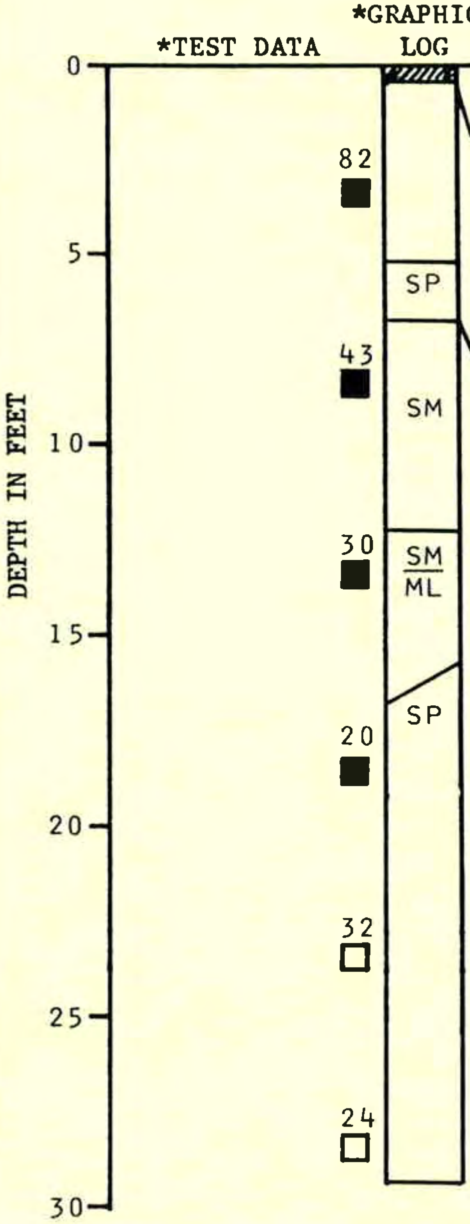
372-02 JHB:DA 5/18/84

GEI 41-81

GeoEngineers Inc.	LOG OF EXPLORATION

MONITOR WELL NO. 16

CASING RIM ELEVATION: 5.77 FEET



DESCRIPTION

2 INCHES ASPHALTIC CONCRETE

4 INCHES GRAY CRUSHED ROCK

GRAY FINE TO MEDIUM SAND WITH SOME SILT AND WOOD (MEDIUM DENSE, MOIST) (FILL)

MODERATE PRODUCT ODOR AT 4 FEET

DARK GRAY TO BLACK FINE TO MEDIUM SAND WITH A TRACE OF SILT AND MODERATE PRODUCT ODOR (MEDIUM DENSE, MOIST)

GRAY SILTY FINE SAND WITH MODERATE PRODUCT ODOR (MEDIUM DENSE, MOIST)

GRAY SILTY FINE TO MEDIUM SAND WITH A TRACE OF ORGANIC MATTER AND LAYERS OF GRAY SILT (MEDIUM DENSE, MOIST)

DARK GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT (LOOSE TO MEDIUM DENSE, WET)

GRADES WITH SHELL FRAGMENTS

BORING COMPLETED AT 28½ FEET ON 5/10/84

4-INCH PVC MONITOR WELL INSTALLED TO 24½ FEET. SLOTTED INTERVAL EXTENDS FROM 4½ TO 24½ FEET.

372-02 JHB:DA 5/18/84

GEI 41-81

*SEE KEY FOR EXPLANATION OF SYMBOLS

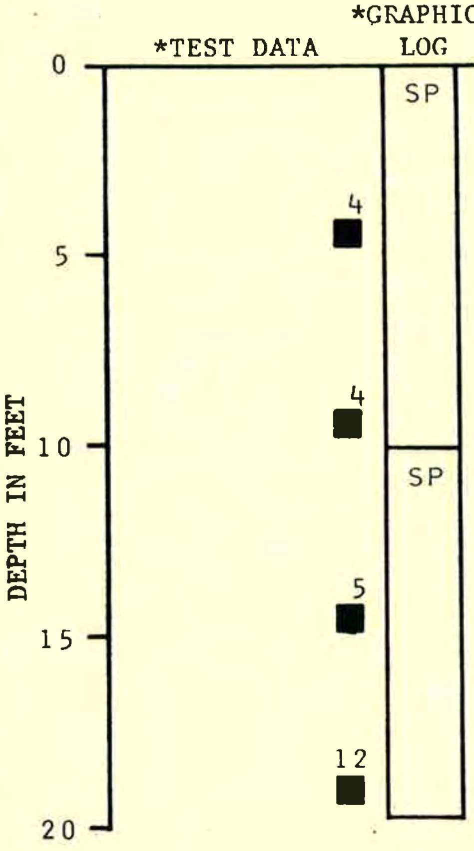
GeoEngineers Inc.

LOG OF EXPLORATION

MONITOR WELL NO. 17

CASING RIM ELEVATION: 3.96 FEET

DESCRIPTION



GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT (LOOSE, MOIST) (FILL)

STRONG PRODUCT ODOR AT 2 FEET

CHANGES TO WET AT 3 FEET

GRAY FINE SAND WITH A TRACE OF SILT AND OCCASIONAL SILT LENSES (LOOSE, WET)

BORING COMPLETED AT 19½ FEET ON 5/25/84

4-INCH PVC MONITOR WELL INSTALLED TO 17½ FEET. SLOTTED INTERVAL EXTENDS FROM 2½ TO 17½ FEET

*SEE KEY FOR EXPLANATION OF SYMBOLS

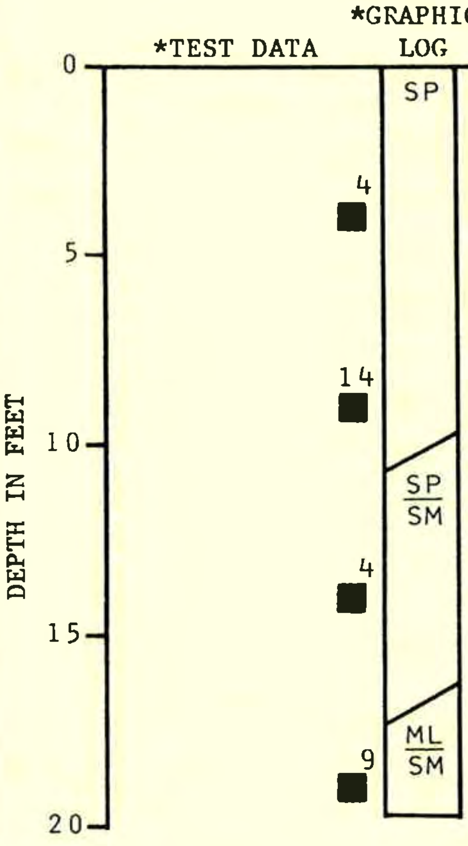
372-02 RAH:JHB:DA 5/30/84

EI 41-81

FIGURE 5

MONITOR WELL NO. 18

CASING RIM ELEVATION: 3.36 FEET



DESCRIPTION

GRAY TO BLACK FINE TO MEDIUM SAND WITH A TRACE OF SILT (LOOSE, MOIST)

STRONG PRODUCT ODOR AT 2 FEET

CHANGES TO WET AT 3 FEET

GRAY FINE TO MEDIUM SAND WITH SOME SILT (LOOSE, WET)

GRAY SANDY SILT AND SILTY FINE SAND (SOFT, WET)

BORING COMPLETED AT 19½ FEET ON 5/25/84

4-INCH PVC MONITOR WELL INSTALLED TO 17½ FEET. SLOTTED INTERVAL EXTEND FROM 2½ TO 17½ FEET

372-02 RAH:JHB:DA 5/30/84

CEI 41-81

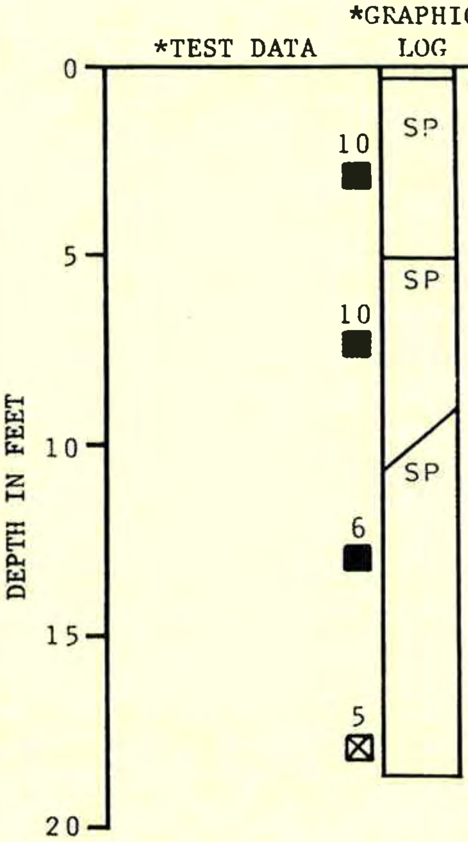
*SEE KEY FOR EXPLANATION OF SYMBOLS

GeoEngineers Inc. | LOG OF EXPLORATION

FIGURE 2

MONITOR WELL NO. 25

CASING RIM ELEVATION: 4.61 FEET



DESCRIPTION

ASPHALTIC CONCRETE

DARK BROWN GRAVELLY FINE TO MEDIUM SAND WITH OCCASIONAL RED BRICK FRAGMENTS AND A TRACE OF SILT (LOOSE, MOIST)

DARK BROWN TO BLACK FINE TO MEDIUM SAND WITH A TRACE OF SILT AND MODERATE PRODUCT ODOR (MEDIUM DENSE TO MOIST)

GRAY TO BLACK FINE TO MEDIUM SAND WITH SOME SILT AND SLIGHT PRODUCT ODOR (LOOSE, WET)

GRADES TO NO PRODUCT ODOR

BORING COMPLETED AT 18.5 FEET ON 7/6/84

2 INCH PVC MONITOR WELL INSTALLED TO 17 FEET
SLOTTED INTERVAL EXTENDS FROM 2 TO 18.5 FEET

372-02 JHB:PM 19/84

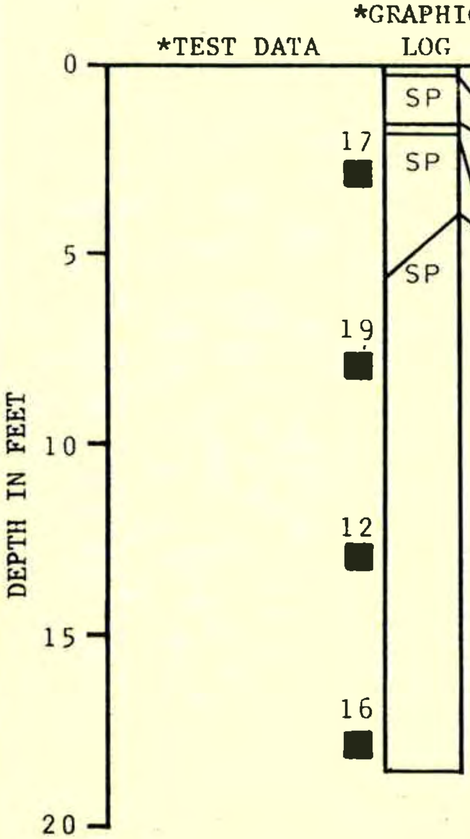
GeoEngineers Inc.

LOG OF EXPLORATION

FIGURE 3

MONITOR WELL NO. 26

CASING RIM ELEVATION: 5.89 FEET



DESCRIPTION

ASPHALTIC CONCRETE

GRAY GRAVELLY FINE TO MEDIUM SAND WITH SOME SILT (LOOSE, MOIST)

GRAY SILT (STIFF, MOIST) (ML)

GRAY FINE TO MEDIUM SAND WITH SILT INCLUSIONS (LOOSE, MOIST)

GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT AND MODERATE PRODUCT ODOR (LOOSE, MOIST)

GRADES TO DARK GRAY AND STRONG PRODUCT ODOR

GRADES TO NO PRODUCT ODOR

BORING COMPLETED AT 18.5 FEET ON 7/6/84

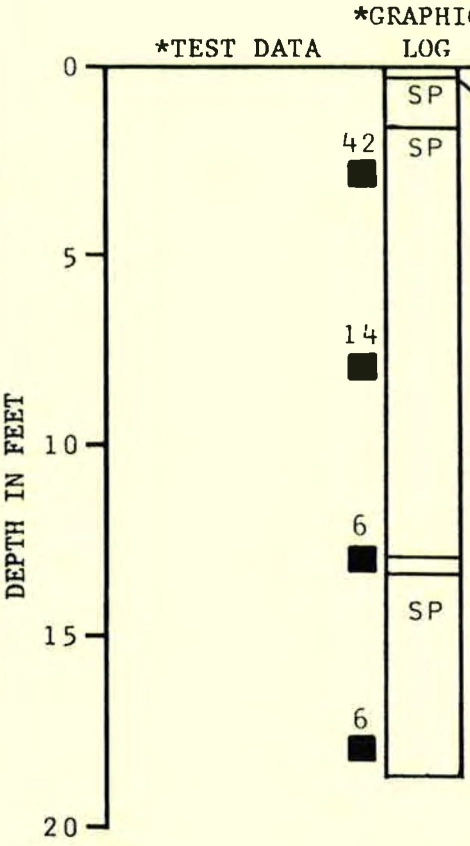
2 INCH DIAMETER PVC MONITOR WELL INSTALLED TO A DEPTH OF 16.5 FEET. SLOTTED INTERVAL EXTENDS FROM 1.5 TO 16 FEET

372-02 JHB:PM 7/19/84

GeoEngineers Inc. | LOG OF EXPLORATION

MONITOR WELL NO. 27

CASING RIM ELEVATION: 5.62 FEET



DESCRIPTION

ASPHALTIC CONCRETE

GRAY GRAVELLY FINE TO MEDIUM SAND (LOOSE, MOIST)

GRAY FINE TO MEDIUM SAND WITH SOME SILT (LOOSE, MOIST)

MODERATE PRODUCT ODOR

BLACK SILT (SOFT, WET) (ML)

DARK GRAY FINT TO MEDIUM SAND WITH A TRACE OF SILT (LOOSE, WET)

BORING COMPLETED AT 18.5 FEET ON 7/6/84

2 INCH DIAMETER PVC MONITOR WELL INSTALLED TO A DEPTH OF 17 FEET. SLOTTED INTERVAL EXTENDS FROM 2 TO 16.5 FEET

372-02 JHB:PM 7/ /84

GeoEngineers Inc. | LOG OF EXPLORATION

FIGURE 10

BORING LOG AND SAMPLE DATA KEY

DRIVEN SAMPLES

MOISTURE CONTENT 11.2%

DRY DENSITY IN PCF 111

28 — BLOWS REQUIRED TO DRIVE SAMPLER ONE FOOT OR INDICATED PENETRATION USING 140 POUND HAMMER FALLING 30 INCHES

"P" INDICATES SAMPLER PUSHED WITH WEIGHT OF HAMMER

■ INDICATES LOCATION OF UNDISTURBED SAMPLE

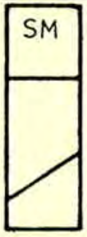
☒ INDICATES LOCATION OF DISTURBED SAMPLE

☐ INDICATES LOCATION OF SAMPLING ATTEMPT WITH NO RECOVERY

OTHER TYPES OF SAMPLES

I INDICATES LOCATION OF THIN WALL, PITCHER, OR OTHER TYPES OF SAMPLES (SEE TEXT)

GRAPHIC LOG



LETTER SYMBOL SOIL TYPE

DISTINCT CONTACT BETWEEN SOIL STRATA

GRADUAL CHANGE BETWEEN SOIL STRATA

BOTTOM OF BORING

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			LETTER SYMBOL	DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-SILT MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS, AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS INDICATE BORDERLINE SOIL CLASSIFICATION

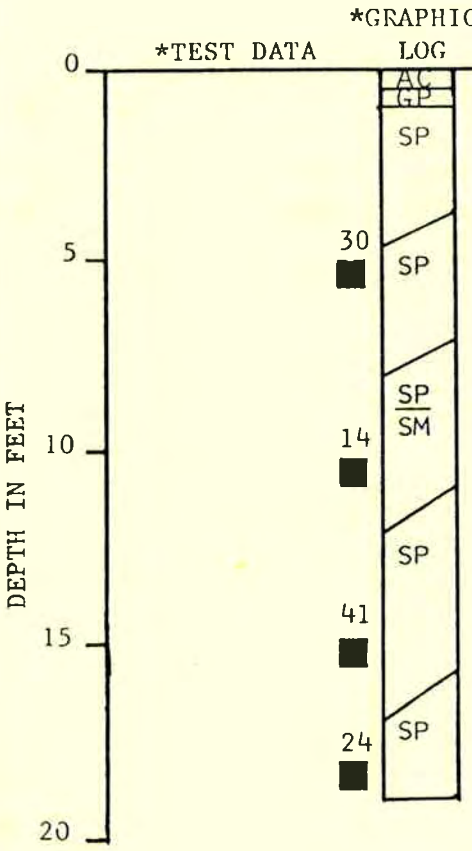
GeoEngineers Inc.

UNIFIED SOIL CLASSIFICATION SYSTEM AND KEY TO SAMPLE DATA

GEI 15-81 (REVISED 3-83)

FIGURE 11

MONITOR WELL NO. 44



DESCRIPTION

0-4" ASPHALTIC CONCRETE

BROWN SANDY FINE GRAVEL (MEDIUM DENSE, MOIST) (FILL)

BROWN FINE TO MEDIUM SAND WITH A TRACE OF GRAVEL (MEDIUM DENSE, MOIST) (FILL)

GRAY FINE TO MEDIUM SAND WITH A TRACE OF GRAVEL AND SILT AND SLIGHT PRODUCT ODOR (MEDIUM DENSE, MOIST) GRAVEL LENS AT 6½ FEET (FILL)

GRAY FINE TO MEDIUM SAND WITH SOME SILT (LOOSE, MOIST) (FILL)

DARK GRAY FINE TO MEDIUM SAND WITH A TRACE OF ORGANIC MATTER AND SILT (MEDIUM DENSE, WET)

DARK GRAY FINE SAND WITH A TRACE OF SILT AND LENSES OF SILTY FINE SAND (LOOSE TO MEDIUM DENSE, WET)

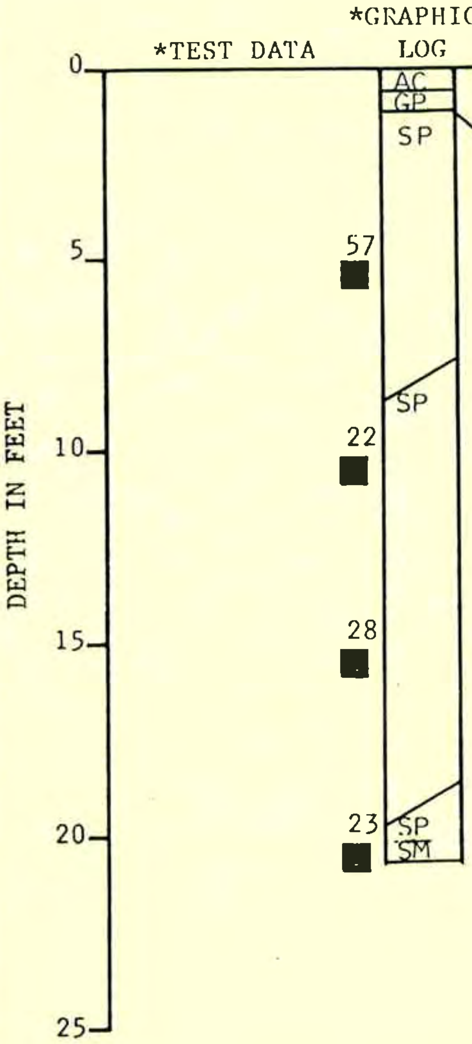
BORING COMPLETED AT 19 FEET ON 5/21/85

TWO INCH PVC MONITOR WELL INSTALLED TO A DEPTH OF 18 FEET, SLOTTED INTERVAL EXTENDS FROM 8.5 TO 17.5 FEET. STEEL MONUMENT AND CEMENT SURFACE SEAL INSTALLED.

*SEE KEY FOR EXPLANATION OF SYMBOLS

GeoEngineers Inc. LOG OF EXPLORATION

MONITOR WELL NO. 45



DESCRIPTION

0-4" ASPHALTIC CONCRETE

GRAY FINE GRAVEL WITH SAND (MEDIUM DENSE, MOIST) (FILL)

BROWN FINE TO MEDIUM SAND WITH A TRACE OF GRAVEL AND SILT (MEDIUM DENSE, MOIST) (FILL)

GRAVEL AND COBBLE LENS AT 8½ FEET

DARK GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT AND SHELLS (LOOSE, MOIST)

DARK GRAY FINE TO MEDIUM SAND WITH LENSES OF SILTY FINE SAND (LOOSE, WET)

BORING COMPLETED AT 20.5 FEET ON 5/21/85

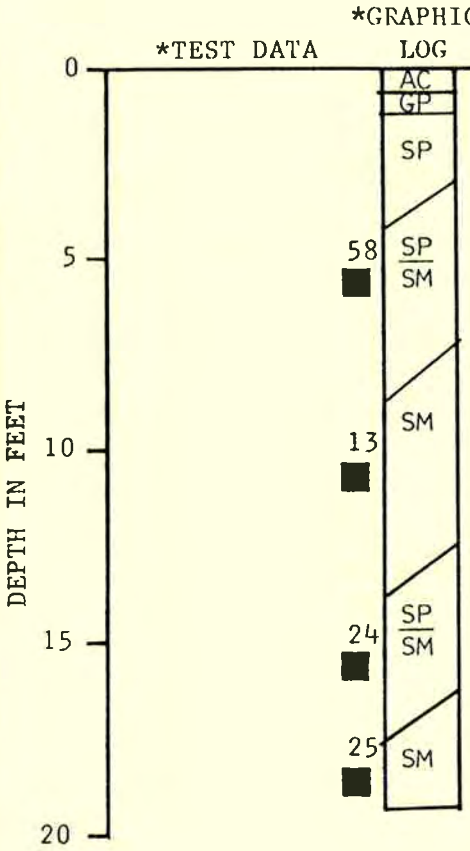
TWO INCH PVC MONITOR WELL INSTALLED TO A DEPTH OF 19.5 FEET, SLOTTED INTERVAL EXTENDS FROM 10 TO 19 FEET. STEEL MONUMENT AND CEMENT SURFACE SEAL INSTALLED.

*SEE KEY FOR EXPLANATION OF SYMBOLS

372-15 JHB:PC 5/23/85

GE 41-81

MONITOR WELL NO. 46



DESCRIPTION

0-4" ASPHALTIC CONCRETE

BROWN SANDY FINE GRAVEL (MEDIUM DENSE, MOIST) (FILL)

BROWN FINE TO MEDIUM SAND WITH A TRACE OF GRAVEL (MEDIUM DENSE, MOIST) (FILL)

BROWN FINE TO MEDIUM SAND WITH SOME SILT AND GRAVEL (MEDIUM DENSE, MOIST) (FILL)

GRAVEL AND COBBLE LENS AT 7 FEET

GRAY SILTY FINE SAND WITH SOME ORGANIC MATTER (LOOSE, MOIST TO WET)

GRAY FINE TO MEDIUM SAND WITH SOME SILT (LOOSE, WET)

GRAY SILTY FINE SAND WITH A TRACE OF ORGANIC MATTER (LOOSE, WET)

BORING COMPLETED AT 19 FEET ON 5/21/85

TWO INCH PVC MONITOR WELL INSTALLED TO A DEPTH OF 18 FEET, SLOTTED INTERVAL EXTENDS FROM 8.5 TO 17.5 FEET. STEEL MONUMENT AND CEMENT SURFACE SEAL INSTALLED.

*SEE KEY FOR EXPLANATION OF SYMBOLS

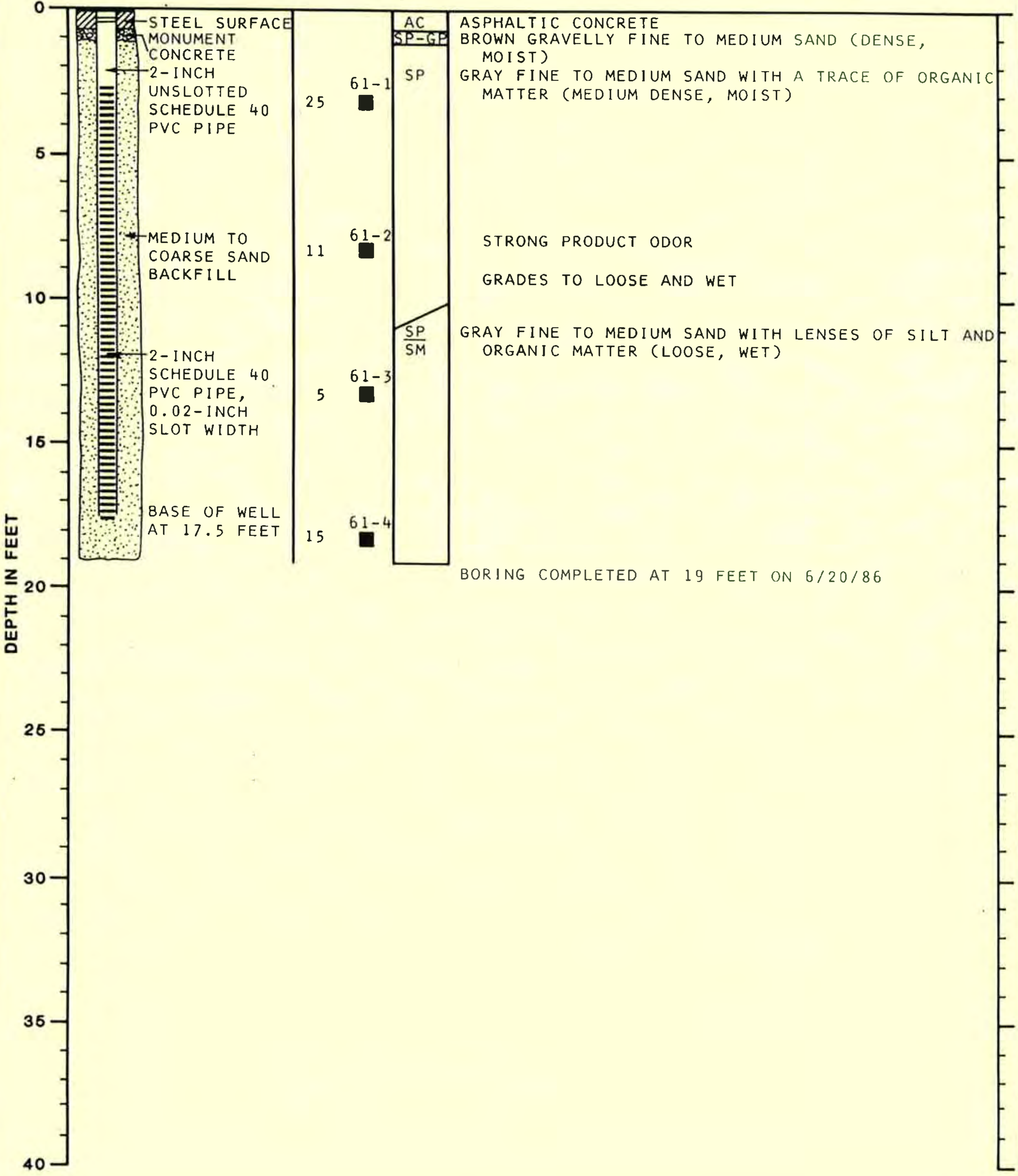
372-15 JHB:PC 5/23/85

GEI 41-81

MONITOR WELL NO. 61

WELL SCHEMATIC
Casing Elevation: 18.68
Casing Stickup: -0.1

DESCRIPTION
Surface Elevation: 18.8 Feet



Blow-Count	Samples
25	61-1 ■
11	61-2 ■
5	61-3 ■
15	61-4 ■

Group Symbol	Description
AC	ASPHALTIC CONCRETE
SP-GP	BROWN GRAVELLY FINE TO MEDIUM SAND (DENSE, MOIST)
SP	GRAY FINE TO MEDIUM SAND WITH A TRACE OF ORGANIC MATTER (MEDIUM DENSE, MOIST)
	STRONG PRODUCT ODOR
	GRADES TO LOOSE AND WET
SP/SM	GRAY FINE TO MEDIUM SAND WITH LENSES OF SILT AND ORGANIC MATTER (LOOSE, WET)

BORING COMPLETED AT 19 FEET ON 6/20/86

Note: See Figure 8 for Explanation of Symbols

303-19 JHB:DMP:EL 7/7/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

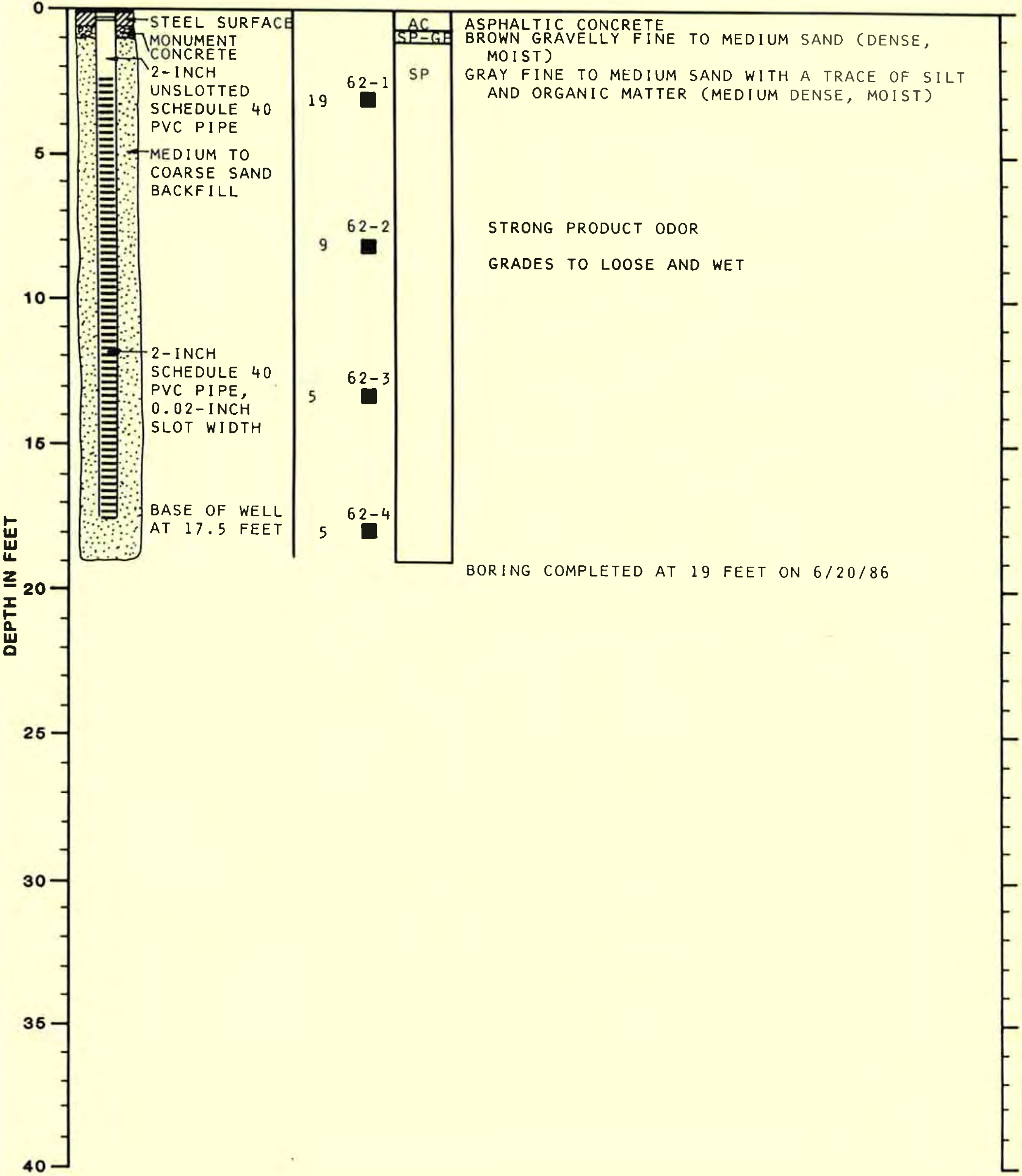
FIGURE 9

MONITOR WELL NO. 62

WELL SCHEMATIC
Casing Elevation: 18.86
Casing Stickup: -0.1

Blow-Count **Samples** **Group Symbol**

DESCRIPTION
Surface Elevation: 19.0 Feet



ASPHALTIC CONCRETE

BROWN GRAVELLY FINE TO MEDIUM SAND (DENSE, MOIST)

GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT AND ORGANIC MATTER (MEDIUM DENSE, MOIST)

STRONG PRODUCT ODOR

GRADES TO LOOSE AND WET

BORING COMPLETED AT 19 FEET ON 6/20/86

Note: See Figure 8 for Explanation of Symbols

303-19 JHB:DMP:EL 7/7/86

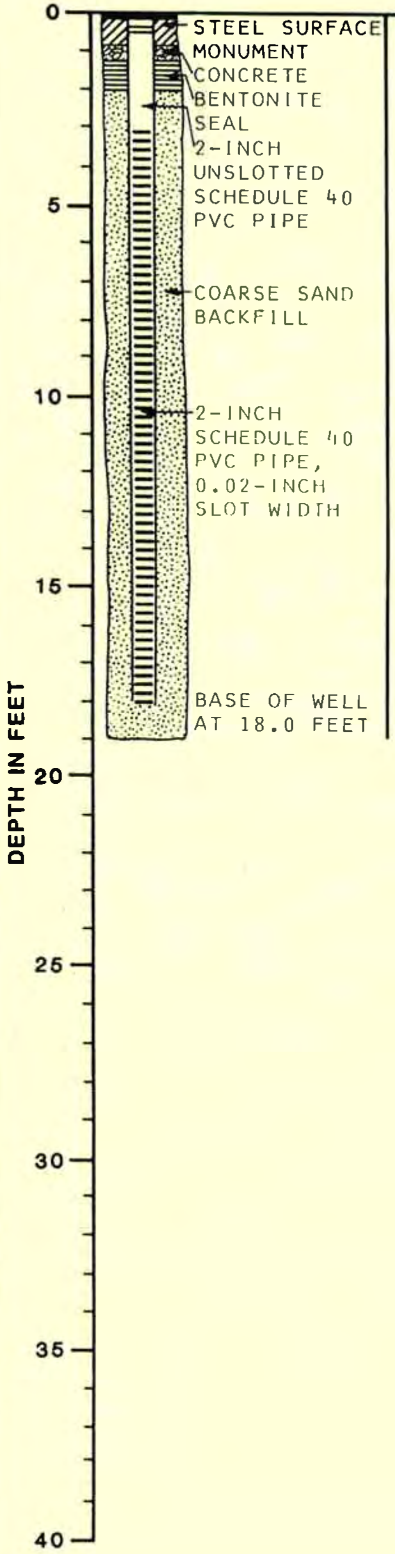
GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE 10

MONITOR WELL NO. 63

WELL SCHEMATIC
Casing Elevation: 18.70
Casing Stickup: -0.33



DESCRIPTION
Surface Elevation: 19.03

Blow-Count	Samples	Group Symbol	Description
		▨	ASPHALTIC CONCRETE PAVEMENT
		SM	GRAY SILTY FINE TO COARSE SAND WITH GRAVEL (MEDIUM DENSE, MOIST) (FILL)
17	■		GRADES TO DARK BROWN
		SP	DARK BROWN FINE TO MEDIUM SAND WITH A TRACE OF SILT (MEDIUM DENSE, MOIST) (FILL)
20	■		
6	■		GRADES TO LOOSE AND WET WITH A TRACE OF ORGANIC MATTER AT 13 FEET
9	■	SP/ML	DARK GRAY FINE TO MEDIUM SAND WITH LENSES OF GRAY SANDY SILT AND A TRACE OF ORGANIC MATTER (LOOSE, WET)

BORING COMPLETED AT 19 FEET ON OCTOBER 6, 1986

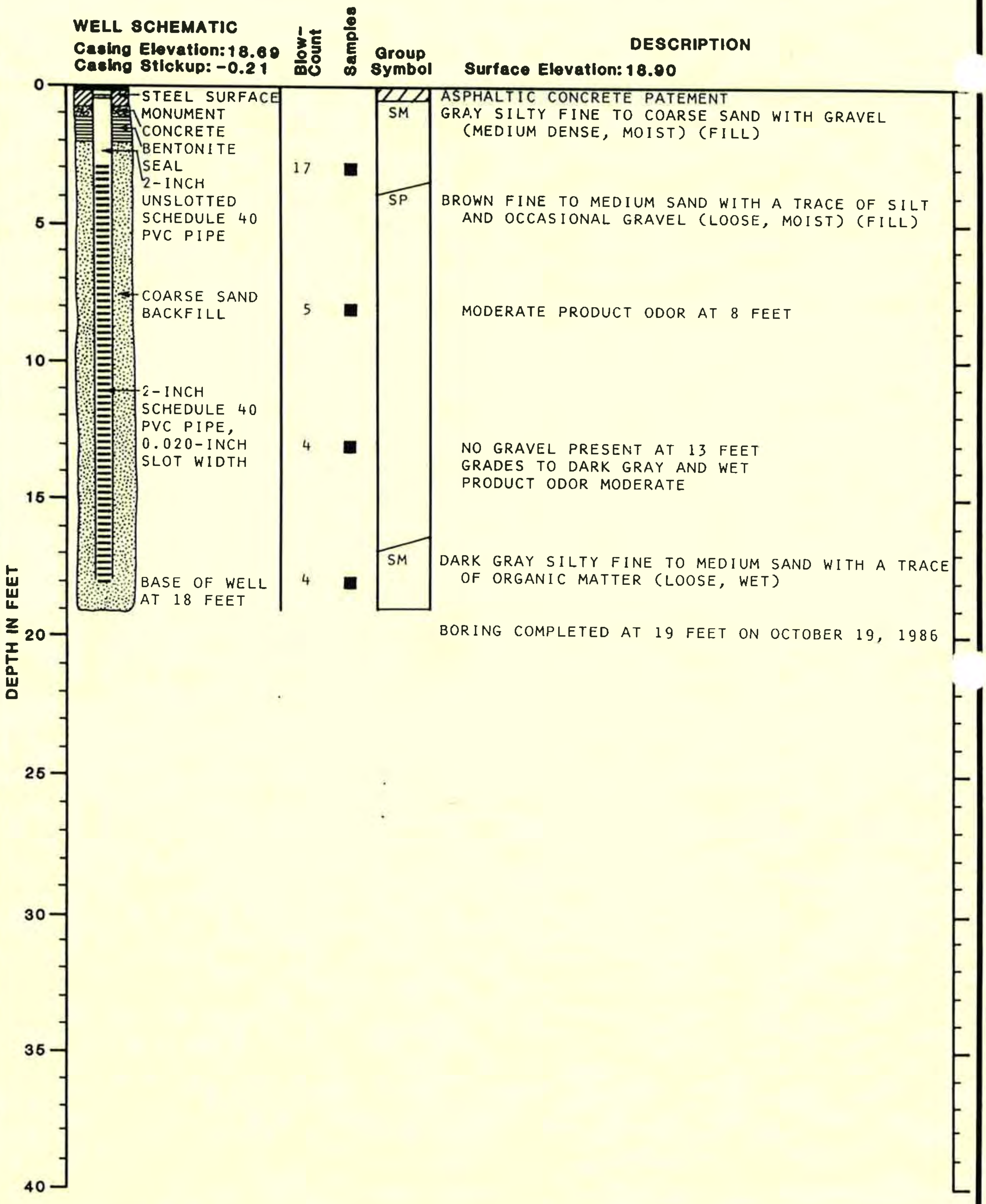
303-19 JAM:EL 11/13/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE 15

MONITOR WELL NO.64



ASPHALTIC CONCRETE PATEMENT

GRAY SILTY FINE TO COARSE SAND WITH GRAVEL (MEDIUM DENSE, MOIST) (FILL)

BROWN FINE TO MEDIUM SAND WITH A TRACE OF SILT AND OCCASIONAL GRAVEL (LOOSE, MOIST) (FILL)

MODERATE PRODUCT ODOR AT 8 FEET

NO GRAVEL PRESENT AT 13 FEET
GRADES TO DARK GRAY AND WET
PRODUCT ODOR MODERATE

DARK GRAY SILTY FINE TO MEDIUM SAND WITH A TRACE OF ORGANIC MATTER (LOOSE, WET)

BORING COMPLETED AT 19 FEET ON OCTOBER 19, 1986

303-19 JAM:EL 11/13/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE 16

DRAFT

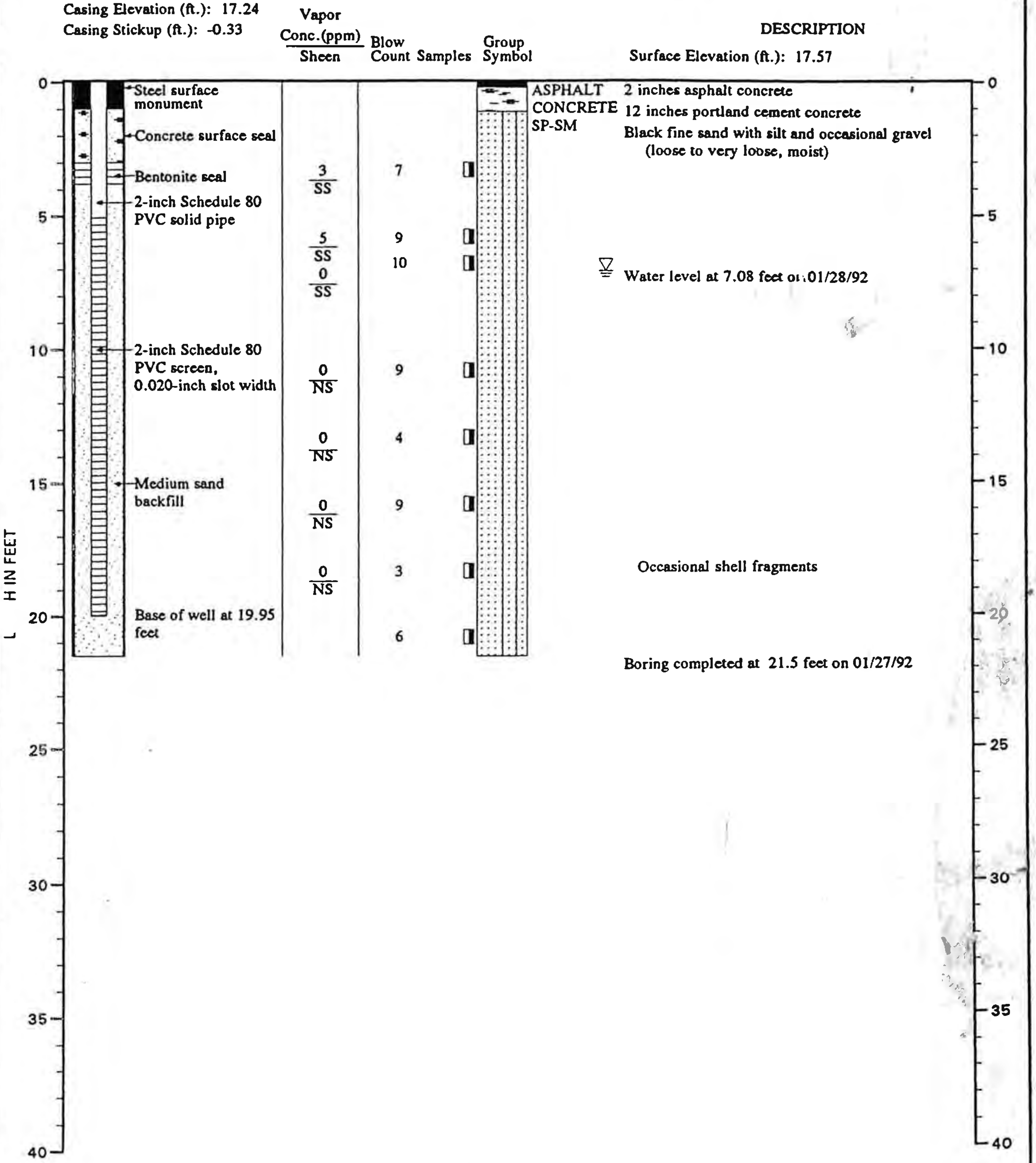
MONITORING WELL MW-73

WELL SCHEMATIC

Casing Elevation (ft.): 17.24
Casing Stickup (ft.): -0.33

DESCRIPTION

Surface Elevation (ft.): 17.57



2 inches asphalt concrete

12 inches portland cement concrete

Black fine sand with silt and occasional gravel (loose to very loose, moist)

Water level at 7.08 feet on 01/28/92

Occasional shell fragments

Boring completed at 21.5 feet on 01/27/92

Note: See Figure A- 2 for explanation of symbols

:LJB:WAP:CMS 4/7/98

·037-R14 Tak10.1

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-3

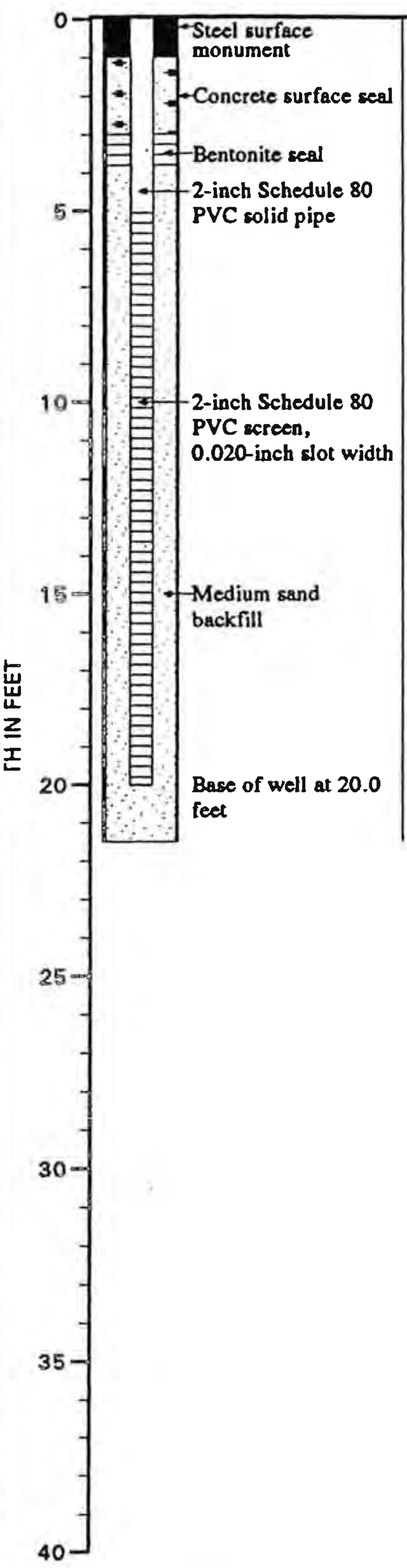
DRAFT

MONITORING WELL MW-74

WELL SCHEMATIC

Casing Elevation (ft.): 17.85
Casing Stickup (ft.): -0.28

Surface Elevation (ft.): 18.13



Vapor Conc.(ppm) / Sheen	Blow Count	Samples	Group Symbol	DESCRIPTION
			ASPHALT	16 inches asphalt concrete
			SM	Gray silty fine sand with gravel (very loose, moist)
0 / NS	3	◨		
			ML	Gray fine sandy silt (medium stiff, moist)
0 / NS	7	◨		
			SP	Gray fine sand (very loose to loose, wet)
				▽ Water level at 7.40 feet on 01/28/92
40 / HS	3	◨		Interbedded with thin layer of gray silt
70 / HS	2	CA ◨		
60 / MS	8	◨		
50 / SS	8	◨		Occasional shell fragments
190 / SS	3	◨		
15 / NS	12	◨		
				Boring completed at 21.5 feet on 01/27/92

Note: See Figure A- 2 for explanation of symbols

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-4

DRAFT

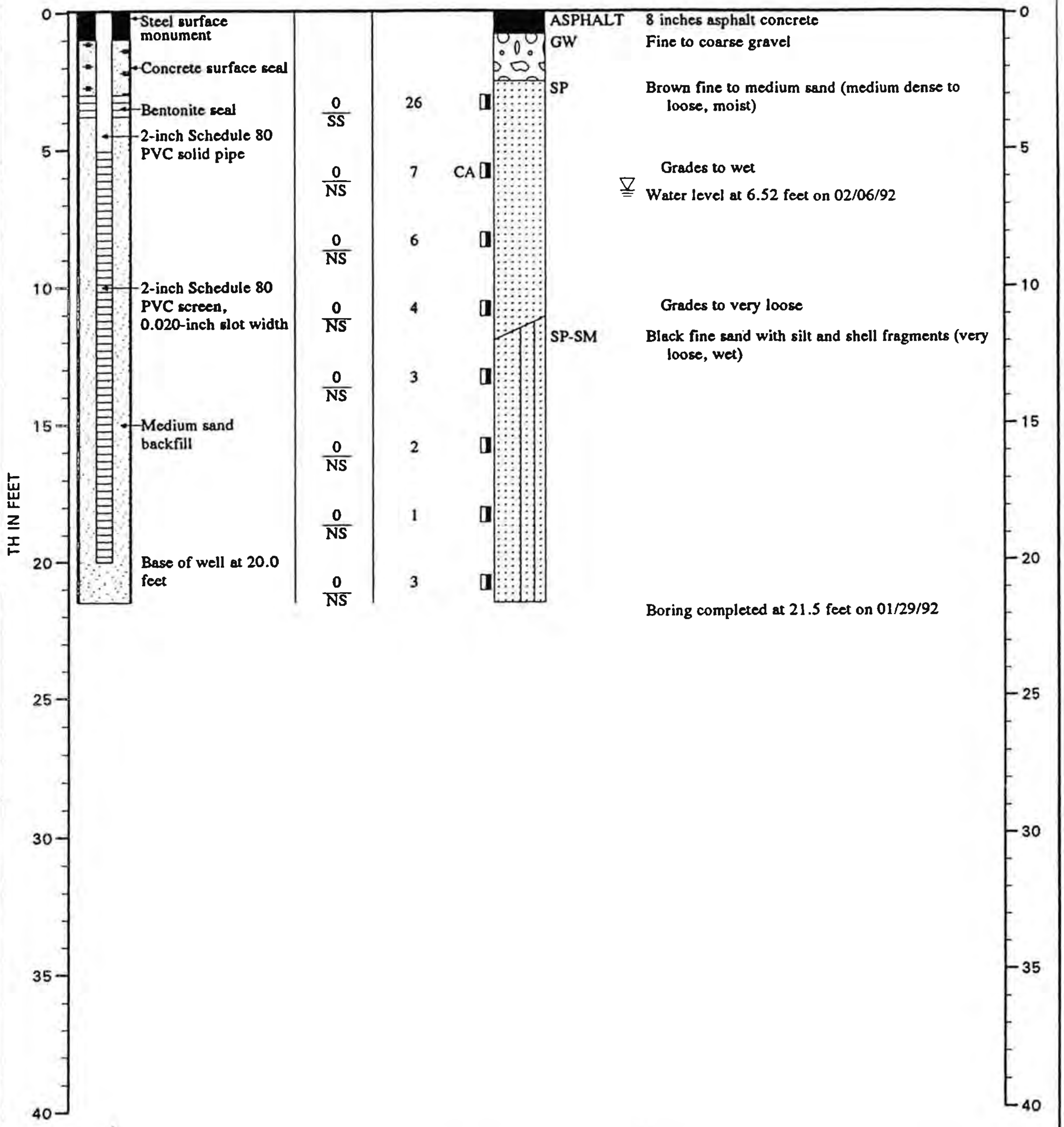
MONITORING WELL MW-75

WELL SCHEMATIC

Casing Elevation (ft.): 18.32
Casing Stickup (ft.): -0.30

DESCRIPTION

Surface Elevation (ft.): 18.62



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
0 / SS	26	▯
0 / NS	7	CA ▯
0 / NS	6	▯
0 / NS	4	▯
0 / NS	3	▯
0 / NS	2	▯
0 / NS	1	▯
0 / NS	3	▯

Group Symbol	Description
ASPHALT	8 inches asphalt concrete
GW	Fine to coarse gravel
SP	Brown fine to medium sand (medium dense to loose, moist)
	Grades to wet
	Water level at 6.52 feet on 02/06/92
	Grades to very loose
SP-SM	Black fine sand with silt and shell fragments (very loose, wet)
	Boring completed at 21.5 feet on 01/29/92

Note: See Figure A- 2 for explanation of symbols

)3-037-R14 Tsk10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-5

DRAFT

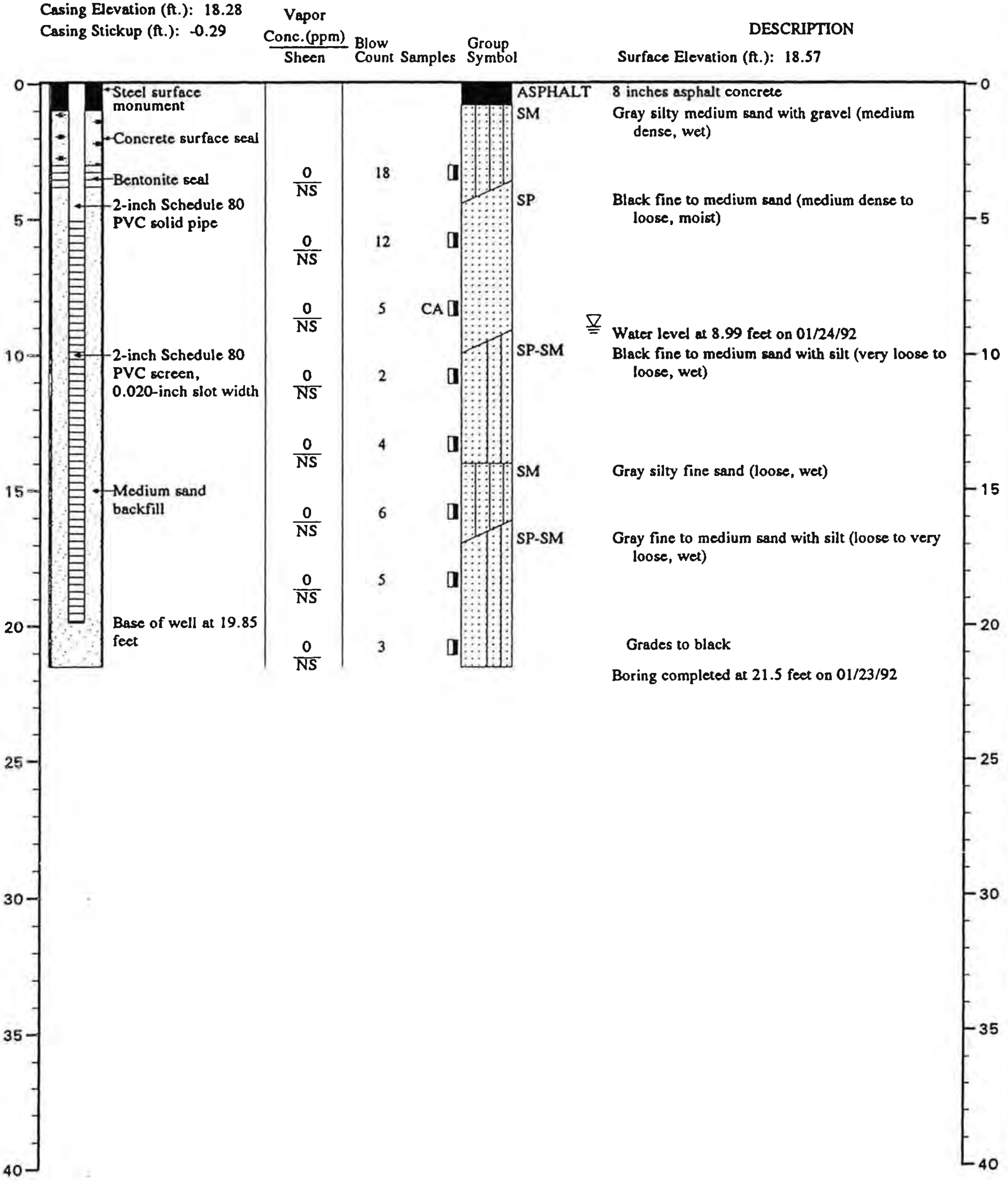
MONITORING WELL MW-76

WELL SCHEMATIC

Casing Elevation (ft.): 18.28
Casing Stickup (ft.): -0.29

DESCRIPTION

Surface Elevation (ft.): 18.57



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
0 / NS	18	▯
0 / NS	12	▯
0 / NS	5	CA ▯
0 / NS	2	▯
0 / NS	4	▯
0 / NS	6	▯
0 / NS	5	▯
0 / NS	3	▯

Group Symbol	Description
ASPHALT	8 inches asphalt concrete
SM	Gray silty medium sand with gravel (medium dense, wet)
SP	Black fine to medium sand (medium dense to loose, moist)
	⊽ Water level at 8.99 feet on 01/24/92
SP-SM	Black fine to medium sand with silt (very loose to loose, wet)
SM	Gray silty fine sand (loose, wet)
SP-SM	Gray fine to medium sand with silt (loose to very loose, wet)
	Grades to black
	Boring completed at 21.5 feet on 01/23/92

Note: See Figure A- 2 for explanation of symbols

3-037-R14 Tsk10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-6

DRAFT

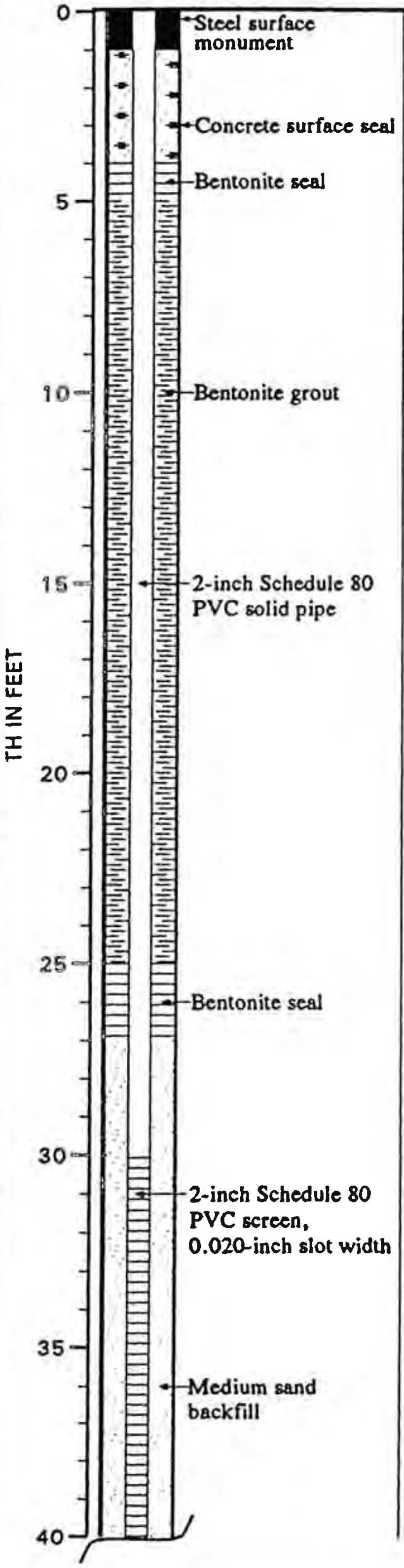
MONITORING WELL MW-77

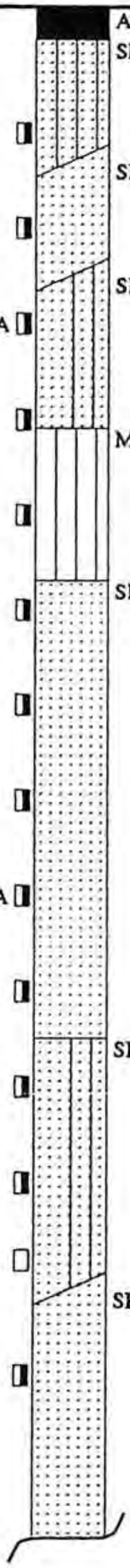
WELL SCHEMATIC

Casing Elevation (ft.): 18.47
Casing Stickup (ft.): -0.35

DESCRIPTION

Surface Elevation (ft.): 18.82





Vapor Conc.(ppm) Sheen	Blow Count	Samples	Group Symbol	Description
			ASPHALT	7.5 inches asphalt concrete
			SM	Black silty fine to medium sand (medium dense, moist)
130 SS	23	◧		
			SP	Black fine sand and a trace of silt (loose, moist)
448 HS	7	◧		
			SP-SM	Black fine sand with silt (loose, wet)
1,012 HS	6	CA ◧		⊻ Water level at 8.46 feet on 01/24/92
1,389 HS	3	◧		
			ML	Black silt with fine sand (soft, wet)
209 MS	4	◧		Grades to gray silt
			SP	Black fine sand and a trace of silt (loose to medium dense, wet)
450 HS	5	◧		
250 MS	9	◧		
142 MS	11	◧		
226 HS	9	CA ◧		
56 HS	13	◧		
			SP-SM	Black fine sand with silt (loose to medium dense, wet)
32 MS	8	◧		
48 SS	14	◧		
		☐		
			SP	Black fine sand (dense, wet)
35 SS	34	◧		

0 5 10 15 20 25 30 35 40

Note: See Figure A- 2 for explanation of symbols

:LJB:WAP:CMS 4/7/95

'3-037-R14 Tsk10.1

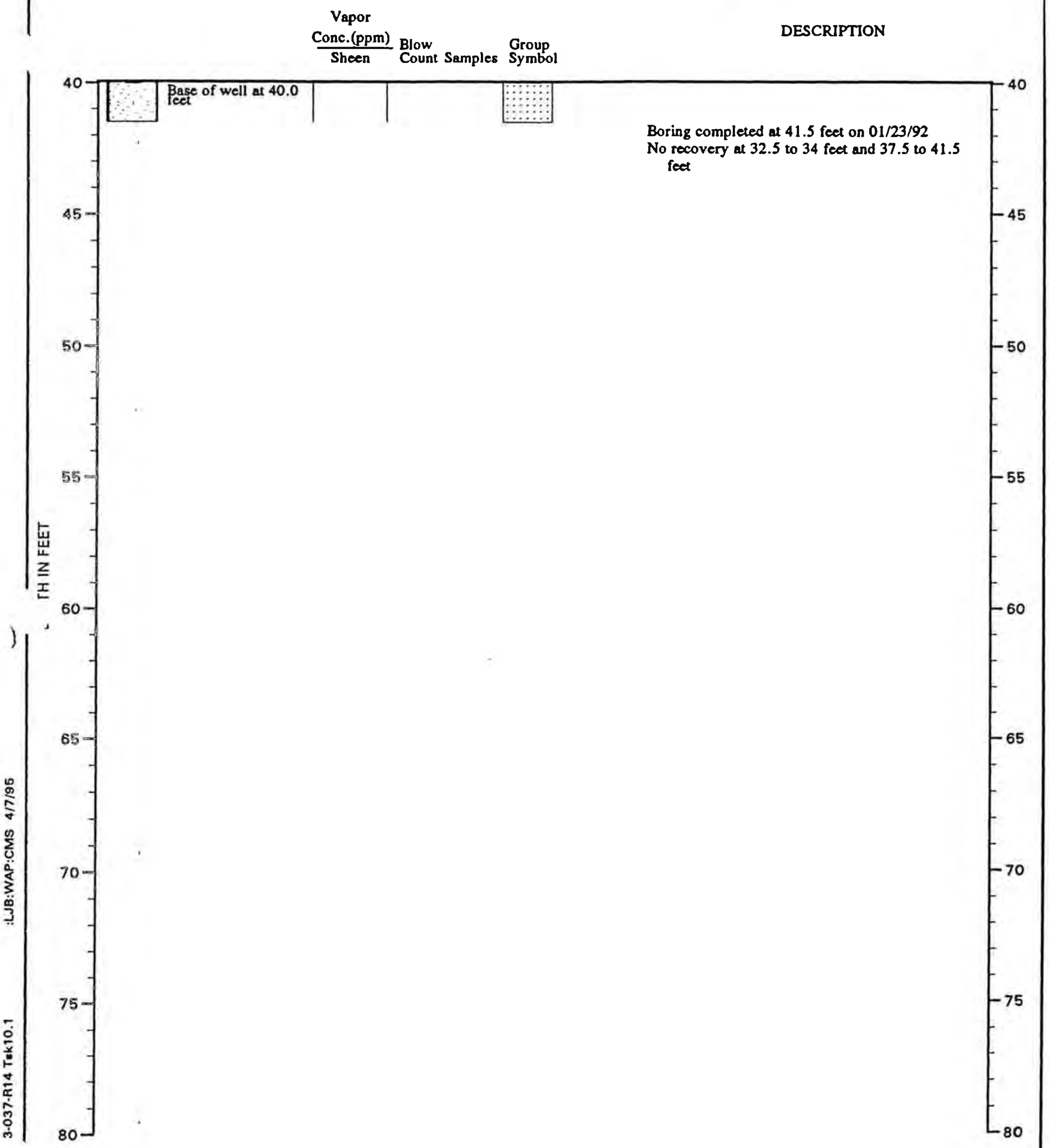
GeoEngineers

LOG OF MONITORING WELL

FIGURE A-7

DRAFT

MONITORING WELL MW-77
(Continued)



Boring completed at 41.5 feet on 01/23/92
No recovery at 32.5 to 34 feet and 37.5 to 41.5 feet

Note: See Figure A- 2 for explanation of symbols

3-037-R14 Tsk10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

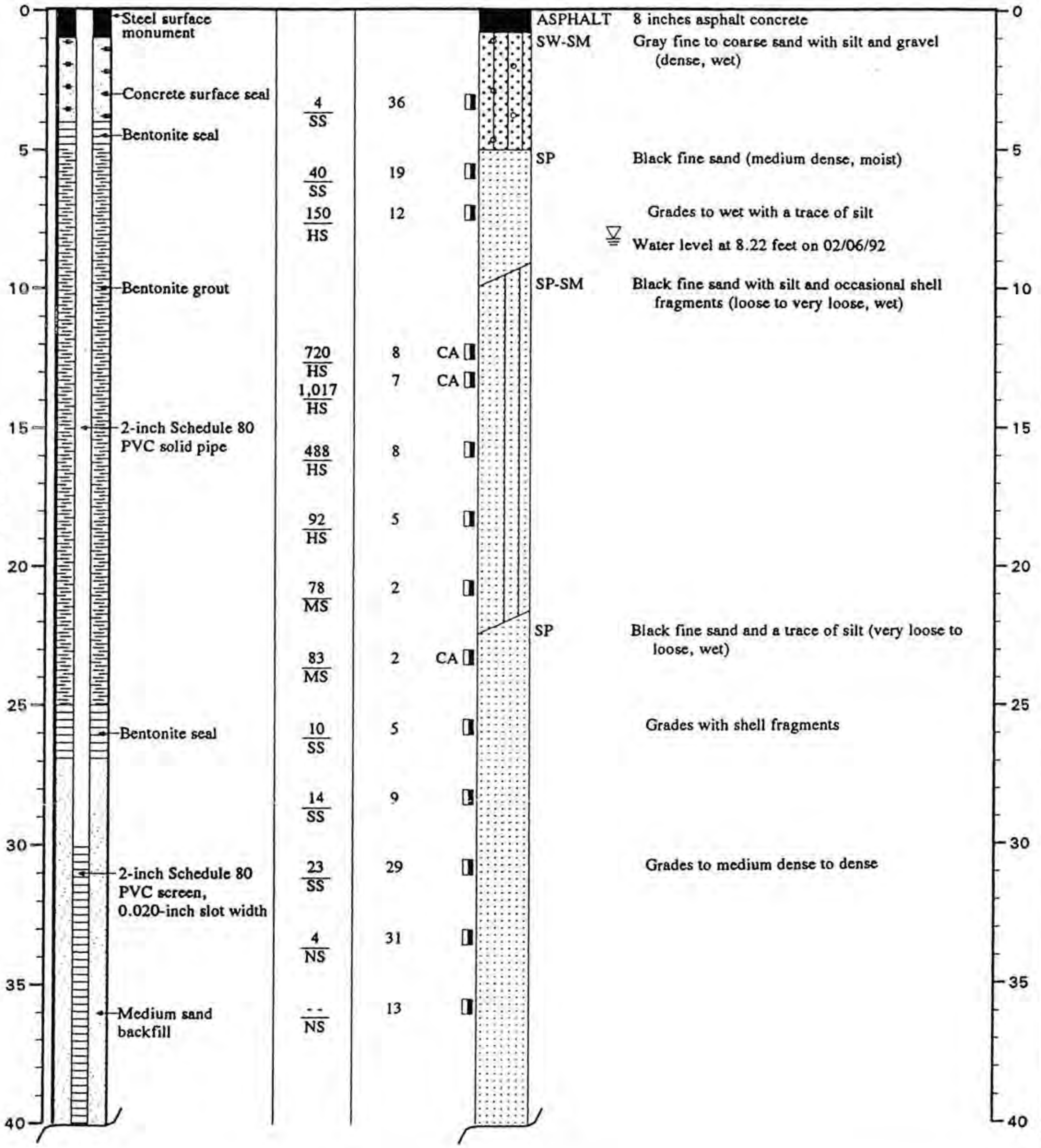
FIGURE A-7

MONITORING WELL MW-78 DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.55
Casing Stickup (ft.): -0.25

Surface Elevation (ft.): 18.80



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
4 / SS	36	▯
40 / SS	19	▯
150 / HS	12	▯
720 / HS	8	CA ▯
1,017 / HS	7	CA ▯
488 / HS	8	▯
92 / HS	5	▯
78 / MS	2	▯
83 / MS	2	CA ▯
10 / SS	5	▯
14 / SS	9	▯
23 / SS	29	▯
4 / NS	31	▯
-- / NS	13	▯

Group Symbol	DESCRIPTION
ASPHALT	8 inches asphalt concrete
SW-SM	Gray fine to coarse sand with silt and gravel (dense, wet)
SP	Black fine sand (medium dense, moist)
	Grades to wet with a trace of silt
	▽ Water level at 8.22 feet on 02/06/92
SP-SM	Black fine sand with silt and occasional shell fragments (loose to very loose, wet)
SP	Black fine sand and a trace of silt (very loose to loose, wet)
	Grades with shell fragments
	Grades to medium dense to dense

Note: See Figure A- 2 for explanation of symbols

GeoEngineers

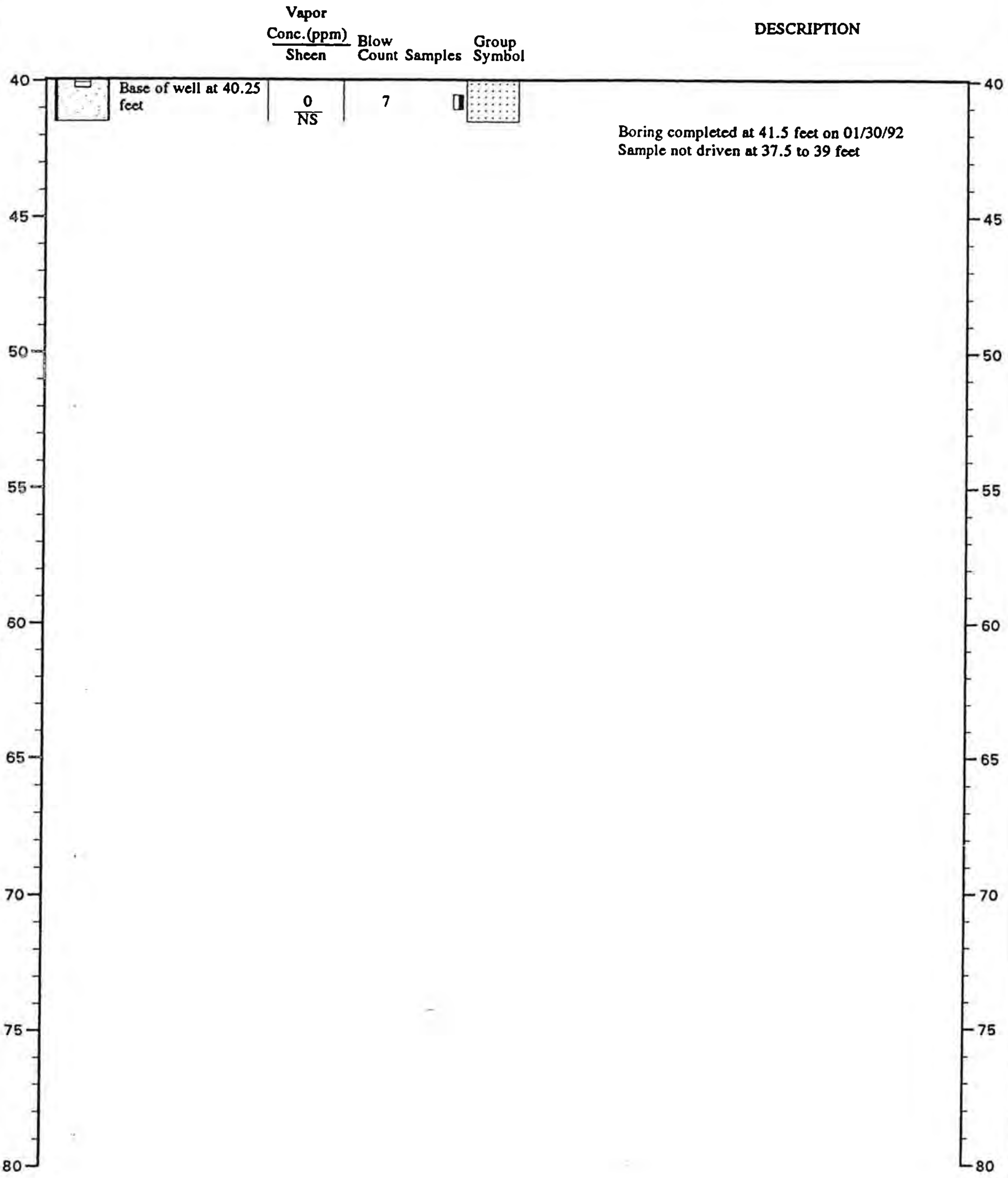
LOG OF MONITORING WELL

FIGURE A-8

DRAFT

MONITORING WELL MW-78
(Continued)

WELL SCHEMATIC



Base of well at 40.25 feet

Boring completed at 41.5 feet on 01/30/92
Sample not driven at 37.5 to 39 feet

Note: See Figure A- 2 for explanation of symbols

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-8

MONITORING WELL MW-7

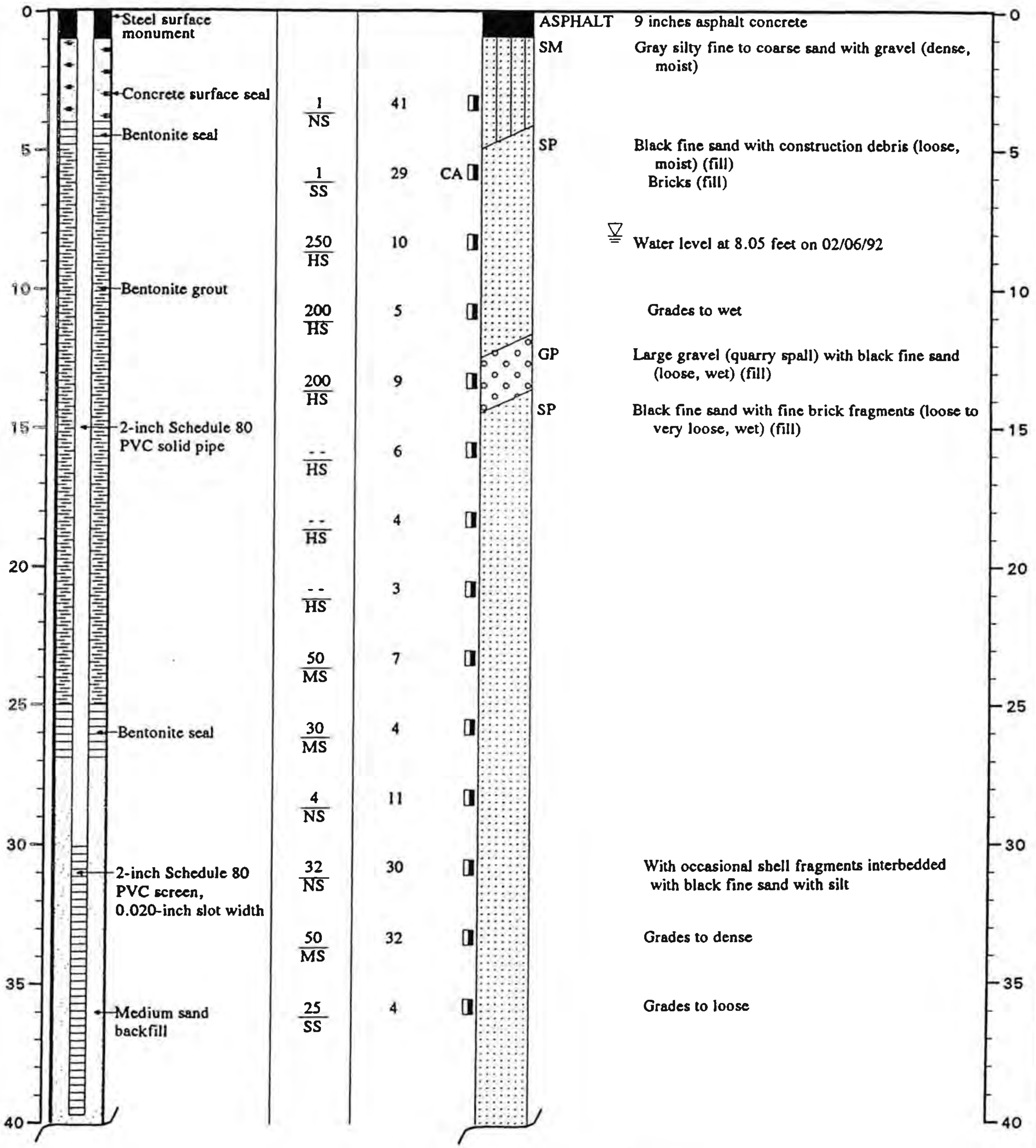
DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.28
Casing Stickup (ft.): -0.29

DESCRIPTION

Surface Elevation (ft.): 18.57



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
1 / NS	41	▮
1 / SS	29	CA ▮
250 / HS	10	▮
200 / HS	5	▮
200 / HS	9	▮
-- / HS	6	▮
-- / HS	4	▮
-- / HS	3	▮
50 / MS	7	▮
30 / MS	4	▮
4 / NS	11	▮
32 / NS	30	▮
50 / MS	32	▮
25 / SS	4	▮

ASPHALT 9 inches asphalt concrete

SM Gray silty fine to coarse sand with gravel (dense, moist)

SP Black fine sand with construction debris (loose, moist) (fill)
Bricks (fill)

∇ Water level at 8.05 feet on 02/06/92

Grades to wet

GP Large gravel (quarry spall) with black fine sand (loose, wet) (fill)

SP Black fine sand with fine brick fragments (loose to very loose, wet) (fill)

With occasional shell fragments interbedded with black fine sand with silt

Grades to dense

Grades to loose

Note: See Figure A- 2 for explanation of symbols

303-037-R14 Tsk10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-9

DRAFT

MONITORING WELL MW-79
(Continued)

WELL SCHEMATIC	Vapor Conc.(ppm) / Sheen	Blow Count	Samples	Group Symbol	DESCRIPTION
Base of well at 39.7 feet	1 / NS	6	◨	▒	Interbedded with black fine sand with silt

Boring completed at 41.5 feet on 01/25/92
Sample not driven at 37.5 feet
Free product at 10 to 21.5 feet

TH IN FEET

Note: See Figure A- 2 for explanation of symbols

3-037-R14 Tsk10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-9

MONITORING WELL MW-80

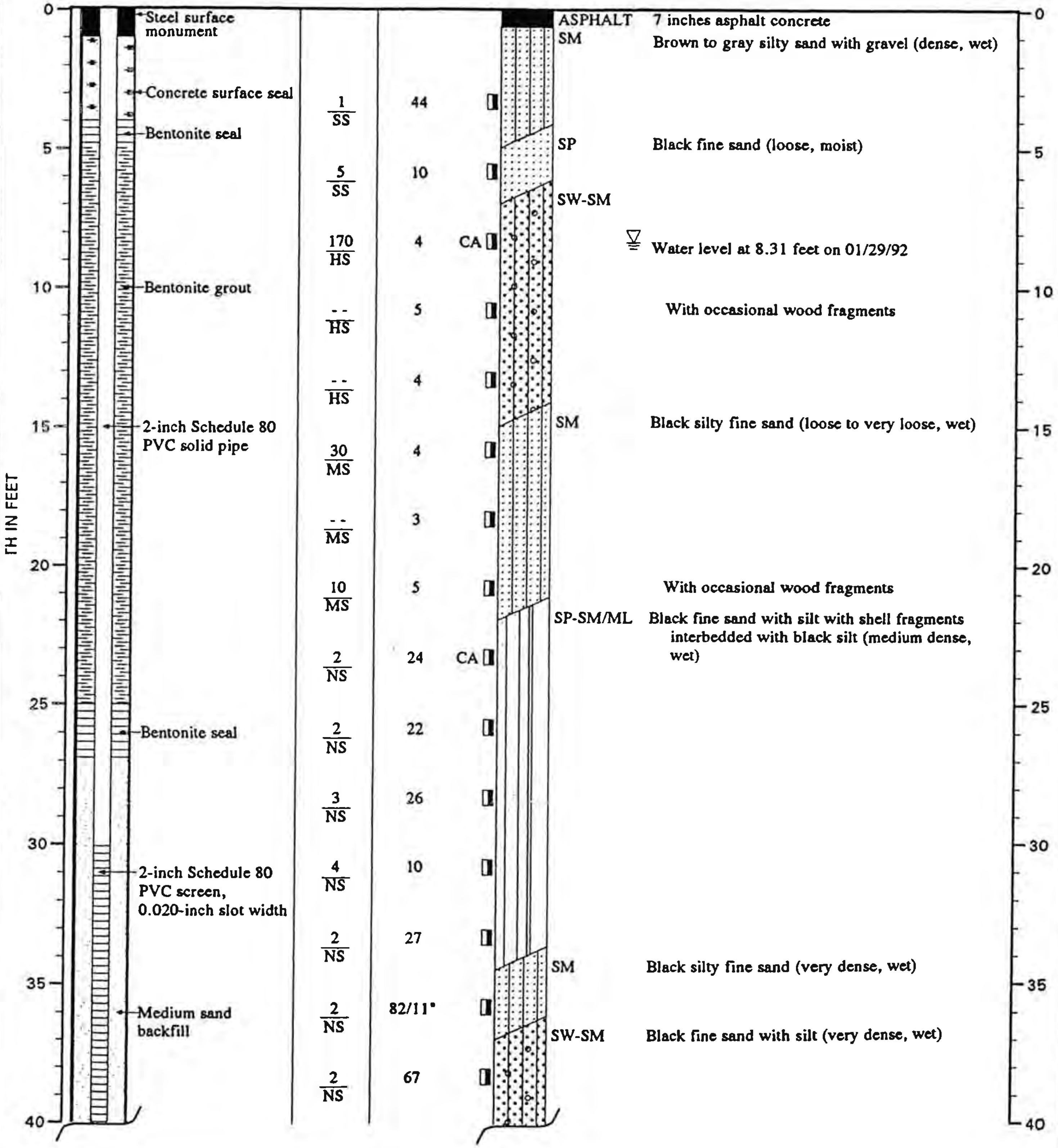
DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.43
Casing Stickup (ft.): -0.33

DESCRIPTION

Surface Elevation (ft.): 18.76



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
1 / SS	44	◧
5 / SS	10	◧
170 / HS	4	CA ◧
-- / HS	5	◧
-- / HS	4	◧
30 / MS	4	◧
-- / MS	3	◧
10 / MS	5	◧
2 / NS	24	CA ◧
2 / NS	22	◧
3 / NS	26	◧
4 / NS	10	◧
2 / NS	27	◧
2 / NS	82/11"	◧
2 / NS	67	◧

Group Symbol	DESCRIPTION
ASPHALT	7 inches asphalt concrete
SM	Brown to gray silty sand with gravel (dense, wet)
SP	Black fine sand (loose, moist)
SW-SM	
	∇ Water level at 8.31 feet on 01/29/92
	With occasional wood fragments
SM	Black silty fine sand (loose to very loose, wet)
	With occasional wood fragments
SP-SM/ML	Black fine sand with silt with shell fragments interbedded with black silt (medium dense, wet)
SM	Black silty fine sand (very dense, wet)
SW-SM	Black fine sand with silt (very dense, wet)

Note: See Figure A- 2 for explanation of symbols

:LJB:WAP:CMS 4/7/98

13-037-R14 Tak10.1

GeoEngineers

LOG OF MONITORING WELL

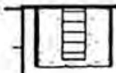
FIGURE A-10

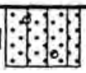
DRAFT

MONITORING WELL MW-80
(Continued)

WELL SCHEMATIC

Depth	Well Schematic	Vapor Conc.(ppm) / Sheen	Blow Count	Samples	Group Symbol	DESCRIPTION
40	Base of well at 41.3 feet	-- / NS	28	▯		Grades to medium dense Boring completed at 41.5 feet on 01/28/92





45

50

55

60

65

70

75

80

Note: See Figure A- 2 for explanation of symbols

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-10

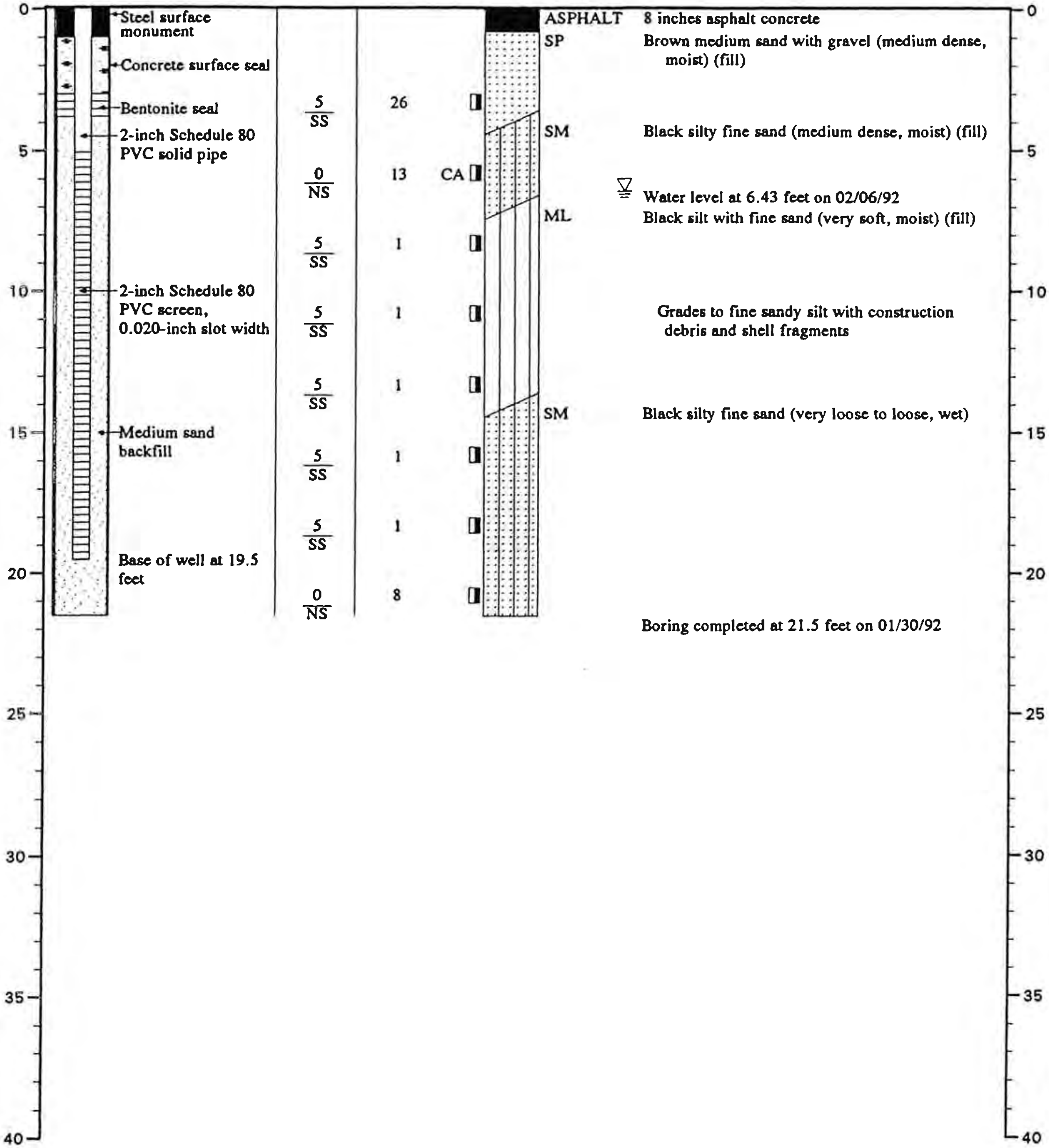
MONITORING WELL MW-81 DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.33
Casing Stickup (ft.): -0.26

DESCRIPTION

Surface Elevation (ft.): 18.59



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
5 / SS	26	◨
0 / NS	13	CA ◨
5 / SS	1	◨
5 / SS	1	◨
5 / SS	1	◨
5 / SS	1	◨
5 / SS	1	◨
0 / NS	8	◨

Group Symbol	Description
ASPHALT	8 inches asphalt concrete
SP	Brown medium sand with gravel (medium dense, moist) (fill)
SM	Black silty fine sand (medium dense, moist) (fill)
	⊽ Water level at 6.43 feet on 02/06/92
ML	Black silt with fine sand (very soft, moist) (fill)
	Grades to fine sandy silt with construction debris and shell fragments
SM	Black silty fine sand (very loose to loose, wet)
	Boring completed at 21.5 feet on 01/30/92

Note: See Figure A- 2 for explanation of symbols

03-037-R14 Tek10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-11

MONITORING WELL MW-82

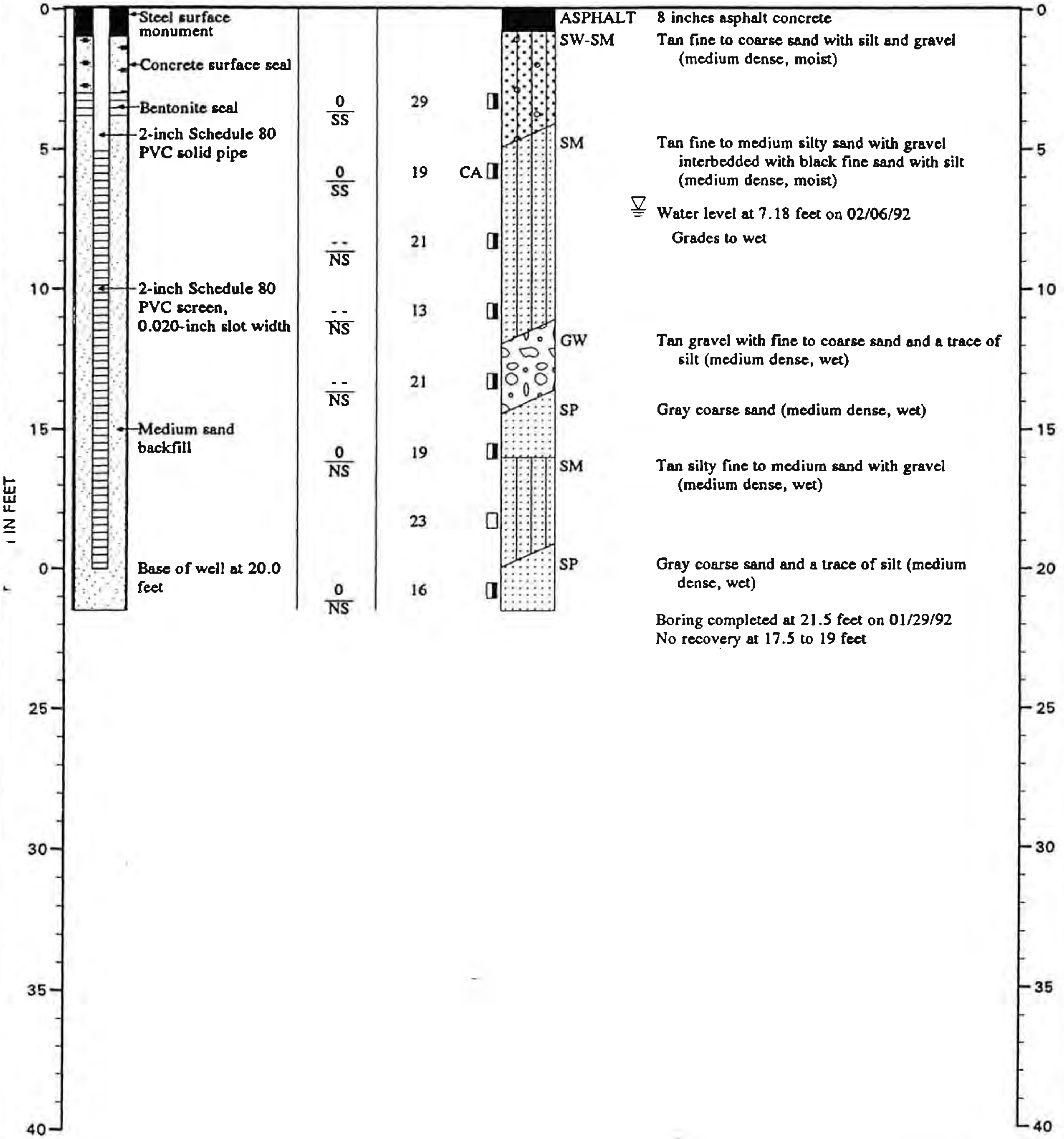
DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.06
Casing Stickup (ft.): -0.42

DESCRIPTION

Surface Elevation (ft.): 18.48



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
0 / SS	29	◧
0 / SS	19	CA ◧
-- / NS	21	◧
-- / NS	13	◧
-- / NS	21	◧
0 / NS	19	◧
	23	☐
0 / NS	16	◧

ASPHALT 8 inches asphalt concrete

SW-SM Tan fine to coarse sand with silt and gravel (medium dense, moist)

SM Tan fine to medium silty sand with gravel interbedded with black fine sand with silt (medium dense, moist)

∇ Water level at 7.18 feet on 02/06/92

Grades to wet

GW Tan gravel with fine to coarse sand and a trace of silt (medium dense, wet)

SP Gray coarse sand (medium dense, wet)

SM Tan silty fine to medium sand with gravel (medium dense, wet)

SP Gray coarse sand and a trace of silt (medium dense, wet)

Boring completed at 21.5 feet on 01/29/92
No recovery at 17.5 to 19 feet

Note: See Figure A- 2 for explanation of symbols

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-12

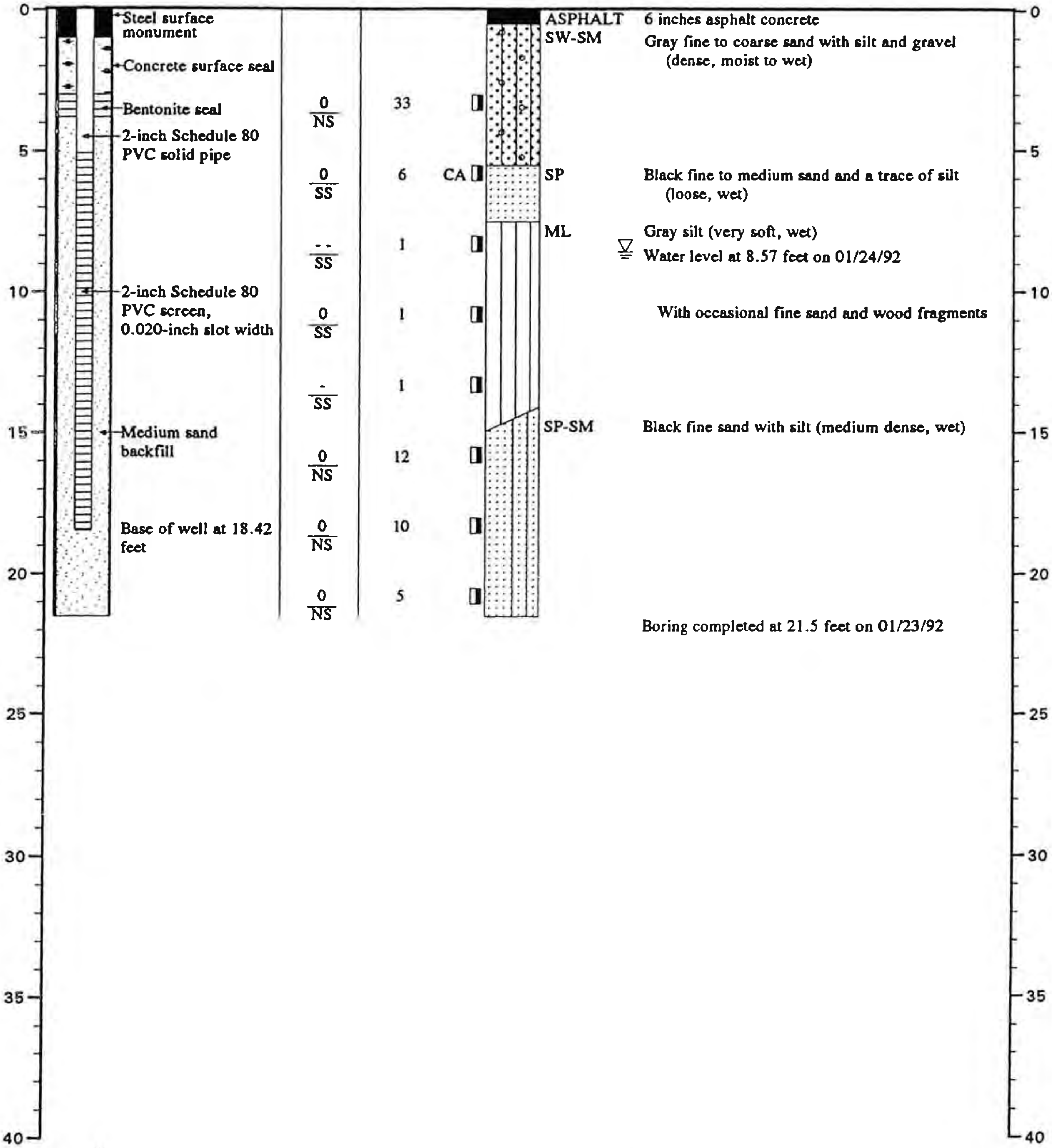
DRAFT

MONITORING WELL MW-83

WELL SCHEMATIC

Casing Elevation (ft.): 18.48
Casing Stickup (ft.): -0.34

DESCRIPTION
Surface Elevation (ft.): 18.82



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
0 / NS	33	▮
0 / SS	6	CA ▮
-- / SS	1	▮
0 / SS	1	▮
- / SS	1	▮
0 / NS	12	▮
0 / NS	10	▮
0 / NS	5	▮

Group Symbol	Description
ASPHALT	6 inches asphalt concrete
SW-SM	Gray fine to coarse sand with silt and gravel (dense, moist to wet)
SP	Black fine to medium sand and a trace of silt (loose, wet)
ML	Gray silt (very soft, wet)
	▽ Water level at 8.57 feet on 01/24/92
	With occasional fine sand and wood fragments
SP-SM	Black fine sand with silt (medium dense, wet)
	Boring completed at 21.5 feet on 01/23/92

Note: See Figure A- 2 for explanation of symbols

:LJB:WAP:CMS 4/7/95

03-037-R14 TEKT0.1

Geo Engineers

LOG OF MONITORING WELL

FIGURE A-13

DRAFT

MONITORING WELL MW-84

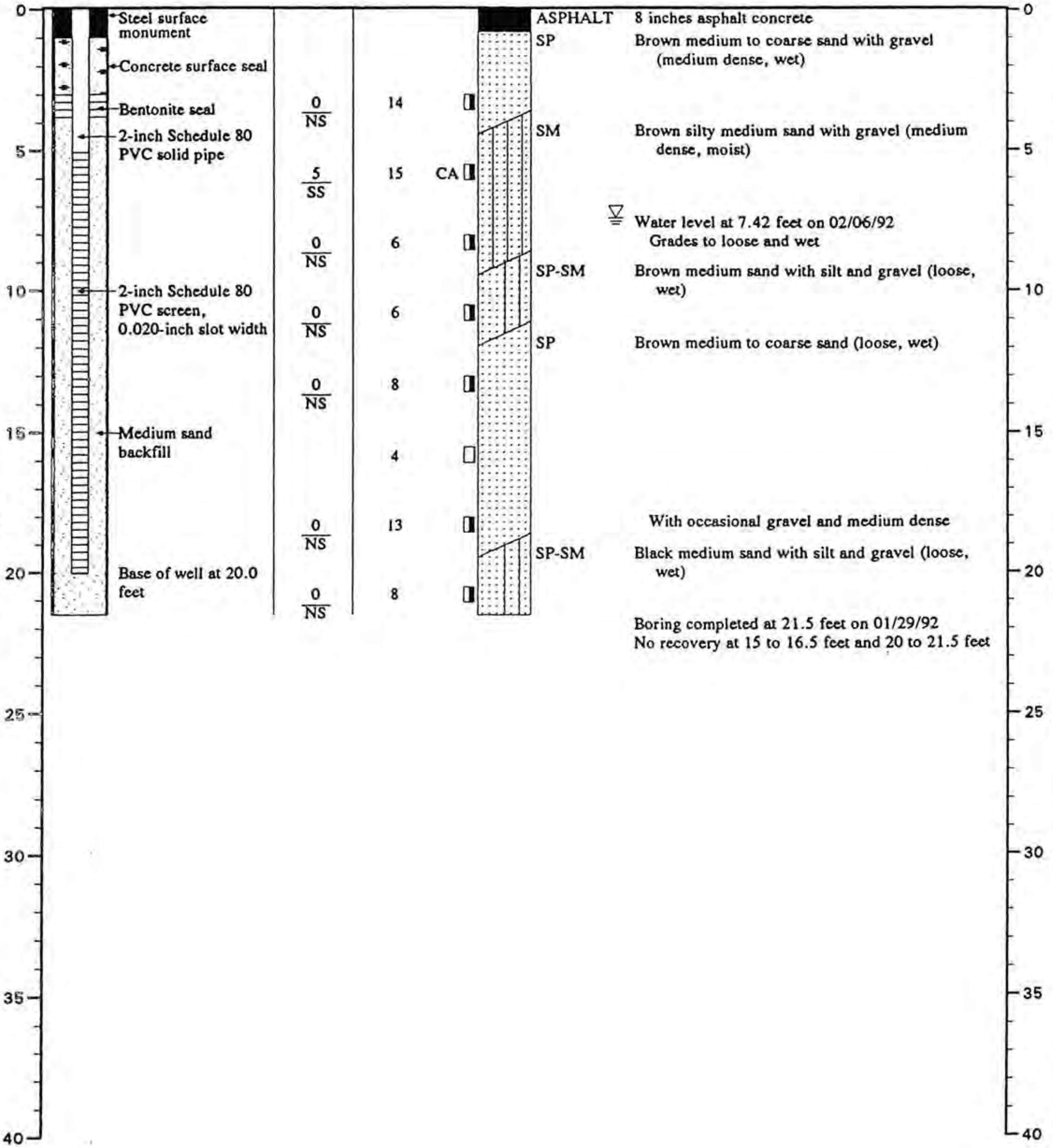
WELL SCHEMATIC

Casing Elevation (ft.): 18.22
Casing Stickup (ft.): -0.31

Vapor Conc.(ppm) / Sheen — Blow Count — Samples — Group Symbol

DESCRIPTION

Surface Elevation (ft.): 18.53



ASPHALT — 8 inches asphalt concrete

SP — Brown medium to coarse sand with gravel (medium dense, wet)

SM — Brown silty medium sand with gravel (medium dense, moist)

Water level at 7.42 feet on 02/06/92
Grades to loose and wet

SP-SM — Brown medium sand with silt and gravel (loose, wet)

SP — Brown medium to coarse sand (loose, wet)

With occasional gravel and medium dense

SP-SM — Black medium sand with silt and gravel (loose, wet)

Boring completed at 21.5 feet on 01/29/92
No recovery at 15 to 16.5 feet and 20 to 21.5 feet

Note: See Figure A- 2 for explanation of symbols

)-037-R14 Tsk10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-14

MONITORING WELL MW-85

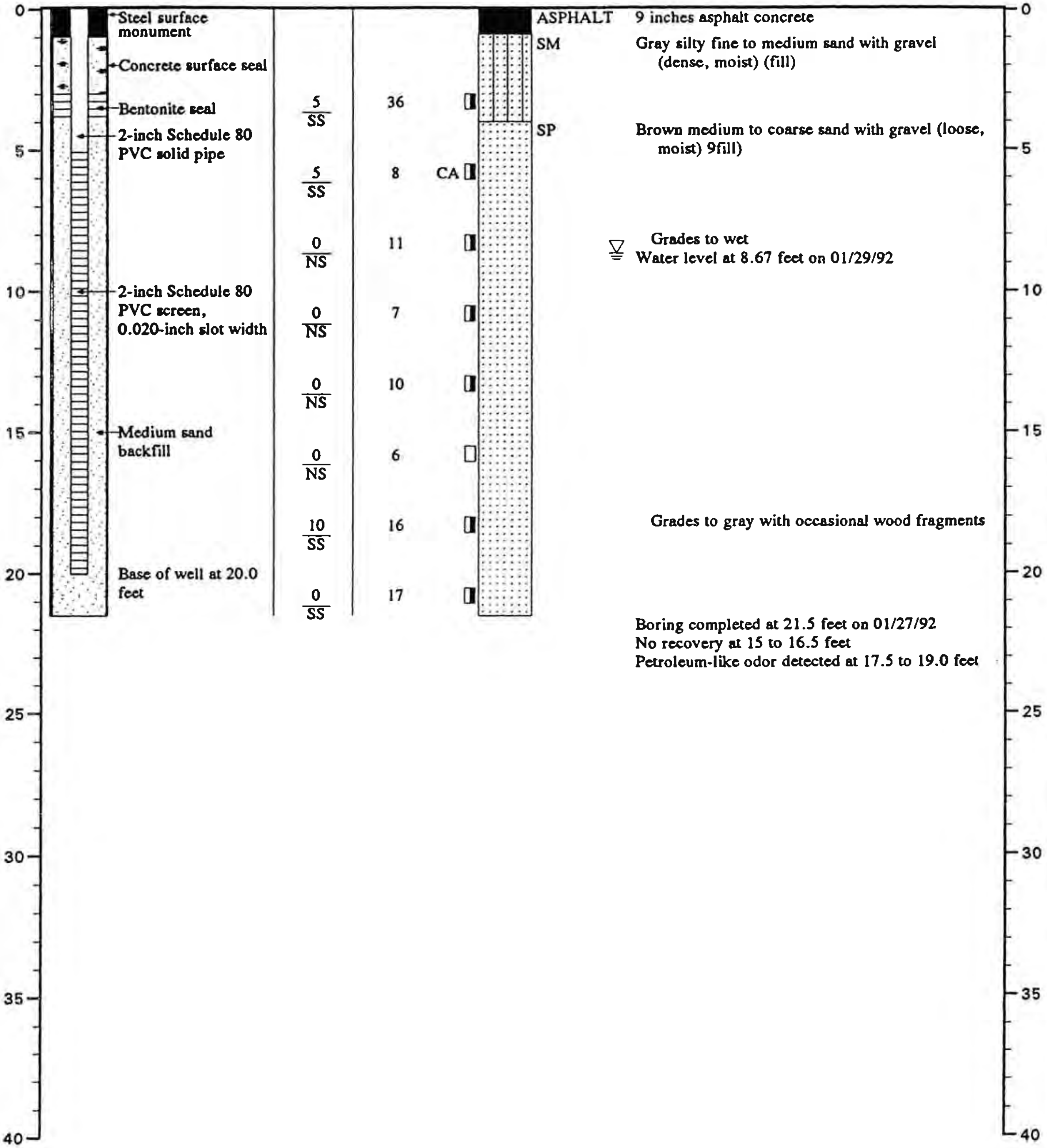
DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.11
Casing Stickup (ft.): -0.33

DESCRIPTION

Surface Elevation (ft.): 18.44



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
5 / SS	36	◨
5 / SS	8	CA ◨
0 / NS	11	◨
0 / NS	7	◨
0 / NS	10	◨
0 / NS	6	☐
10 / SS	16	◨
0 / SS	17	◨

Group Symbol	Description
ASPHALT	9 inches asphalt concrete
SM	Gray silty fine to medium sand with gravel (dense, moist) (fill)
SP	Brown medium to coarse sand with gravel (loose, moist) 9fill)

Grades to wet
Water level at 8.67 feet on 01/29/92

Grades to gray with occasional wood fragments

Boring completed at 21.5 feet on 01/27/92
No recovery at 15 to 16.5 feet
Petroleum-like odor detected at 17.5 to 19.0 feet

Note: See Figure A- 2 for explanation of symbols

Geo Engineers

LOG OF MONITORING WELL

FIGURE A-15

:LJB:WAP:CMS 4/7/95

03-037-R14 Tsk10.1

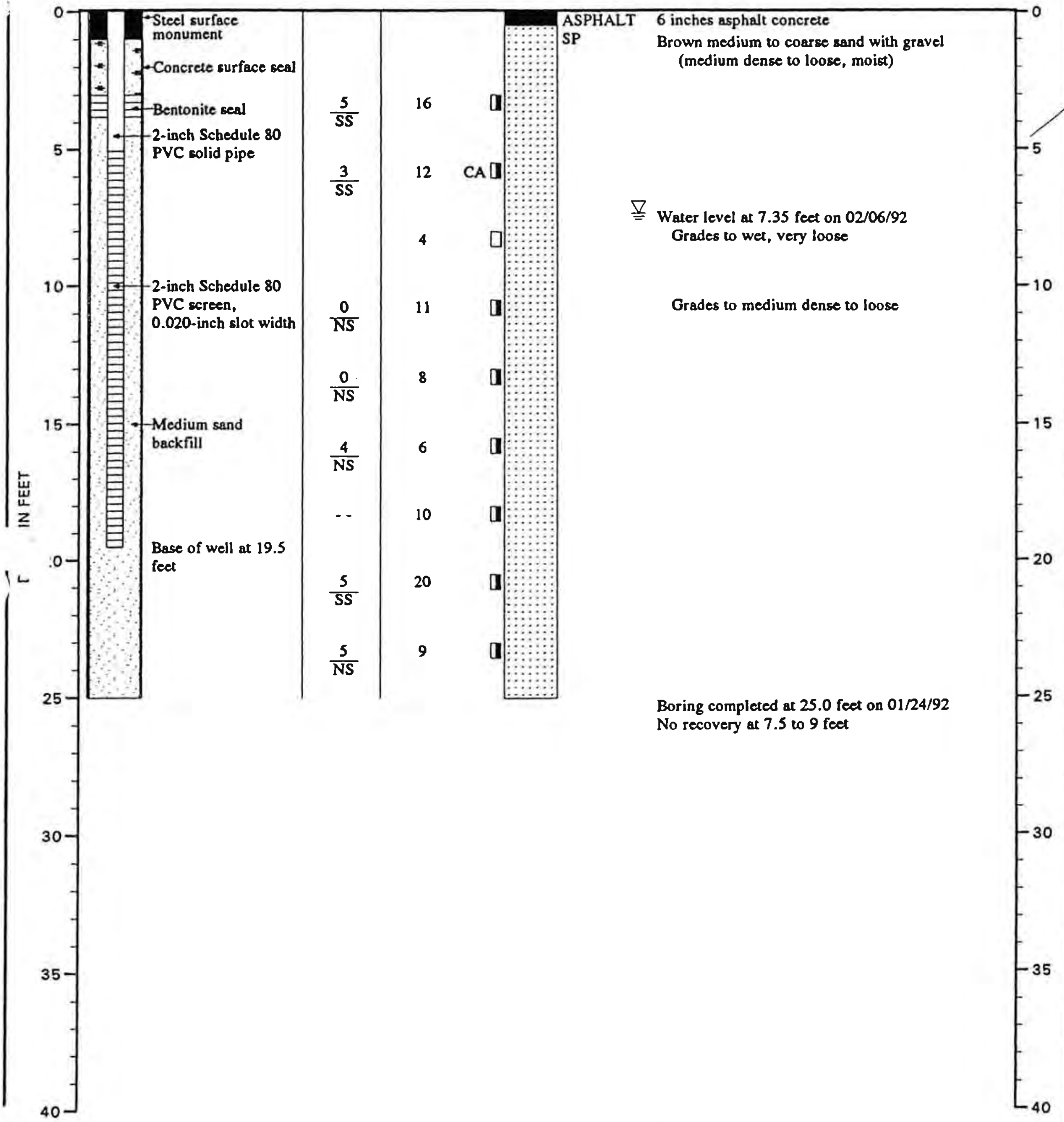
MONITORING WELL MW-86 DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.03
Casing Stickup (ft.): -0.29

DESCRIPTION

Surface Elevation (ft.): 18.32



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
5 / SS	16	◧
3 / SS	12	CA ◧
	4	☐
0 / NS	11	◧
0 / NS	8	◧
4 / NS	6	◧
- -	10	◧
5 / SS	20	◧
5 / NS	9	◧

6 inches asphalt concrete

Brown medium to coarse sand with gravel (medium dense to loose, moist)

Water level at 7.35 feet on 02/06/92
Grades to wet, very loose

Grades to medium dense to loose

Boring completed at 25.0 feet on 01/24/92
No recovery at 7.5 to 9 feet

Note: See Figure A- 2 for explanation of symbols

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-16

MONITORING WELL MW-87

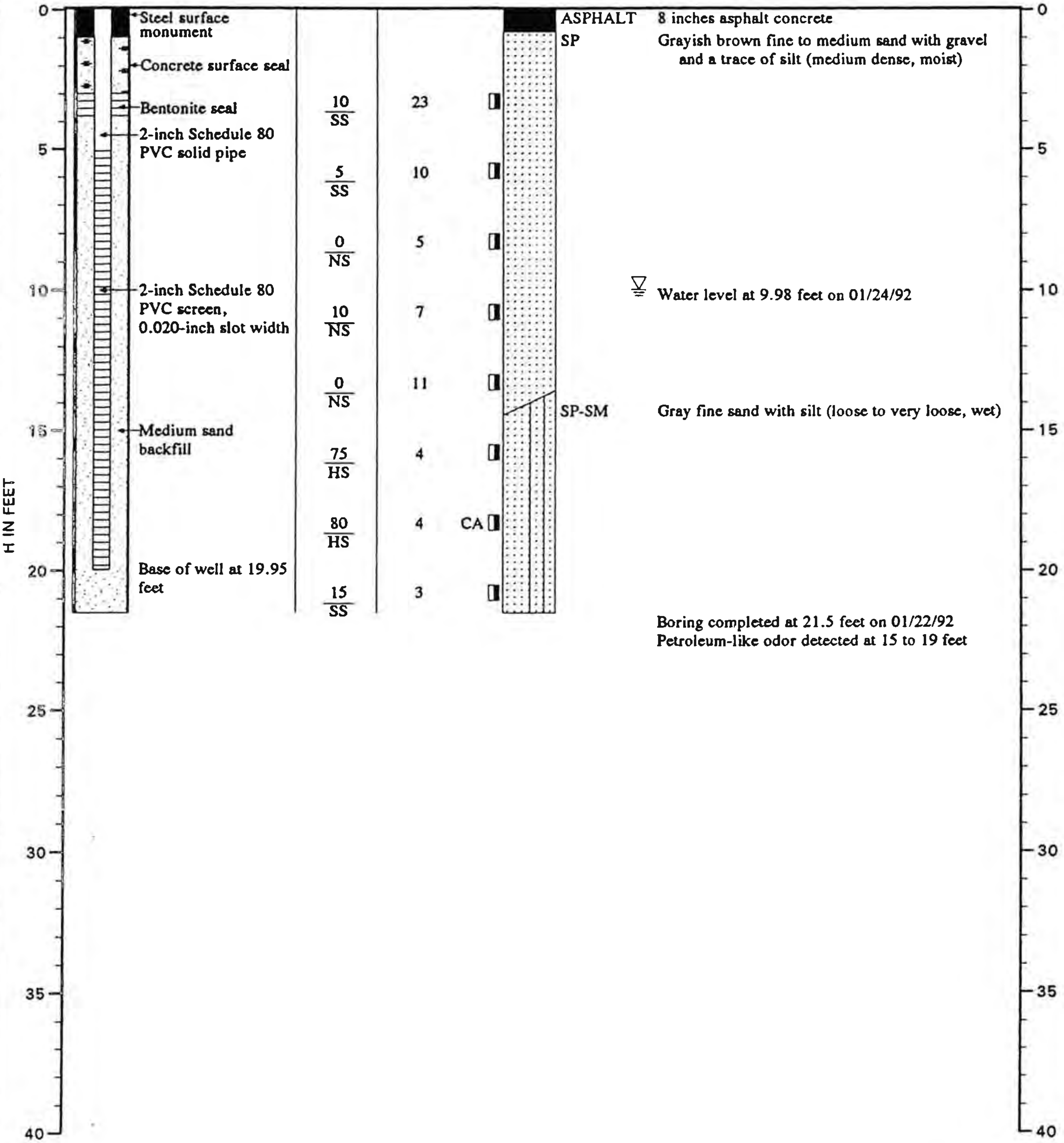
DRAFT

WELL SCHEMATIC

Casing Elevation (ft.): 18.23
Casing Stickup (ft.): -0.31

DESCRIPTION

Surface Elevation (ft.): 18.54



Vapor Conc.(ppm) / Sheen	Blow Count	Samples
10 / SS	23	◨
5 / SS	10	◨
0 / NS	5	◨
10 / NS	7	◨
0 / NS	11	◨
75 / HS	4	◨
80 / HS	4	CA ◨
15 / SS	3	◨

Group Symbol	Description
ASPHALT	8 inches asphalt concrete
SP	Grayish brown fine to medium sand with gravel and a trace of silt (medium dense, moist)
SP-SM	Gray fine sand with silt (loose to very loose, wet)

Water level at 9.98 feet on 01/24/92

Boring completed at 21.5 feet on 01/22/92
Petroleum-like odor detected at 15 to 19 feet

Note: See Figure A- 2 for explanation of symbols

3-037-R14 Tsk10.1 :LJB:WAP:CMS 4/7/95

GeoEngineers

LOG OF MONITORING WELL

FIGURE A-17

Appendix D Standard Operating Procedures and Field Forms

1 INTRODUCTION

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) describes the procedures for collecting the water level and LNAPL measurements from groundwater monitoring wells. The purpose of this procedure is to describe the field methods for gauging static water levels and product accumulations in monitoring wells. All wells should be considered to contain contaminated groundwater and therefore proper decontamination procedures shall be followed.

1.2 Health and Safety Considerations

Sampling personnel should be aware that the water level and LNAPL measurements involves potential physical hazards primarily associated with direct and direct contact with contaminated water and LNAPL. Adequate health and safety measures must be taken to protect sampling personnel from these potential hazards. The project Health and Safety Plan (HASP) generally addresses physical and other potential hazards. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed. In the absence of a HASP, work will be conducted according to the ENSR Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

2 RESPONSIBILITIES

2.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the procedures outlined within this SOP and with specific sampling, quality assurance, and health and safety requirements outlined within the project-specific plans. The sampling technician is responsible for proper packaging and shipment of environmental samples and for proper documentation of sampling activities for the duration of the sampling program.

2.2 Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the activities in accordance with the project plan and this SOP. The project manager is also responsible for ensuring that proper arrangements have been made with the designated analytical laboratory. These arrangements include, but are not necessarily limited to, subcontractor agreements, analytical scheduling, and bottle/cooler orders. The project manager may delegate some of these responsibilities to other project staff.

3 REQUIRED MATERIALS

Materials likely include the following:

- The following equipment is required for water level gauging:
- Hand tools to open well vaults/monuments
- Nitrile Gloves
- PVC gloves (outer) for system wells
- Oil/water Interface Probe
- Simple Green cleaner
- Dilute Alconox solution (or equivalent detergent-potable water mixture)
- Distilled or deionized (DI) water
- Oil-absorbent pads
- Field project notebook/pen

4 METHOD

4.1 Select and Decontaminate Equipment

- All water/product level and decontamination equipment is should be brought to site or stored in the storage area, with proper labels.
- Select the Oil/Water Interface Probe(s) that will be used for collecting data and record the instrument manufacturer and model number on the Well Data Remove visible contamination by wiping equipment with Simple Green and an oil-absorbent pad.
- Soap wash (dilute Alconox solution [or equivalent detergent-potable water mixture]) probe and the first several feet of the tape (i.e. any part of the instrument which has contacted product or groundwater).
- Distilled/DI water rinse.
- Second distilled/DI water rinse. Repeat as necessary to decontaminate the equipment.

4.2 Gauge Wells

- Set one or more delineators around the well, depending on the well vault size and how long you plan to be at that well.
- Remove the well monument/ open vault lid.

- Remove water inside the monument, vaults that might reach the well head and flow down the well casing. Note quantity/level on the Well Data Collection Form.
- Carefully remove the well cap – some wells may be pressurized or under vacuum (note on Well Data Collection Form).
- Before measuring the static water levels, allow for equalization of atmospheric pressure and stabilization of the groundwater surface. If the down hole equipment must be removed before gauging or the well plug has a vacuum or pressure. The time required for this varies across the site.
- Measure the depth from the top of casing (TOC) to the static product/water level with a water probe or oil/water interface probe. Reference points have been marked on the TOC of each well. If the reference mark has worn off, measure to the side of the casing closest to the river.
- Record the depth to product and water measurements on the Well Data Collection Form, along with the time of measurement and any comments.
- Decontaminate the probe and any portion of the tape which may have contacted product or groundwater.
- Replace the well cap securely on the well.
- Replace the monument/close the vault lid. Make sure lid is flush before moving on.

4.3 Decontaminate Equipment

- Soap wash (dilute Alconox solution [or equivalent detergent-potable water mixture]) probe and the first several feet of the tape (i.e. any part of the instrument which has contacted product or groundwater).
- Distilled/DI water rinse.
- Second distilled/DI water rinse.
- Repeat as necessary to decontaminate the equipment before placing it back into the equipment compound.

5 DOCUMENTATION

Water level and product depth measurements are documented on the Well Data Collection Form.

Attachment 1 - Well Data Collection Form

Date/Time: ____

Personnel: ____

Tide Level: ____

Equipment Used: ____

Well ID	Time	Depth to Product	Depth to Water	Product Thickness	Product removed?	Estimated Volume of Product Removed	Depth to bottom of Well	Notes
		Ft btc	Ft btc	feet	If present	Gallons	Ft btc	

Notes:

Btc = below top of casing

1 INTRODUCTION

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) describes the procedures for the packaging and shipment of environmental samples. This SOP also covers packaging and delivering environmental samples directly to a laboratory. This SOP assumes samples will be packed and shipped, often overnight, to a receiving laboratory. The procedures listed in this SOP are more stringent than may be necessary if a laboratory courier is used or if samples are transported directly to their destination by a sampling team member. Should the latter occur, the procedures may be modified to reflect a lesser degree of packaging requirements

Two general categories of samples exist: environmental samples consisting of water, soil, and or sediment submitted for routine environmental testing, and waste material samples which include non-hazardous solid wastes and/or hazardous wastes as defined by 40 CFR Part 261 submitted for environmental testing or bench/pilot-scale treatability testing. Packaging and shipping procedures differ for the two categories.

Department of Transportation (DOT) regulations apply to hazardous or potentially hazardous waste/products. However, environmental samples are not considered a hazardous waste by definition and do not require special DOT regulations.

1.2 General Principles

Sample packaging and shipment generally involves the placement of individual sample containers into a cooler or other similar shipping container and placement of packing materials and coolant in such a manner as to isolate the samples, maintain the required temperature, and to limit the potential for damage to sample containers when the cooler is transported.

1.3 Quality Assurance Planning Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific work plan or Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will specify sample packaging and shipment requirements if variations to the indicated procedures are necessary on a particular project.

1.3.1 Health and Safety Considerations

Sampling personnel should be aware that packaging and shipment of samples involves potential physical hazards primarily associated with handling of occasional broken sample containers and lifting of heavy objects. Adequate health and safety measures must be taken to protect sampling personnel from these potential hazards. The project Health and Safety Plan (HASP) generally addresses physical and other potential hazards. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed. In the absence of a HASP, work will be conducted according to the ENSR Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

2 RESPONSIBILITIES

2.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the procedures outlined within this SOP and with specific sampling, quality assurance, and health and safety requirements outlined within the project-specific plans. The sampling technician is responsible for proper packaging and shipment of environmental samples and for proper documentation of sampling activities for the duration of the sampling program.

2.2 Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the activities in accordance with the project plan and this SOP. The project manager is also responsible for ensuring that proper arrangements have been made with the designated analytical laboratory. These arrangements include, but are not necessarily limited to, subcontractor agreements, analytical scheduling, and bottle/cooler orders. The project manager may delegate some of these responsibilities to other project staff.

3 REQUIRED MATERIALS

Materials likely include the following:

- Sample coolers
- Sample containers
- Shipping labels
- Chain-of-custody records, custody seals
- Bubble wrap
- Vermiculite (granular), or styrofoam pellets
- "Blue Ice" refreezable ice packs, or ice cubes

- Transparent tape, or rubber bands
- Fiber tape
- Duct tape
- Zipper-lock plastic bags
- Trash bags
- Health and Safety supplies
- Equipment decontamination materials
- Field project notebook/pen

4 METHOD

4.1 General Method Description

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when any of the following conditions are applicable:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis;
- Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

4.1.1 Sample Documentation

The following information must accompany each shipment of samples on a chain-of-custody form (Figure 1) where each sample has an individual entry:

- Sample collector's name, mailing address and telephone number,
- Analytical laboratory's name, mailing address and telephone number,
- A unique identification of each sample,
- Sample description (matrix),
- Number and type of sample containers,
- Container size,
- Preservative,
- Type and method of analysis requested, and
- Date and time that the samples were collected and prepared for shipping,
- Special handling instructions, including notation of suspected high concentration samples.

4.1.2 Laboratory Notifications

Prior to sample collection, the Project Manager, or designated alternative must notify the laboratory manager of the number, type and approximate collection and shipment dates for the samples. If the number, type or date of sample shipment changes due to program changes which may occur in the field, the Project Manager or alternate must notify the laboratory of the changes. Additional notification from the field is often necessary when shipments are scheduled for weekend delivery.

4.1.3 Cooler Inspections

Laboratories will often re-use coolers. Every cooler received at a project location should be inspected for condition and cleanliness. Any coolers that have cracked interior or exterior linings/panels or hinges should be discarded as their insulating properties are now compromised. Any coolers missing one or both handles should also be discarded if replacement handles (i.e., knotted rope handles) can not be fashioned in the field.

The interior and exterior of each cooler should be inspected for cleanliness before using it. Excess strapping tape and old shipping labels should be removed. If the cooler interior exhibits visible contamination or odors it should be decontaminated in accordance with CRETE SOP 100 (Decontamination of Equipment) prior to use. Drain plugs should be sealed on the inside with duct tape to prevent any leakage.

4.1.4 Isolating Samples

Sample containers used for VOC analysis may be grouped into a single cooler, with separate chain-of-custody record, to limit the number of trip blanks required for transportation and analysis. Individual VOC samples may also be placed into Zipper-lock bags to further protect the samples.

Contaminated Samples - Sample containers with presumed high contaminant concentrations should be isolated within their own cooler with each sample container placed into a Zipper-lock bag.

4.2 Sampling Packing Methods

Sample packaging should be conducted in the following manner:

1. Place plastic bubble wrap matting over the base of each cooler or shipping container as needed. Or a 2- to 3-inch thickness layer of vermiculite may be used as a substitute base material.
2. If shipping samples overnight or 2 day, Insert a clean trash bag into the cooler to serve as a liner.
3. Check that each sample container is sealed, labeled legibly, and is externally clean. Re-label and/or wipe bottles clean if necessary. Clear tape should be placed over the labels to protect them or samples jars should be placed in zip lock bags to separate jars from melting ice water or broken water sample jars. Wrap each sample bottle individually with bubble wrap secured with tape or rubber bands. Place bottles into the cooler in an upright single layer with approximately

one inch of space between each bottle. If plastic and glass sample containers are used, alternate the placement of each type of container within the cooler so that glass bottles are not placed side by side.

4. Insert cooler temperature blanks if required.
5. Place additional vermiculite, bubble wrap, and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler to a level which meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling.
6. Place cubed ice or cold packs in heavy duty Zip-lock type plastic bags, close the bags, and distribute the packages in a layer over the top of the samples. Cubed ice should be double-bagged to prevent leakage. Loose ice should never be used. Cold packs should be used only if the samples are chilled before being placed in the cooler.
7. Add additional bubble wrap/styrofoam pellets or other packing materials to fill the balance of the cooler or container.
8. Obtain two pieces of chain of custody tape and enter the custody tape numbers in the appropriate place on the chain-of-custody form. Sign and date the chain-of-custody tape.
9. Complete the chain-of-custody form. If shipping the samples involves use of a third party commercial carrier service, sign the chain-of-custody record thereby relinquishing custody of the samples. Shippers should not be asked to sign chain of custody records. If a laboratory courier is used, or if samples are transported to the laboratory, the receiving party should accept custody and sign the chain-of-custody records. Remove the last copy from the form and retain it with other field notes. Place the original (with remaining copies) in a Zipper-lock type plastic bag and tape the bag to the inside lid of the cooler or shipping container.
10. Close the top or lid of the cooler or shipping container.
11. Place the chain of custody tape at two different locations (i.e., one tape on each side) on the cooler or container lid and overlap with transparent packaging tape.
12. Packaging tape should be placed entirely around the sample shipment containers. A minimum of two full wraps of packaging tape will be placed at least two places on the cooler.
13. Repeat the above steps for each cooler or shipping container.

4.3 Sample Shipping Method

Packaged sample coolers should be shipped using one of the following options:

4.3.1 Hand Delivery

When a project member is transporting samples by automobile to the laboratory, the cooler should only be sealed with tape. In these cases, chain-of-custody will be maintained by the person transporting the sample and chain-of-custody tape need not be used. Chain-of-custody records should be relinquished upon delivery and a copy of the record retained in the project file.

4.3.2 Laboratory Courier

Laboratory couriers are usually employees of the analytical laboratory receiving the samples. As such, they will accept custody of the samples and must be asked to sign the chain-of-custody records. Chain-of-custody records do not need to be sealed in the cooler although it is recommended that the coolers be sealed with tape. All other packaging requirements generally apply unless otherwise specified in the QAPP.

If the laboratory courier is not authorized to accept custody of the samples, or if the requirements of the project plan preclude transfer to the laboratory courier, samples will be handled as described below in Section 4.3.3.

4.3.3 Third Party Courier

If overnight shipment is required, a third party package delivery service should be used. Transport the cooler to the package delivery service office or arrange for package pick-up at the site. Fill out the appropriate shipping form or airbill and affix it to the cooler. Some courier services may use multi-package shipping forms where only one form needs to be filled out for all packages going to the same destination. If not, a separate shipping form should be used for each cooler. Keep the receipt for package tracking purposes should a package become lost. Please note that each cooler also requires a shipping label which indicates point of origin and destination. This will aid in recovery of a lost cooler if a shipping form gets misplaced. Never leave coolers unattended while waiting for package pick-up. Airbills or waybills will be maintained as part of the custody documentation.

4.4 Sample Receipt

Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the tape number corresponds with the number on the chain-of-custody record. The laboratory will note the condition of the samples upon receipt and will identify any discrepancies between the contents of the cooler and chain-of-custody. The analytical laboratory will then forward the back copy of the chain-of-custody record to the project manager to indicate that sample transmittal is complete.

5 QUALITY CONTROL

The potential for samples to break during transport increases greatly if individual containers are not snugly packed into the cooler. Completed coolers may be lightly shake-tested to check for any loose bottles. The cooler should be repacked if loose bottles are detected.

Environmental samples are generally shipped so that the samples are maintained at a temperature of approximately 4°C. Temperature blanks may be required for some projects as a quality assurance check on shipping temperature conditions. These blanks usually are supplied by the laboratory and consist of a 40-ml vial or plastic bottle filled with tap water. Temperature blanks should be placed near the center of the cooler.

6 DOCUMENTATION

Documentation supporting sample packaging and shipment generally consists of chain-of-custody records and shipping records. In addition, a description of sample packaging procedures will be written in the field project notebook. All documentation will be retained in the project files following project completion

1 INTRODUCTION

1.1 Purpose and Applicability

This standard operating procedure (SOP) is concerned with the collection of valid and representative samples of groundwater from monitoring wells. The scope of this document is limited to field operations and protocols applicable during groundwater sample collection. Field data sheets are included in Attachment 1.

This SOP is written in a broad-based manner and considers the application of a variety of sampling equipment in the collection of representative groundwater samples. Respective state and/or federal agency regulations may require specific types of equipment to be used when applying this SOP to a particular project. The project manager should review the applicable regulatory requirements, if any, prior to the start of the field sampling program. Deviations from this SOP to accommodate regulatory requirements should be reviewed in advance of the field program and documented in the project work plan. This SOP is specific to Washington State and was prepared following Washington State Department of Ecology SOP guidance (see Attachment 2).

1.2 Quality Assurance Planning Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific QAPP. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements typically suggest the collection of a sufficient quantity of quality control (QC) samples such as field duplicate, equipment and/or field blanks and matrix spike/matrix spike duplicate (MS/MSD) samples. These requirements should be outlined in the QAPP. Additional information regarding quality assurance sample collection relevant to groundwater sampling is contained in Section 5.0 of this SOP.

1.3 Health and Safety Considerations

Groundwater sampling may involve chemical hazards associated with the materials being sampled. Adequate health and safety measures must be taken to protect project sampling personnel from potential chemical exposures or other hazards.

These measures must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed.

2 RESPONSIBILITIES

2.1 Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project-specific work plan.

2.2 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the sampling procedures outlined within this SOP and with specific sampling, quality assurance, and health and safety requirements outlined within project-specific work plans (Sampling Plan, HASP, QAPP). The sampling technician is responsible for collection of groundwater samples and for proper documentation of sampling activities as samples are being collected.

3 REQUIRED MATERIALS

Groundwater sampling objectives may vary significantly between projects. Project objectives should be defined within the project-specific work plans. The list of required materials below identifies the types of equipment which may be used for a range of groundwater sampling applications. From this list, a project-specific equipment list should be selected based upon project objectives and other factors such as the depth to groundwater, well construction, required purge volumes, and analytical parameters, among others. The various types of sampling equipment which may be used include:

Well Purging Equipment

- Bailers
- Bladder pumps
- Submersible pumps
- Peristaltic pumps
- Centrifugal Pumps
- WaterraTM pumps

Field Instruments

- Individual or multi-parameter meter(s) to measure temperature, pH, specific conductance, dissolved oxygen (DO) oxidation reduction potential (ORP), and/or turbidity
- Water level measuring device
- Interface probe or product detection paste

Sampling Equipment

- Reusable or disposable bailers
- Peristaltic pump

- Bladder pump

Sample Preparation Equipment

- Filtration equipment
- Intermediate containers
- Sample kit (i.e., bottles, labels, preservatives, custody records, cooler)

General Equipment

- Project-specific sampling plans (SAP, QAPP, HASP)
- Sample collection records
- Field notebook/pen
- Waterproof marker pens
- Deionized water dispenser bottler
- Sample cup
- Buckets
- Coolers, or sample shuttles
- Instrument calibration solutions
- Power source (generator of 12V marine battery)
- Equipment decontamination supplies (refer to SOP 7600)
- Health and safety supplies
- First-Aid kit
- Tool box

Expendable Materials

- Deionized water supply
- Disposable bailer string (nylon or polypropylene)
- 0.45 micron filters
- Paper towels
- Plastic sheeting
- Ice/blue ice for sample preservation
- Disposable latex powder-free glove liners
- Disposable nitrile gloves
- Plastic trash bags
- Ziplock® bags

This equipment list was developed to aid in field organization and should be used in preparation for each sampling event. Depending on the site-specific sampling plan, additional material and equipment may be necessary and should be determined before the scheduled sampling event. Similarly, not all of the items shown in this list may be necessary for any one sampling event.

4 METHOD

4.1 Instrument Calibration

Field instruments will be calibrated according to the recommendations from the manufacture.

4.2 Sampling Preparation

Before opening the well, a clean working surface shall be set up around the well head. Prior to opening the well, the required health and safety gear (as specified in the site specific HASP) shall be donned. This, at a minimum, usually means wearing nitrile (or similar) gloves to limit the potential for exposure to contaminants as well as reduce the potential for handling-induced contamination of sampling equipment.

4.3 Well Security and Condition

At each monitoring well location, observe the conditions of the well and surrounding area. The following information shall be noted on the Groundwater Sample Collection Record (Attachment 1) or in the field notebook:

- Condition of the wells identification marker
- Condition of the well lock and associated locking cap
- Integrity of the well - protective outer casing, obstructions or kinks in the well casing, presence of water in the annular space, and the top of the interior casing
- Condition of the general area surrounding the well

4.4 Measuring Point Determination

Before collecting a water level measurement, check for an existing measuring point (notch, or other visible mark) established either at the time of well installation or by the latest survey. Generally, the measuring point is referenced from the top of the well casing (TOC), not the protective casing. If no measuring point exists, a measuring point should be established, clearly marked, and identified on the Groundwater Sample Collection Record or the field logbook. The same measuring point should be used for subsequent sampling events.

4.5 Free Product Determination

Wells that may potentially contain free product should be assessed for product with an interface probe or product detection paste. Interface probes generally operate on the same principle as a water level tape although they are designed to register water and product levels usually with different audible tones. Product paste generally is used in combination with some type of measuring tape which is lowered into the well with a coating of paste applied to it. Wells containing free product are generally not used for groundwater sampling, since the concentration of contaminants present in the free product can adversely effect the quality of the water sample, lending to a non-representative water sample.

4.6 Water Level Measurement

To obtain a water level measurement, lower the probe of a water level measuring device into the well until the audible sound of the unit is detected or the light on an electronic sounder illuminates. At this time the precise measurement should be determined (to nearest 0.01 feet) by repeatedly raising and lowering the tape to converge on the exact measurement. Obtain the reading of the TOC measuring point. The water level measurement should be entered on the Groundwater Sample Collection Record or in the field records.

The measurement device shall be decontaminated immediately after use with a non-phosphatic detergent and rinsed with distilled water. Generally, only that portion of the tape which enters the water table should be cleaned. It is important that the measuring tape is never placed directly on the ground surface or allowed to become kinked. Measuring devices, including interface probes, which come into contact with free product will likely require more thorough decontamination (see SOP 100).

4.7 Purge Volume Calculation

Wells designated for sampling require purging to remove stagnant water in the well. A single casing volume of groundwater will be calculated after measuring the length of the water column and checking the well casing diameter. The Groundwater Sample Collection Record provides information used to compute the casing volume, which includes: a diagram, a numerical conversion table, and the standard calculation. The volume of standing water in the well (ie., one purge volume) should be entered on the Groundwater Sample Collection Record.

4.8 Well Purging Methods and Procedures

Prior to sample collection, purging must be performed for all groundwater monitoring wells to remove stagnant water from within the casing and gravel pack and to ensure that a representative groundwater sample is obtained.

There are three general types of non-dedicated equipment used for well purging and include: bailers, surface pumps and down-well pumps. The purge method and equipment selected should be specified in the project-specific work plans.

NOTE: This SOP only describes the most common equipment and methods used for purging. Other purging equipment, as well as dedicated equipment, can be used provided that the method employed does not have an adverse affect on the overall quality of the groundwater.

Regardless of the purge method, purge water temperature, pH, and specific conductance will be monitored at predetermined purge volumes and recorded on the Groundwater Sample Collection Record. Additional water quality parameters may be required by the project-specific sampling plan. In general, purging will be considered complete following the withdrawal of at least 3 to 5 well volumes of groundwater and when all field parameters have stabilized to within 10% of their preceding measurements.

Purging a well to dryness may occur under some low-yield conditions. When the well recovers, a cascading effect may occur within the screened zone which can volatilize some organic compounds. This may be considered inappropriate by regulatory agencies when volatile organic compounds (VOC) are the target analyte of interest. Purging a well to dryness, then sampling after it has recovered may be acceptable for other target analytes, however. Under low yield conditions, low-flow sampling pumps such as bladder pumps may be required for VOC sample collection.

4.8.1 Surface Pumps

Well purging using pumps located at the ground surface can be performed with peristaltic or centrifugal pumps if the water level in the well is within approximately 20 feet of the top of the well.

Peristaltic pumps provide a low rate of flow typically in the range of 0.02-0.2 gallons/minute (75-750 ml/min). For this reason, peristaltic pumps are not particularly effective for well purging. Peristaltic pumps are suitable for purging situations where disturbance of the water column must be kept minimal for particularly sensitive analyses.

Centrifugal pumps are designed to provide a high rate of pumping, in the range of 5 to 40 gallons/minute (gpm), depending on pump capacity. Discharge rates can also be regulated somewhat, provided the pump has an adjustable throttle. These pumps also require polyethylene or teflon-lined polyethylene tubing as suction line. The pump may also require priming to initiate flow.

4.8.2 Peristaltic Pump Procedure

Attach a new suction and discharge line to the peristaltic pump. Silicon tubing must be used through the pump head and must meet the pump head specifications. A second type of tubing may be attached to the silicon tubing for use as the suction and discharge lines. The secondary tubing material, usually consisting of polyethylene or teflon-lined polyethylene, should be compatible with the target analytes. The suction line must be long enough to extend to the static groundwater surface and reach further should drawdown occur during pumping.

Measure the length of the suction line and lower it down the monitoring well until the end is in the upper foot or more of the water column. Start the pump and direct the discharge into a graduated bucket. Adjust the pumping rate with the speed control knob so that a smooth flowing discharge is attained.

Measure the pumping rate in gallons per minute by recording the time required to fill a calibrated bucket. The pumping shall be monitored to assure continuous discharge. If drawdown causes the discharge to stop, the suction line will be lowered very slowly further down into the well until pumping restarts.

Measurements of temperature, pH and specific conductance (and/or other assigned parameters) should be made after each well purge volume and documented on the Groundwater Sample Collection Record or in the field logbook. Samples may be collected after the required purge volume has been removed and the specific field parameters have stabilized to within 10% of their preceding measurement. Project-specific sampling objectives may require that the sample be collected with a bailer.

4.9 Sample Collection Methods and Procedures

- Groundwater samples can be collected using similar methods employed for purging, provided these methods do not adversely affect the quality of the groundwater. These methods include bailing, surface pumping and down-well pumping.
- In most cases during sampling, groundwater will be transferred to the appropriate containers directly for the discharge source. During transfer, discharge tubing and other equipment shall not contact the inside of the sample containers. In addition, a clean pair of nitrile or latex gloves will be worn during sample collection and handling.
- As a general rule of thumb, samples should be collected in order of decreasing volatilization of the target parameters. The preferred order of sample collection is as follows: volatile organic compounds, extractable organic compounds (e.g., semivolatile organic compounds, PCBs, pesticides), metals, and general water chemistry (ions and turbidity).
- Peristaltic pumps equipped with the appropriate type tubing will be used to collect groundwater from wells in which the water resides at a depth less than 20 feet. Sample bottles shall be filled directly from the pump's discharge line and care shall be taken to keep the discharge tube from contacting the sample container.
- Groundwater samples requiring filtration prior to placement in sample containers can be placed in intermediate containers for subsequent filtration, or may be filtered directly with in-line disposable 0.45-micron filters, as described in SOP 7131.
- After sampling is complete, all used tubing and filters shall be disposed of appropriately.
- Centrifugal pumps are generally not recommended for use in sample collection, especially when volatile organic compounds are the target analyte of interest. Samples for other analytes, however, may be obtained with use of an in-line sample trap. It is suggested that if samples cannot be obtained before going through the pump, that samples be obtained by using a bailer once purging is complete and pumping has ceased. Collecting samples from the pump discharge is not recommended.
- After sampling is complete, all suction line tubing should be disposed of properly.
- The filtration of groundwater samples shall be performed either directly from the pump discharge line or from laboratory-supplied intermediate containers. In either case, well purging

shall be performed first. Fresh groundwater shall then be filtered directly into sample containers.

5 QUALITY CONTROL

5.1 Field Blank/Equipment Blank Sample Collection

Field blank samples serve as a quality assurance check of equipment and field conditions at the time of sampling. Field blank samples are usually prepared by transferring analyte-free water into a clean set of sample containers, then analyzing it as a sample. Sometimes, the analyte-free water is transferred over or through the sampling device before it is placed into the sample containers. This type of field blank sample is known as an equipment blank. The QAPP contains specific information regarding the type and number of field blanks or equipment blanks required for collection.

5.2 Field Duplicate Sample Collection

Field duplicate samples are collected for the purpose of providing two sets of results for comparison. These samples are used to assess precision. Duplicate samples are usually prepared by splitting the sample into two sets of sample containers, then analyzing each set as a separate sample. The QAPP contains specific information regarding the type and number of duplicate samples for collection.

5.3 MS/MSD Sample Collection

MS/MSDs provide information about the effect of the sample matrix on digestion and measurement methodology. For samples submitted for MS/MSD analysis, triple sample volume is generally required (contact the analytical laboratory for information specific to the project analytical parameters). The QAPP contains specific information regarding the frequency of MS/MSD samples.

6 DOCUMENTATION

Specific information regarding sample collection should be documented in several areas: the sample chain-of-custody record, sample collection record, field notebook, and sample labels, tags.

Attachment 1 Low Flow Ground Water Sample Collection Record

Attachment 2 Washington State Department of Ecology Standard Operating Procedure for Purging and Sampling Monitoring Wells plus Guidance on Collecting Samples for Volatiles and other Organic Compounds. Version 2.1, dated 12/06/2016.

Attachment 1 - Low Flow Ground Water Sample Collection Record

Well ID: ____

Date/Time: ____

Personnel: ____

Tide Level: ____

Equipment Used: ____

Time/ Flow Rate	Vol. Remd. (Litters)	Temp (C)	pH	Spec Cond (uS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Color/Odor

Sample Collection: ____

Comments: ____

Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Purging and Sampling Monitoring Wells plus Guidance on Collecting Samples for Volatiles and other Organic Compounds

Version 2.1

Author - Pamela B. Marti
Date -

Unit Approval Martha Maggi, Groundwater/Forests & Fish Unit Supervisor
Date -

QA Approval - William R. Kammin, Ecology Quality Assurance Officer
Date -

EAP078

APPROVED: 10/4/2011
RECERTIFIED: 1/27/2014
RECERTIFIED: 12/06/2016

Signatures on File

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
1/27/2014	2.0	Minor edits all sections, added Appendix B	All, added Append B	Pam Marti
12/01/2016	2.1	Minor editorial changes; no technical changes	all	Pam Marti
12/06/2016	2.1	Cover page, footer, recertification	all	Bill Kammin

TABLE OF CONTENTS

Page

Environmental Assessment Program

Standard operating procedure for purging and sampling monitoring wells.

1.0 Purpose and Scope

1.1 The Environmental Assessment Program (EAP) is responsible for measuring, assessing, and reporting information about the environmental condition and health of Washington's land and water resources. This information is used by resource managers, policymakers, and others to help protect and manage Washington's environment. As such there is a need to document and ensure that consistent and scientifically defensible practices, procedures, and techniques are used by EAP staff, and that the data and information they provide are of consistent and high quality.

1.2 The goals for collecting groundwater samples from monitoring wells are varied, but can include: characterizing ambient conditions, defining the nature and extent of groundwater problems; or determining trends in contaminant concentrations with time, location, or both.

1.3 Groundwater measurements and samples should be as representative of in situ conditions as possible. Several factors such as changes in temperature, pressure, and exposure to air can alter the groundwater chemistry during the sampling process. This SOP summarizes the general procedures and practices that EAP staff use to help ensure that representative groundwater samples are collected when sampling wells that do not typically have installed or dedicated pumps (e.g. monitoring wells).

2.0 Applicability

2.1 This SOP applies to EAP staff collecting and handling groundwater samples from monitoring wells or other wells that do not have a dedicated down-hole pump. It provides general information to help guide field staff in proper purging and sampling techniques. Field staff are encouraged to supplement the information in this SOP by reviewing the large body of existing literature on the science of groundwater sampling (see reference list). Alternative procedures are allowed as long as they are properly documented in the project Quality Assurance Project Plan (QAPP), and provide scientifically valid and legally defensible groundwater data.

2.2 Field staff should be familiar with other standard procedures related to activities described in this SOP (e.g. measurement of groundwater levels, use of GPS equipment, etc.). Depending on the analyte(s) being sampled, there can also be special sample pre-treatment, filtering, post-treatment, and collection procedures that must be adhered to. Digital versions of all EAP SOP's can be found on Ecology's quality assurance page at www.ecy.wa.gov/programs/eap/quality.html.

3.0 Definitions

3.1 Aquifer – An underground layer of saturated permeable/porous rock or sediments (e.g. gravel, sand or silt) that is capable of storing and releasing water to wells and springs.

3.2 Dissolved Oxygen – The relative amount of oxygen that is dissolved or carried in water.

3.3 Data Quality Objectives (DQO's) – Data Quality Objectives are qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions (USEPA, 2006).

3.4 Depth-to-Water – The measured depth to the top of the groundwater surface in a well. Also referred to in this SOP as water level measurement.

3.5 EAP – Environmental Assessment Program

3.6 Ecology – Washington State Department of Ecology

3.7 EIM – Environmental Information Management System. A searchable database of environmental information (e.g. water quality results, etc.) developed and maintained by the Washington State Department of Ecology.

3.8 Field Data Sheets – Weather resistant sheets ("Rite in the Rain" ® writing paper) used to document all field activities, sample data, methods, and observations for each collection site.

3.9 GPS - Global Positioning System

3.10 Measuring Point – A fixed and clearly marked point on a well casing from which depth-to-water/water level measurements are made. Fixed water level measuring points are established to ensure data comparability over time and among field samplers.

3.11 ORP – Oxidation-Reduction Potential. The electric potential required to transfer electrons from one compound or element (the oxidant) to another compound (the reductant). Used as a qualitative measure of the state of oxidation in water.

3.12 pH – A measure of the acidity or alkalinity of water. A pH value of 0 to 7 indicates that an acidic condition is present, while a pH value of 7 to 14 indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

3.13 Quality assurance project plan (QAPP) – A written plan that describes how a study will be conducted and its results assessed.

3.14 Specific Conductance (SC) – A measure of the water's ability to conduct an electrical current. Specific conductance is related to the concentration and charge of dissolved ions in water.

3.15 Static Water Level – The level of water in a well that is not being affected by the withdrawal or injection of water.

3.16 Water table elevation – The elevation of the top water surface of an unconfined aquifer.

4.0 Personnel Qualifications/Responsibilities

4.1 Staff new to groundwater sampling should review the most recent USGS National Field Manual for the Collection of Water-Quality Data (USGS, 1997); The Essential Handbook of Ground-Water Sampling (Nielsen, 2007), or an equivalent, for background information on the principles and techniques of groundwater monitoring. Staff should have a working understanding of the groundwater monitoring needs for their particular project prior to preparing the project Quality Assurance Project Plan (QAPP) and beginning field work.

4.2 Field staff should have a detailed working knowledge of the project QAPP to ensure that credible and useable data are collected, and should be briefed by the field lead on the sampling goals and objectives prior to arriving at the site.

4.3 This document supplements but does not replace the need for on-the-job training. All field staff should be familiar with the sampling equipment and instruments being used. The field lead is responsible for ensuring that all field staff adhere to prescribed sampling methods when conducting field work.

4.4 EAP staff who conduct groundwater sampling are responsible for complying with this SOP and the requirements of the EAP safety manual - particularly Chapter 1 "General Field Work" and the following sections of Chapter 2: "Groundwater Sampling and Water-Level Measurements" and "Hazardous Waste Sites" (Ecology, 2015).

5.0 General List of Equipment and Supplies

5.1 Sample Measuring and Collecting Equipment
5.1.1 Field data sheets
5.1.2 Water level measuring equipment (e.g. calibrated electric water level meter, graduated steel tape)
5.1.3 Water quality meters and probes (e.g. pH, SC, DO, temperature, ORP)
5.1.4 Probe calibration standards/reagents
5.1.5 Field analytical devices (e.g. spectrophotometer, turbidimeter, etc.)

5.1.6 Flow cell
5.1.7 Pump (submersible, peristaltic, bladder)
5.1.8 Power supply (generator, battery)
5.1.9 Extension cord
5.1.10 Sample tubing and connectors
5.1.11 Sample containers/bottles
5.1.12 Sample preservatives
5.1.13 Sample filters/tubing adapters (analyte specific)
5.1.14 Laboratory grade deionized water for quality assurance samples
5.1.15 Coolers with ice or ice packs
5.1.16 55-gallon barrels (to store and properly dispose of contaminated purge water)

5.2 Cleaning and Disinfecting Supplies

5.2.1 Deionized water
5.2.2 Laboratory grade soap (Liquinox®)
5.2.3 Dilute chlorine bleach solution
5.2.4 Cleaning solvents, if applicable

5.3 Safety Equipment

5.3.1 Nitrile gloves
5.3.2 Hearing protection
5.3.3 Safety goggles
5.3.4 Hard hat
5.3.5 First aid kit
5.3.6 Orange vest, Ecology issued
5.3.7 Traffic cones
5.3.8 Traffic signs, if applicable

5.4 Miscellaneous Equipment

5.4.1 Well location map
5.4.2 All applicable SOPs
5.4.3 Field paper work: property owner contact information, field data sheets, sample bottle labels and tags, chain-of-custody sheets.
5.4.4 Pencils, pens, etc.
5.4.5 Permanent marking pen or paint stick (for marking water level measuring point)
5.4.6 Calculator
5.4.7 Well keys, if applicable
5.4.8 Compass
5.4.9 GPS unit
5.4.10 Digital camera
5.4.11 Paper towels or clean rags
5.4.12 Plastic garbage bags
5.4.13 Plastic sheeting for ground cover
5.4.14 Buckets, plastic 5-gallon
5.4.15 1-liter container (to calibrate purge volume/rate)
5.4.16 Stop watch

5.4.17 Field bag (containing rain gear, rubber boots, work gloves, etc.)
5.4.18 Hand cleaner
5.4.19 Product/Water interface probe, if applicable

5.5 Tools

5.5.1 Steel hand measuring tape (engineer scale)
5.5.2 Socket wrench set
5.5.3 Allen wrench set
5.5.4 Pipe wrenches
5.5.5 Crescent wrenches
5.5.6 Set of screwdrivers
5.5.7 File
5.5.8 Knife
5.5.9 Hammer
5.5.10 Pliers
5.5.11 Hack saw
5.5.12 Crow bar/manhole hook
5.5.13 Shovel
5.5.14 Machete
5.5.15 Whiskbroom
5.5.16 Spare well cover bolts/nuts
5.5.17 Spare well caps/plugs
5.5.18 Spare pad locks/keys
5.5.19 Wire brush
5.5.20 WD-40 (to be used away from the well head)
5.5.21 Bailing device (e.g. cooking baster, peristaltic pump with battery)
5.5.22 Flashlight
5.5.23 Spare batteries (e.g. electric-tape, GPS, flashlight)
5.5.24 Tape (duct tape/electrical tape)
5.5.25 Well tagging equipment

6.0 Summary of Procedure

6.1 Project Planning

6.1.1 A Quality Assurance Project Plan (QAPP) must be completed and approved before collecting water quality samples for analysis. The QAPP details project goals, data quality objectives, quality assurance procedures, sample handling requirements (container requirements, preservation, holding times), and field and laboratory procedures. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Lombard, 2004) provides detailed guidance on developing EAP project plans. A QAPP can reference SOPs for standard field monitoring or measurement procedures; however, non-standard procedures or deviations should be described in detail in the QAPP.

6.1.2 Detailed information should be collected for each well location whenever practical, including: well construction logs, previous water level data, site access agreements, and other relevant information about the well being sampled. An example of a well reconnaissance field form is included in Appendix A.

6.1.3 Well location and construction information for wells that are sampled should be entered into Ecology's Environmental Information Management (EIM) system database.

6.1.3.1 If the well hasn't been previously inventoried, use a GPS receiver when first visiting the well to define a preliminary latitude and longitude coordinate. The field-collected coordinates can be refined using mapping tools when entering the well into the EIM system.

6.1.3.2 If the well hasn't been assigned a Department of Ecology unique well ID tag, then it should be tagged as described in EAP SOP081 *Procedures for Tagging Wells* (Pitz, 2011). Well tags are available from Ecology's Water Resources Program. Securely attach the tag to the well casing, or other permanent, easily-seen fixture of the well. Once a well is tagged, complete the well tag form and submit to Ecology's Water Resource Program along with a copy of the well log.

6.2 Sample Equipment Selection

6.2.1 Selecting equipment for purging and sampling a well requires site and project specific considerations to ensure that all collected samples meet the project objectives and data quality requirements. Groundwater chemistry can be altered by changes in temperature, pressure, and exposure to air that are brought on by the sampling process. Therefore, it is imperative to select sample equipment and follow sampling procedures that minimize these changes. General considerations for equipment selection are discussed below. More detailed information can be found in documents such as the USGS National Field Manual for the Collection of Water-Quality Data, and Nielsen (2007) The Essential Handbook of Ground-Water Sampling.

6.2.2 Factors to consider when selecting sample equipment include: the analytes being evaluated, the type and location of well being sampled, physical characteristics of the well (diameter and total depth), depth to water, the amount of water to be purged, geology adjacent to the screened interval and the groundwater chemistry.

6.2.2.1 Sample equipment must be compatible with the analytes being sampled. This includes the materials the sample equipment is made of, as well as its operation.

6.2.2.2 Sampling equipment can be a source of sample bias or error. Equipment that contacts the sample should be made of inert material to the extent possible. Materials commonly used include high quality stainless steel (pumps), and various forms of plastic (pumps, pump tubing and connectors). As explained by Nielsen (2007), sample materials should not sorb analytes from samples, desorb previously sorbed analytes into samples, leach matrix components that could affect analyte concentrations or cause artifacts, or be physically or chemically degraded by the water chemistry.

6.2.2.3 In general, the softer or more flexible forms of metal or plastic have been found to be more reactive than rigid forms. For example, soft tubing (e.g. silicone, polyvinyl chloride - Tygon®) is found to be more gas permeable and sorptive of organic compounds. It is suitable for sampling inorganic analytes only. The more rigid tubing (e.g. polytetrafluorethylene (Teflon®), polyethylene, and propylene) appear to offer greater performance over other materials for both inorganic and organic analytes (Table 1).

Table 1: General guidelines for selecting equipment on the basis of construction material and target analytes (USGS 1997)

Material	Description	Inorganic	Organic
Plastics			
Polytetrafluorethylene (Teflon® or Teflon-lined polyethylene)	Chemically inert for most analytes.	Yes (Potential source of fluoride)	Yes (Sorption of some organics)
Polypropylene	Relatively inert for inorganic analytes.	Yes	Do not use.
Polyethylene	Relatively inert for inorganic analytes.	Yes	Do not use.
Polyvinyl chloride (PVC)	Relatively inert for inorganic analytes.	Yes	Do not use.
Silicone (Silastic)	Very porous. Relatively inert of most inorganic analytes.	Yes (Potential source of silica)	Do not use.
Nylon	Relatively inert for inorganic analytes.	Yes	Do not use.
Metals			
Stainless Steel, 316-grade (SS 316)	SS-316 metal having the greatest corrosion resistance. (Used for submersible pump casings)	Yes (Potential source of Cr, Ni, Fe, and possibly Mn and Mo if corroded).	Yes (Do not use if corroded).
Stainless Steel, 304-grade (SS 304)	Similar to SS-316, but less corrosion resistant.	Do not use.	Yes (Do not use if corroded).
Other metals: brass, iron, copper, aluminum, and galvanized and carbon steel		Do not use. (except as noted for isotopes)	Yes (Do not use if corroded).

6.2.2.4 Pumps transport water from depth to the land surface by two methods, suction lift or positive pressure. The pumping mechanism for most suction-lift pumps (e.g. peristaltic and centrifugal pumps) is at land surface. Positive-pressure pumps (e.g. submersible and bladder) are placed below the static water level. Pump selection is analyte dependent. In general, suction lift pumps are not recommended for sampling volatile organics because of the vacuum that is created at the intake to draw the sample to the land surface. The vacuum can result in the loss of volatile organics or other dissolved gases.

6.2.2.5 The physical characteristics of a well may also dictate equipment selection. Smaller diameter wells are becoming increasingly common in groundwater investigations. Such wells limit the potential range of equipment that can be used for sample collection (e.g. peristaltic pump, small diameter bladder pump or bailer).

6.2.2.6 The depth to water may also dictate equipment selection. All sample pumps have a defined lift capability. This is the ability of the equipment to move water from the static water level depth to the top of the well casing. For example the lift capability of suction-based pumps (peristaltic and centrifugal pumps) is about 25 feet. Depth to water also effects pump operation, since the pumping rate typically decreases with increased depth to water.

6.2.2.7 Being able to control the pumping rate is an important consideration when selecting sample equipment. Sampling rates should be high enough to fill sample containers efficiently and with minimal exposure to the atmosphere, but low enough to minimize sample alteration by agitation or aeration. This is especially important for sensitive analytes, such as volatile organic compounds and trace metals, which should be taken at low flow rates.

6.3 Field Work Preparation

6.3.1. Prior to sampling, inventory consumable field supplies such as disposable gloves, calibration standards, tubing, filters, etc. Order necessary supplies. Allow ample time for delivery.

6.3.2. Arrangements must be made with Ecology’s Manchester Environmental Laboratory before sampling. The Manchester Environmental Laboratory (MEL) Laboratory User's Manual (Ecology, 2016) contains detailed guidance on the planning steps necessary to request, track, ship, and analyze water quality samples collected in the field.

6.3.2.1. To notify the lab submit a *Pre-sampling Notification* form and a *Sample Container Request* form a minimum of 2 weeks prior to sampling. For large projects the lab should be informed 4-6 weeks prior to sampling. Examples of the lab notification forms are provided in Appendix A.

6.3.2.2. Coordinate with the lab regarding any special arrangements such as contract lab analysis, special courier or delivery of samples.

6.3.2.3. Inventory sample bottles when they arrive to ensure the lab provided the correct type and number.

6.3.3. Establish the order the wells will be sampled. Sample order is either based on logistics or the known or suspected water quality of a sample location. For contaminated sites, wells should be sampled in order of increasing chemical concentrations (known or anticipated). This minimizes the possibility for cross-contamination of the sample equipment.

6.3.3.1. A few days before a planned sampling event contact the property owner, property operator or resident to confirm the sampling date and time and to discuss any site access issues.

6.3.3.2. Before going in the field prepare field data sheets for each well/sample location. It can be helpful to bring previous sample data for each well such as water level, pump intake placement, pump rate, total purge time, stabilized field parameter values, etc. Other sample paperwork should also be filled out as much as possible. Paperwork for a sample event typically includes: bottle labels and tags, and a *Manchester Lab Chain-of-Custody/Lab Analysis Required* form (LAR). Examples of field data sheets are provided in Appendix A.

6.3.3.3. Field data sheets, bottle labels/tags, and laboratory paperwork should include the following information: station name and ID, laboratory number, requested analysis, and sample preservation method if applicable.

6.3.4. Inspect all equipment and verify that water quality field meters are in good working order, calibrate properly, and are fully charged. Calibration procedures are normally outlined in the meter user's manual.

6.3.5. Field equipment, especially equipment being placed in a well, that is going to be reused must be properly cleaned, disinfected, or decontaminated prior to and after use in each well. Cleaning procedure depends on the equipment being used (water level equipment, field parameter probes, down well sample equipment) and the type of well being sampled (e.g. observation well, regulated facility monitoring well).

6.3.5.1. It is recommended that gloves (Nitrile) be worn when cleaning sample equipment. This will help maintain sanitary conditions of the cleaned equipment and will protect the sampler from the cleaning products being used. When not in use, equipment should be placed on a clean surface, such as a clean plastic sheet. If the equipment is not re-used immediately it should be wrapped in plastic sheeting or aluminum foil. Equipment should never be placed on bare soil prior to using it in a well.

6.3.5.2. Water level measuring equipment: rinse the probe and any submerged tape with deionized water before and after use in a well. Wipe or air dry. If the well is suspected or known to be contaminated, the probe and any submerged tape should be wiped with a disinfectant-soaked towel or washed in a 0.1-0.2% laboratory grade soap (e.g. Liquinox) solution, followed by a tap water and deionized water rinse.

6.3.5.3. Water quality field probes may be rinsed with deionized water between sample locations. If the probes are slow to respond and additional cleaning is needed, then the probes should be cleaned and maintained according to the manufacturer's instructions.

6.3.5.4. Down well equipment, such as a submersible pump, should be washed in a laboratory grade soap (e.g. Liquinox) solution. Use a brush to scrub the exterior of the sample equipment. Flush the equipment with the 0.1-0.2% soap solution, then with tap water. Rinse with deionized water. If the pump can be disassembled, wash the separate parts in the detergent solution with a brush, followed by a tap water and deionized water rinse. Parts of the sample equipment that are difficult to submerge while cleaning, like a pumps electrical cable, can be wiped down with a disinfectant-soaked towel and then rinsed thoroughly with deionized water.

6.3.5.5. If the equipment is used in a contaminated well, additional cleaning may be required. The equipment may need a chemical rinse (e.g. acetone, nitric acid, methanol, isopropyl alcohol) depending on what analytes are being sampled. Rinse the equipment with deionized water. Place the equipment on a clean surface to air dry.

6.3.5.6. Equipment that is difficult to clean, such as pump tubing, should be replaced between sample locations. As mentioned previously pump tubing has the potential to provide a source of error because of the amount of contact with the sampled water. Therefore to help prevent possible cross-contamination it is advisable not to reuse sample tubing between sample locations. For long-term projects tubing may be dedicated to a well, but should not be used at other locations.

6.4. Purging and Sampling Procedures

6.4.1. All groundwater sampling follows the same basic standard procedures. These generally include checking and setting up the field sample equipment, collecting an initial water level measurement, installing sample equipment in the well, purging the well at a low flow rate, properly collecting, preserving and labeling all samples, and safely delivering the samples to the lab. Each step should be followed with care to ensure that collected groundwater samples meet-the objectives and data quality requirements of the project.

6.4.2. Upon arriving at a well, set out safety equipment such as traffic cones and signs as needed.

6.4.3. Check the site for hazardous conditions, either physical or chemical.

6.4.4. If needed, spread clean plastic sheeting on the ground around the well to keep sample equipment clean.

6.4.5. Set up and field check sample equipment: water level meter, water quality meters and flow cell, selected pump and power supply, etc.

6.4.5.1. Wear clean disposable powder-free gloves (e.g. Nitrile) when handling all equipment used for collecting and processing samples.

6.4.5.2. If you haven't already done so, calibrate field water quality meters according to the manufacturer's instruction. Field parameters should be measured in a closed-atmosphere flow cell. If for some reason it's not possible to use a flow cell at a particular location, it should be noted on the field data sheet.

6.4.5.3. If a gasoline-powered generator is used for the pump power supply, locate it as far from the well head or sample collection area as possible, preferably downwind.

6.4.6. Remove the well cover and cap. For monitoring wells on regulated facilities you will probably need a key.

6.4.6.1. If the well has not been sampled before, establish and document a water level measuring point using the procedures described in SOP EAP052, *Manual Well Depth and Depth-to-Water Measurements* (Marti, 2009).

6.4.6.2. If the well is equipped with a pressure transducer or other down well instrumentation carefully note its position. Remove the instrumentation from the well according to SOP EAP074, *Use of Submersible Pressure Transducers during Groundwater Studies* (Sinclair and Pitz, 2010). Note the removal time on the field data sheet.

6.4.7. Measure the static water level according to SOP EAP052 (Marti, 2009). Record the water level value, date, and time on the well specific field data sheet (Appendix A). The water level should be measured twice to confirm a stable and accurate measurement. The water level should be measured before inserting any other field equipment into the well.

6.4.7.1. If the well is suspected or known to have free floating product the water level and product thickness should be measured with an interface probe.

6.4.8. It can be helpful to know the amount of standing water in a well, particularly for projects where the purge water needs to be managed and properly disposed. To calculate the amount of standing water in one well volume, use the following information: measured water level, well diameter and total depth. The amount of standing water can be calculated using a variety of methods. One equation is:

Well volume: $V = 0.041 \times HD^2 =$ ____ gallons, where

V is volume of water in the well, in gallons,

H is height of water column in well (i.e. total well depth – measured depth to water), in feet, and
D is the inside diameter of the well casing, in inches

6.4.9. If the well is not equipped with a dedicated sampling system, install a decontaminated pump (e.g. submersible, bladder) or pump tubing (e.g. peristaltic). Slowly lower the equipment through the water column to avoid stirring up particulates.

6.4.9.1. If the well has been sampled before, the final pump intake should be placed at the same depth as used in previous sample events. Record the intake depth on the field data sheets.

6.4.9.2. If the well has not been previously sampled, position the pump intake at a depth prescribed by the project manager/field lead. In most cases the pump intake is set near or within the screened or open interval of the well. The final intake depth depends on the project objectives and should be specified in the QAPP.

6.4.10. Once the pump or pump tubing has been placed in the well, slowly lower the water level probe back into the well to measure water levels throughout purging. This is particularly important for low yield wells.

6.4.11. If the well has been sampled before, review past field data sheets for purge rates, total purge time, stabilized field parameter values, and amount of drawdown if any, prior to sample collection.

6.4.12. Start purging. Set the pump controller to the desired pumping rate. Depending on the target analytes pumping rates can vary from no greater than 1 L/min to as little as 150 mL/min.

6.4.12.1. Use water level measurements to help establish the optimum pump rate (which should not exceed 1L/min for low-flow sampling techniques). Purging should not cause a significant drawdown in the well. Significant drawdown is considered to be 5 percent of the total height of the water column or depth to the top of the screen. If unacceptable drawdown occurs at the initial set pumping rate, gradually decrease the pump rate until the water level stabilizes at an acceptable level. Record the final pump rate on the field data sheet.

6.4.12.2. Use the manufacturer supplied pump regulator rather than a secondary in-line valve system or other after-market device to adjust the pump flow. Managing the flow rate with an after-market device can cause sample agitation and alteration.

6.4.13. Purge water from wells that are not on regulated facilities or related to site cleanup work may be discharged directly to the ground as long as the water is not contaminated. Direct the purge water away from the wellhead and work area. Purge water from wells associated with a regulated facility or cleanup site that is contaminated should be collected and disposed of in accordance with Washington State regulations (Chapter 173-303-400 WAC).

6.4.14. During purging and sample collection the flow should be a smooth, solid stream of water with no air or gas bubbles in the tubing or flow cell. Gradually adjust the pumping rate to eliminate bubbles if present.

6.4.15. Once the flow is constant begin monitoring field parameter values in a flow cell at regular intervals (e.g. 2 to 5 minutes). The frequency of these measurements depends on the pump rate and the estimated time for the field parameters to stabilize. At a minimum, there should be a complete exchange of water in the flow cell between measurements.

6.4.16. Record the field parameter values, time of measurement, water level, and if tracking, the amount of purge water discharged. Note and provide qualifying remarks if parameter readings are anomalous or unstable due to instrument problems. Record observations on the pumped water's appearance (e.g. clarity, odor, etc.) during purging and sampling.

6.4.17. Continue purging until all field parameters stabilize as specified in 6.4.18 or in the project specific QAPP. Monitored field parameters for EAP studies include but are not limited to pH, specific conductance, dissolved oxygen, and water temperature. Field parameters should be specified in the project QAPP.

6.4.18. Field parameters are considered stable when 3 consecutive readings fall within the following stabilization criteria:

pH	± 0.1 standard units
Specific Conductance	± 10.0 µmhos/cm for values < 1000 µmhos/cm
	± 20.0 µmhos/cm for values > 1000 µmhos/cm
Dissolved Oxygen	± 0.05 mg/L for values < 1 mg/L
	± 0.2 mg/L for values > 1 mg/L
Temperature	± 0.1° Celsius
ORP	± 10 millivolts

6.4.18.1. If sampling for metals, turbidity should be measured and have either stabilized or be below 10 NTUs. Turbidity readings should be below 5 NTUs if metals samples will not be filtered.

6.4.19. Once field parameters stabilize conduct any end of purge field parameter analysis (e.g. confirmation of low dissolved oxygen, alkalinity, iron) as specified in the project QAPP.

6.4.20. Collect samples once field parameters stabilize and any other field data has been collected. Do not stop or significantly change the pumping rate during the final phase of purging or while sampling. Purging and sample withdrawal should form a continuous process.

6.4.21. Samples should be collected in a specific order as determined in the project QAPP. The order of sample collection, processing and preservation for specific analytes should be adhered to consistently throughout a project. The recommended sequence for sample collection and processing is often based on logistics for maintaining sample integrity.

6.4.21.1 Sample collection order is usually based on the analytes' sensitivity to change. Those analytes most sensitive to change (e.g. organics) are usually collected first, while analytes less sensitive to change (e.g. nutrients) may be collected last.

6.4.21.2 The sequence can be modified, depending on the types of samples to be collected and on data objectives. The relative importance of each analyte should be evaluated by project. Samples for analytes of most interest may be collected first to ensure that a representative sample is obtained. This is particularly important when sampling low-yielding wells which may not have a sufficient volume of water to fill all sample containers.

6.4.21.3 Modification in sample order may also be necessary to maintain sample integrity. For example, sulfate samples should be collected before samples preserved with sulfuric acid (e.g. nitrogen series, phenolics). This can prevent the accidental contamination of an unpreserved sulfate sample with sulfuric acid preservative used for another sample. Likewise, nitrogen series samples should be collected before samples preserved with nitric acid (e.g. total and dissolved metals).

6.4.21.4 When filtering samples for several analytical parameters they should be filtered in a specific order so that the analytical concentration will not be significantly affected as the pore size of the filter decreases as more water passes through it. For example the USGS recommends the following filter sequence: trace elements, mercury, major cations, major anions and nutrients (including alkalinity), radiochemicals, and stable isotopes (Wilde, 2004).

6.4.22. Change to clean disposable powder free gloves.

6.4.23. Prepare sample containers. To avoid possible container contamination, keep sample containers capped until it's time to fill them.

6.4.24. Sample containers should be filled by transferring water directly from the sampling apparatus (discharge tubing, filters, etc.) into the appropriate sample container. During sample collection the discharge line/filter should be close to but not touching the sample container.

6.4.24.1. Analyte specific sampling procedures are provided in Appendix B for volatile compounds and other organics. Sample procedure for general chemistry parameters and metals are described in SOP EAP099, *Purging and Sampling Monitoring Wells for General Chemistry Parameters* (Carey, 2016) and SOP EAP100, *Collecting Groundwater Samples for Metals Analysis from Monitoring Wells* (Pitz, 2015).

6.4.24.2. All samples requiring preservation must be preserved as soon as practical. Refer to analyte specific SOPs for proper preservation methods.

6.4.24.3. Collect quality control (QC) samples such as a field replicate from the well(s) specified in the project QAPP. Field replicate samples are collected by alternating the sample stream between two of the same type sample containers.

6.4.24.4. Collect any additional QC samples before leaving the site. These may include field blanks (e.g. filter, equipment, transport). The types and numbers of quality control samples should be specified in the project QAPP.

6.4.25. Label sample containers and immediately place in an ice filled cooler. Samples must remain at or below 6°C throughout handling, storage, and shipping. Do not freeze samples.

6.4.26. Record sample date and time, final water level, and total purge volume on the field data sheet. Record any final observations or comments related to sample collection.

6.4.27. Follow the procedures in the project QAPP or Manchester Lab Manual for sample handling and management (e.g. chain of custody, sample courier service or any special shipping requirements or restrictions).

6.4.27.1. Be conscious of analytical holding times and minimize the time between sampling and delivery to the laboratory.

6.4.28. If the well is equipped with a transducer or other down well instrumentation that was removed during sampling, replace the equipment according to SOP EAP074, *Use of Submersible Pressure Transducers during Groundwater Studies* (Sinclair and Pitz 2010). Note the reinstall time on the field data sheet,

6.4.29. When all work at the well site is complete, properly close and secure the well.

6.4.30. Note any physical changes to the well on the field data sheets, such as erosion or cracks in the protective concrete pad or alteration to the well casing.

6.4.31. All equipment used to collect groundwater samples should be cleaned or disinfected as previously described. Store the equipment for transport to the next sample location or at the conclusion of the field study.

6.5. Low Volume and Poor Recovery Wells - Purging and Sampling Procedures

6.5.1. Even with a low pumping rate, some wells experience significant drawdown or in extreme cases may even purge dry. Slow recovering wells or wells that purge dry require extra care in order to be purged and sampled with minimal disturbance to the water column and fine materials in and around the well screen.

6.5.2. For low volume and poor recovery wells, review past field data sheets if available for previous purge rates, amounts of drawdown, and purge volume prior to sample collection.

6.5.3. Measure the well's water level as described in steps 6.4.6. and 6.4.7.

6.5.4. If you suspect the well may be low yielding, calculate the amount of standing water in one well volume as described in step 6.4.8.

6.5.5. If the well is not equipped with a dedicated sampling system, install a decontaminated pump or pump tubing. Slowly lower the equipment through the water column to avoid stirring up particulates. The final pump intake depth should be near the bottom of the screened interval. To prevent stirring up particulates it is important not to touch the well bottom. Record the intake depth on the field data sheet.

6.5.6. Once the pump or pump tubing is in place, slowly lower the water level probe back into the well. It is important to frequently measure the water level throughout purging in low volume or poor recovery wells to enable the pump rate to be adjusted downward if necessary.

6.5.7. Start purging at a rate less than 0.5 liter per minute if the pump capacity allows. Record the pump rate on the field data sheet.

6.5.8. At regular intervals record field parameter values, water level, time of measurement, and amount of purge water discharged. Allow at least one complete exchange of water in the flow cell between measurements. Note and provide qualifying remarks if parameter readings are anomalous, the water level is dropping or if at some point the water level stabilizes. Record observations on the pumped waters appearance (e.g. clarity, odor, etc.) during purging and sampling.

6.5.9. Continue purging until field parameters stabilize per section 6.4.18. Attempts should be made to avoid purging low yielding wells dry. However, if this is not possible shut the pump off and allow the well to recover at least once before collecting samples. This generally constitutes an adequate purge, and the well can be sampled as soon as it has recovered sufficiently to produce an adequate volume of water to fill the sample containers. If time permits, purge the well a second time and allow it to recover before sampling. Samples should be collected within 24 hours of the final purge/recovery cycle.

6.5.9.1. It should be noted that there can be significant alterations in groundwater chemistry when a well is purged dry and allowed to recover before sampling. Groundwater chemistry can change as formation water surrounding or entering the screened interval of the well is exposed to air which can affect volatile organics and redox sensitive analytes. Increased turbidity can also be an issue when sampling metals and some general chemistry parameters (Nielsen, 2007).

6.5.10. Collect samples once field parameters stabilize and any end of purge analysis has been conducted.

6.5.10.1. If the well has been purged dry and allowed to recover, field parameters should be measured after sample collection if there is an adequate volume of water.

6.5.11. Sample containers should be filled in the order specified in the project QAPP. However, when sampling low-yielding wells which may not have a sufficient volume of water to fill all the sample containers, the relative importance of each analyte should be evaluated. Samples for analytes of most interest should be collected first to ensure a representative sample is obtained. Discuss with the lab the minimum volume of sample needed for each analyte.

6.5.12. Fill, preserve, label and store sample containers as described in steps 6.4.24. through 6.4.27. Follow analyte specific sampling procedures which are provided in Appendix B for volatile compounds and other organics. Follow analyte specific sampling procedures for general chemistry parameters and metals as described in SOP EAP099, *Purging and Sampling Monitoring Wells for General Chemistry Parameters* (Carey, 2016) and SOP EAP100, *Collecting Groundwater Samples for Metals Analysis from Monitoring Wells* (Pitz, 2015).

6.5.13. Record sample date and time, final water level, and total purge volume on the field data sheet. Record any final observations or comments related to sample collection such as elapsed time for complete purge of the well and recovery rate of the well.

6.5.14. Follow the procedures in the project QAPP or Manchester Lab Manual for sample handling and management (e.g. chain of custody, sample courier service or any special shipping requirements or restrictions). Be conscious of analytical holding times and minimize the time between sampling and delivery to the laboratory.

6.5.15. Replace any down well instrumentation according to EAP074, *Use of Submersible Pressure Transducers during Groundwater Studies* (Sinclair and Pitz, 2010). Note the reinstall time on the field data sheet.

6.5.16. Properly close and secure the well.

6.5.17. Note any physical changes to the well on the field data sheets, such as erosion or cracks in the protective concrete pad or alteration to the well casing.

6.5.18. All equipment used to collect groundwater samples should be cleaned or disinfected as previously described. Store the equipment for transport to the next sample location or at the conclusion of the field study.

7.0 Records Management

7.1 Monitoring wells that EAP samples must be documented to enable information about their location, construction, and subsequent monitoring data to be archived in Ecology's Environmental Information Management (EIM) system and well log imaging databases. Consult the EIM help documents for a list of the well specific metadata required by EIM.

7.2 Station information and monitoring notes should be documented, during each site visit on site specific field data sheets. Examples are presented in Appendix A. All field entries should be neat and concise. The field lead is responsible for reviewing the form(s) for completeness before leaving a field site.

7.3 EAP staff have developed a number of data analysis spreadsheets, field forms, and other tools to standardize data collection and processing for groundwater monitoring projects. See the EAP Groundwater Assessment SharePoint site for the most up-to-date version of these tools. Examples of some of the field forms are provided in Appendix A.

7.4 All hardcopy documentation, such as well reports and field data sheets, are kept and maintained by the project lead. At the completion of a project, hardcopies are boxed and moved to EAP archives.

8.0 Quality Control and Quality Assurance

8.1 To ensure that good quality data are obtained throughout a project, a Quality Assurance Project Plan (QAPP) must be completed and approved before performing any field work. The QAPP details project goals, data quality objectives, quality assurance program procedures, sample handling requirements, and field and laboratory procedures.

8.2 Both the equipment and procedures used in collecting and handling groundwater samples have limitations that introduce a certain level of error, variability and bias into the final analytical results. To minimize the level of error, all field staff should follow these general QA/QC procedures when collecting samples:

8.2.1. Follow the project QAPP and any applicable standard operating procedures (SOP) when collecting and handling samples.

8.2.2. Calibrate and maintain field water quality meters according to the manufacturer instructions. Document the calibration in the field notes.

8.2.3. Use equipment to purge and sample that is compatible with the characteristics of the well and analytes being sampled. Operate equipment in accordance with the manufacturer instructions, unless otherwise specified in the project QAPP.

8.2.4. Properly collect, handle, and store samples.

8.2.5. Collect the appropriate quality control samples. These may include a field replicate, and field blanks (e.g. filter, equipment, transport). The types and number of quality control samples should be specified in the project QAPP.

8.2.6. Follow the procedures in the project QAPP or Manchester Lab Manual for sample handling and management (e.g. chain of custody).

8.2.7. Document all data, observations, notes, deviations from project QAPP, etc. on the field data sheets and other project paperwork.

8.2.8. Properly clean, maintain, and store all field equipment after use.

8.2.9. Use consistent procedures from well to well.

9.0 Safety

9.1 Proper safety precautions must be observed when collecting groundwater samples. Field work should follow protocols described in the Environmental Assessment Program Safety Manual (Ecology, 2015). A working knowledge of sections "Groundwater Sampling and Water-Level Measurements" and "Hazardous Waste Sites" in Chapter 2 is expected. Protocols in the EAP Safety Manual should be used to complement the judgment of an experienced field professional.

9.2 A Field Work Plan form must be completed to document field personnel, sampling locations, overnight lodging, planned itinerary, contact person(s), and emergency contacts. If using a boat to access a site an Ecology Float Plan must be completed.

9.3 Always consider the safety situations when sampling a monitoring well. In addition to the possible chemical hazards if the water to be sampled is contaminated, there are many physical hazards associated with sampling monitoring wells. Monitoring wells are frequently located on or near active business or industrial sites, so field staff must remain aware of the typical hazards associated with these sites such as traffic. Many wells are located in parking lots, alleyways, or along roadways. Consult the EAP Safety Manual for further guidance regarding working near traffic. Other physical hazards can include heavy lifting, noise, electricity, steep, slippery, or uneven terrain, animals or insects, and the weather.

9.4 All EA Program field staff who work on hazardous-waste sites are required to complete and maintain certification in FIRST AID/CPR and the 40-hour Hazardous Materials Safety & Health Training.

10.0 References

10.1 Carey, B.M., 2016. Standard Operating Procedure for Purging and Sampling Monitoring Wells for General Chemistry Parameters. Washington State Department of Ecology, Environmental Assessment Program, EAP099.

10.2 Driscoll, F. G., 1986, Groundwater and Wells, 2nd Edition, Johnson Filtration Systems, Inc., St. Paul, Minn., 1089 p.

10.3 Lane, S.L., Flanagan, Sarah, and Wilde, F.D., 2003, Selection of Equipment for Water Sampling (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A2. http://pubs.water.usgs.gov/twri9A2

10.4 Lombard, S. and C. Kirchmer, 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology, Environmental Assessment Program. https://fortress.wa.gov/ecy/publications/summarypages/0403030.html

10.5 Marti, P.B., 2009. Standard Operating Procedure for Manual Well-Depth and Depth-to-Water Measurements. Washington State Department of Ecology, Environmental Assessment Program, EAP052.

10.6 Nielsen, D.M. and G.L. Nielsen, 2007. The Essential Handbook of Ground-Water Sampling. CRC Press. 309 p.

10.7 Parker, Louise V., 1994, The Effects of Ground Water Sampling Devices on Water Quality: A Literature Review, Ground Water Monitoring Review, Vol. 14, No. 2, p. 130-141.

10.8 Pitz, C., 2011. Standard Operating Procedure for Tagging Wells. Washington State Department of Ecology, Environmental Assessment Program, EAP081.

10.9 Pitz, C., 2015. Standard Operating Procedure for Collecting Groundwater Samples for Metals Analysis from Monitoring Wells. Washington State Department of Ecology, Environmental Assessment Program, EAP100.

10.10 Puls, R.W. and Paul, C.J., 1995, Low-flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems, Ground Water Monitoring and Remediation; Vol. 15, N. 1, p. 116-123.

10.11 Puls, R.W., and Barcelona, M.J., 1996, Low-flow (minimal drawdown) Ground-Water Sampling Procedures, U.S. Environmental Protection Agency, Ground-Water Issue Paper EPA/540/S-95/504, 12 p. Sinclair, K. and C. Pitz, 2010. Standard Operating Procedure for Use of Submersible Pressure Transducers during Groundwater Studies. Washington State Department of Ecology, Environmental Assessment Program, EAP074.

10.12 U.S. Environmental Protection Agency, 2006. Guidance on Systematic Planning Using the Data Quality Objective Process. EPA QA/G-4.

10.13 U.S. Geological Survey, 1995, Groundwater Data Collection Protocols and Procedures for the National Water Quality Assessment Program: Collection and Documentation of Water Quality Samples and Related Data, U.S. Geological Survey Report 95-399. http://water.usgs.gov/nawqa/OFR95-399.html

10.14 U.S. Geological Survey, 1997 to present, National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, available online at http://pubs.water.usgs.gov/twri9A

10.15 Washington State Department of Ecology, 2016. Manchester Environmental Laboratory - Lab Users Manual. 10th edition.

10.16 Washington State Department of Ecology, 2015. Environmental Assessment Program, Safety Manual.

10.17 Wilde, F.D., Radtke, D.B., Gibs, Jacob, and Iwatsubo, R.T., eds., 2004 with updates through 2009, Processing of Water Ssamples (version 2.2): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A5. http://water.usgs.gov/owq/FieldManual/chapter5/html/Ch5_contents.html

10.18 Wisconsin Department of Natural Resources, 1996, Groundwater Sampling Field Manual, Publication No. PUBL-DG-038 96, 82 p.

10.19 Wisconsin Department of Natural Resources, 1996, Groundwater Sampling Desk Reference Parts A and B, Publication No. PUBL-DG-037 96,

Appendix A: Example Field Forms

EAP has developed several spreadsheet templates and field form to speed and where possible automate the tasks required to evaluate, install, and process groundwater sampling data. Examples of commonly used forms are included here. See EAP's Groundwater Assessment SharePoint site for up-to-date versions. These tools and forms can easily be modified to accommodate the needs of particular instruments or projects.

Well Reconnaissance Field Sheet

Date: ______________________ **Time:** ______________________

Field Crew: ______________________

Well ID: ______________________

Well Tag ID: ______________________

Well Owner Name: ______________________

Facility Name: ______________________

Current Phone Number: ______________________

Current Mailing Address: ______________________

____

____

Renter? ☐ **Name:** ______________________

Permission granted to locate well? ☐

Permission granted to collect Water Level? ☐

Permission granted to sample well for Water Quality? ☐

Permission granted to tag well? ☐ **Tagged?** ☐

Call ahead required before site visit? ☐

Recon GPS Well Coordinates:

Recording Datum: **NAD83HARN** ☐ **NAD83** ☐ **NAD27** ☐

DDLAT: ______________________ **DDLONG** ______________________

Wellhead Photo #: ______________________

Comments: ______________________

____

____

____

____

____

____

Add sketch map of well location on back

Water Level Data Field Sheet

Well Tag #:

Well Study Name:

DDLAT:

DDLONG

T:

R:

SEC:

Recording Datum:

NAD83HARN:

NAD83:

Well Owner:

Well Address

MP Height: **(ft)**

MP Date / /

Photo

MP Description:

Date	Time (PST or PDT)	Hold (ft)	Cut (ft)	Depth Below MP (ft)	Water Level (below LSD)	Status	Mthd.	Accu.	Remark
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									

Date	Time (PST or PDT)	Hold (ft)	Cut (ft)	Depth Below MP (ft)	Water Level (below LSD)	Status	Mthd.	Accu.	Remark
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									
/ /									

Status Codes

D	E	F	G	H	I	J	N	O	P	R	S	T	V	W	X	Z
Dry	Recently Flowing	Flowing	Nearby Flowing	Nearby Recently Flowing	Injector	Site Monitor	Discon-tinued measuring	Obstruction	Pump-ing	Recently Pumped	Nearby Pumping	Nearby Recently Pumping	Foreign Matter on Water	Well Des-troyed	Affected by Surface Water Site	Other

Method of Measurement Codes

A	B	C	E	G	H	L	M	N	R	S	T	V	Z
Airline	Analog	Cal. Airline	Estimate	Pressure Gage	Cal. Pressure Gage	Geophys Log	Mano-meter	Non-Recording Gage	Reported	Steel Tape	Electric Tape	Calibrated E-tape	Other

Measurement Accuracy Codes

0	1	2
±1 FT	±0.1 FT	±0.01 FT

Well Name: ______________________________

Well Tag ID: ______________________________

Groundwater Quality Sampling Field Sheet

Well Tag ID: ____________________ **Well Name:** ____________________

Well Owner: ____

Well Address: ____

Date: ________ / ______ / ________ **Sample Time (PST/PDT):** ____________________

Lab Sample #: ____________________ **Crew:** ____________________

Pumping Rate: ____________________ **Meter:** ____________________

Duplicate: ☐ **Equipment Blank:** ☐ **Reference:** ☐

Duplicate Lab Sample #: ____________________ **Equipment Blank Lab #:** ____________________

Purge Parameters:

Time	pH	Temp. (ºC)	Cond. (µS/cm)	DO (mg/L)	Water level (feet)

Groundwater Quality Sampling Field Sheet (cont.)

Well Tag ID: ______________________ **Well Name:** ______________________

Purge Parameters (cont.):

Time	pH	Temp (°C)	Cond (µS/cm)	DO (mg/L)

Photometric O_2 : **Kit:** ______________ **Conc.** ______________

Photometric O_2 : **Kit:** ______________ **Conc.** ______________

Colormetric O_2 : ______________________________

Field Alkalinity : **Kit:** ______________ **Conc.** ______________

ORP: ______________________________

Other: ______________________________

Comments :

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Sample Container Request Form

Please FAX to Leon Weiks: (360) 871-8850
(Phone for Leon Weiks: (360) 871-8825)

Requestor: ______________________________

Project Name: ____________________

Phone: _________________________________

Today's Date: ____________________

Location for Delivery: ____________________

Date Needed by: __________________

Index #	Description	Qty.
1	1 gallon jar *	
2	1/2 gallon jar *	
3	1 liter jar * (wide mouth) (special request only)	
4	1 liter jar (narrow mouth) (oil & grease) **	
5	8 oz short jar *	
6	8 oz short jar **	
8	4 oz short jar *	
9	4 oz short jar **	
11	40 mL vial w/septum *	
13	2 oz short jar w/septum * (Volatiles: solids only)	
14	125 mL amber glass bottle * (carbamate)	
15	1 liter amber bottle * (narrow mouth)	
16	500 mL HDPE bottle (metals)	
17	1 gallon cubitainer	
19	125 mL clear Nalgene (nutrients or COD; bottle contains 1:1 sulfuric acid)	
20	125 mL amber Nalgene (filters and syringe also required for orthophosphate)	
21	125 mL polypropylene bottle (hardness - bottle contains acid) **For Hexachrome, request bottle without acid**	

Index #	Description	Qty.
22	500 mL poly bottle	
23	1000 mL poly bottle	
24	1000 mL amber poly	
25	250 mL amber poly bottle (Cyanide) (contains Sodium Hydroxide)	
26	60 mL poly bottle (TOC/DOC or TP; bottle contains 1:1 hydrochloric acid)	
27	250 mL glass or poly bottle (fecal coli)	
28	500 mL glass bottle or poly (multiple micro tests)	
29	250 mL glass or poly bottle **with thiosulfate** (fecal coliform - chlorinated)	
30	500 mL glass or poly bottle **with thiosulfate** (multiple micro tests - chlorinated)	
31	8 oz plastic jar (grain size only)	
32	1 liter jar ** with **sulfuric acid** (wide mouth, clear; for phenolics)	
33	sterile specimen cup (micro)	
34	2 oz short jar (TOC - NO septum)**	
35	Soil VOA/BTEX Airtight Sampling Capsules (3 per sample)	
36	Soil VOA/BTEX Sampling Handle (1 per sampling event)	
	Other Supplies	

*organic free with Teflon lined lids, with Certificate of Analysis. **same as "*" but does not include Certificate of Analysis.

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

PRE-Sampling Notification

Fax to Manchester Laboratory: (360) 871-8850

☐ Enforcement

Project Name: ________________________________ **SIC:** ______ ☐ Monitoring _

Requested by: ____ Sampling Date(s): ______ ☐ Emergency _

Program: ____ Date to Lab: ______ ☐ Class II _

Phone No.: ____ Sample Pickup Location: ______ ☐ Preliminary Invest. _

QAPP: ☐ Yes ☐ No Date results needed by: __________ ☐ Special turnaround

General Chemistry	W	S	O	Microbiology		W	S	O	Organic Chemistry	W	S	O
Alkalinity		▨	▨	Fecal Coliforms ☐ MF ☐ MPN					Base/Neutral/Acids (BNA)			
Conductivity		▨	▨	E. Coli MF ☐ “MUG” ☐ mTEC2					Polynuclear Aromatics (PAH)			
Hardness		▨	▨	E. Coli MPN								
pH				% Klebsiella					Volatile Organic Analysis (VOA)			
Turbidity		▨	▨						BTEX			
☐ Fluoride ☐ Chloride ☐ Sulfate									Pest/PCB's (Organochlorine)			
Cyanide ☐ Total ☐ Dissociable				**Metals**	**W_T**	**W_D**	**S**	**O**	Pesticides only (Organochlorine)			
Total Solids		▨	▨	Priority Pollutant Metals (13 elements)					PCB's only			
Total Nonvolatile Solids		▨	▨	TCLP metals					OP - Pests (Organophosphorous)			
Total Suspended Solids		▨	▨	Hardness					Herbicides (Chlorophenoxy)			
Total Nonvolatile Suspended		▨	▨						Nitrogen Pesticides			
Total Dissolved Solids		▨	▨	Mercury (Hg) ☐ Low Level ☐ Regular					PCL Pesticides (8085)			
Chlorophyll ☐ Filtered in field ☐ Filtered at lab		▨		Other: List individual elements:					PBDEs			
% Solids	▨								Hydrocarbon ID (match to source)			
% Volatile Solids (TVS)	▨								TPH-ID (gas/diesel/oil)			
Total Organic Carbon									TPH-G_X			
Dissolved Organic Carbon									TPH-D_X			
Biochemical Oxygen Demand (BOD) 5 day		▨	▨									
BOD - Inhibited		▨	▨						TCLP-VOA			
BOD - Ultimate		▨	▨						TCLP-BNA			
Ammonia			▨						TCLP-Herbicides			
Nitrate-Nitrite			▨						TCLP-Pesticides			
Orthophosphate			▨									
Total Phosphorous			▨									
☐ TPN ☐ TKN			▨	Asbestos								

Comments: Enter the number of samples in the appropriate box(es) above.

W = water S = soil/sediment O = other (please specify) W_{TR} = water total W_D = water dissolved

Project Name: ____________________

SIC: ___ ___ ___ ___ ___ **Program:** ____________________

☐ Preliminary Investigation ☐ For HW Designation **Date Results needed by:** ____________________

Send Results to: ____________________ **Mail Stop:** ____________________

☐ Monitoring ☐ For NPDES **Name/Reference # of QAPP for this project:** ____________________

Sampling							General Chemistry																			Micro					Metals					Organic Chemistry														
Date Year: ☐ Mo Day	Time (Military) 0001 - 2400 Hr Mn	Field Station Identification	Manchester Lab Sample Number	Matrix Code	Source Code	No. of Containers	Alkalinity	Conductivity	pH	Turbidity	☐ Chloride ☐ Sulfate	Fluoride	Total Suspended Solids	Total Dissolved Solids	☐ Total Solids ☐ % Sol ☐ Vol Sol	TOC	DOC	BOD5	Oil & Grease (HEM)	Ammonia	Nitrite/Nitrate	Total Phosphorus	Orthophosphate	TPN	Chlorophyll ☐ filters	Fecal Coliform ☐ MF ☐ MPN	Total Coliform ☐ MF ☐ MPN	E. Coli ☐ MF ☐ MPN	% Klebsiella	Enterococcus	PP Mets	Mercury (Hg) ☐ low level	Hardness	Individual Elements (please list)	☐ Total ☐ Dissolved	VOA	BTEX	TPHG	TPHD	HCID Only (Hydrocarbon ID)	PCB aroclors	☐ Pest 1 ☐ w/PCB aroclors	☐ Pest 2 ☐ w/PCB aroclors	☐ Pest 3 ☐ w/PCB aroclors	Carbamates	PESTMS	Herbicides	PBDE	BNA	PAH

Project Officer: ____________________

Phone Number: ____________________

Cell Number: ____________________

Samplers: ____________________

Chain of Custody Record

Relinquished By:	Received By:	Yr	Mo	Da	Hr	Mn	Seal I.D.	Condition of Seals	Comments (Temperature, Preserv., etc.)

Recorder: ____________________ Comments: ____________________

Matrix Codes

Code Description
10 Water
11 Field Filtered Water
12 Filter from Water
13 Water to be filtered upon receipt at lab
40 Soil/Sediment
41 Frozen Soil/Sediment (PSEP)
45 Semi-Solid/Sludge
70 Tissue
80 Oil/Solvent
90 Waste
00 Other (Use only if no other apply)

Source Codes

Code Description
00 Unspecified Source
01 Unknown Liquid Media (Drum/Tank)
02 Unknown Liquid Media (Spill Area)
03 Unknown Liquid Media (Waste Pond)
10 Water (General)
12 Ambient Stream/River
13 Lake Reservoir
14 Estuary/Ocean
15 Spring/Seepage
16 Rain
17 Surface Runoff/Pond (general)
18 Irrigation Canal/Return Flow
20 Well (General)
21 Well (Industrial/Agricultural)
22 Well (Drinking Water Supply)
23 Well (Test/Observation)
24 Drinking Water Intake
25 Drinking Water (At Tap)
30 Effluent Wastewater (General)
31 Municipal Effluent
32 Municipal Inplant Waters
33 Industrial Surface Runoff/Leachate
34 Industrial Effluent
35 Industrial Inplant Waters
36 Industrial Surface Runoff/Pond
37 Industrial Waste Pond
38 Landfill Runoff/Pond/Leachate
40 Sediment (General)
42 Bottom Sediment or Deposit
44 Sludge (General)
45 Sludge (WastePond)
46 Sludge (Drum/Tank)
48 Soil (General)
49 Soil (Spill/Contaminated Area)

Code Description

50 Bore Hole Material
60 Air (General)
61 Ambient Air
62 Source or Effluent Air
63 Industrial or Workroom Air
70 Tissue (General)
71 Fish Tissue
72 Shellfish Tissue
73 Bird Tissue
74 Mammal Tissue
75 Macroinvertebrate
76 Algae
77 Periphyton
78 Plant/Vegetation
80 Oil/Solvent (General)
81 Oil (Transformer/Capacitor)
82 Oil/Solvent (Drum Tank)
83 Oil/Solvent (Spill Area)
84 Oil/Solvent (Waste/Pond)
90 Commercial Product Formulation
95 Well Drill Water
96 Well Drill Mud
97 Well Sealing Material
98 Gravel Pack Material

Appendix B:
Collecting Samples for Volatile Organics and other Organic Compounds

This Appendix applies to EAP staff collecting and handling groundwater samples for volatile organic compounds (VOCs) and other organic compounds (e.g. semi-volatiles, total petroleum hydrocarbons, polynuclear aromatic hydrocarbons, pesticides, polychlorinated biphenyls).

It describes common procedures and practices that EAP staff use to collect these samples from wells without dedicated sampling pumps. General information is provided here and in Section 6.0 of this SOP to help guide field staff in the selection of proper sample equipment and sampling techniques. There are several documents that provide detailed information on this topic, including the USGS National Field Manual for the Collection of Water-Quality Data (USGS, 1997) and The Essential Handbook of Ground-Water Sampling (Nielsen, 2007).

Sample Equipment Selection

Selecting equipment for purging and sampling a well for VOCs, other volatile analytes and organics requires specific considerations, preparations and precautions. All sample-contact components of the equipment used should be constructed of stainless steel or Teflon®. The manner of sample equipment operation must be compatible with characteristics of the well and the analytes being sampled to obtain data that will meet the project objectives and data quality requirements.

When sampling for volatile analytes sample equipment should be chosen to minimize changes in pressure, temperature and atmospheric exposure of the water pulled from the aquifer. For this reason these samples should be collected with positive pressure/displacement pumps. Positive pressure pumps most commonly used by EAP are stainless steel submersible or bladder pumps.

Although peristaltic pumps are regularly used to purge and sample monitoring wells they are not recommended for sampling volatile analytes. Peristaltic pumps are negative pressure or suction lift pumps that create a vacuum in the intake line that draws the sample to the land surface. The vacuum can result in the loss of volatile analytes.

Following are some basic considerations for the most commonly used sample equipment.

Submersible and Bladder Pumps

Submersible and bladder pumps have similar operating requirements. Both are lowered into the well's water column. The pumps should be slowly lowered through the water column to avoid stirring up particulates or aerating the water in the well casing.

It is recommended that the intake depth of the pump and pumping rate for wells that are sampled repeatedly remain the same for all sample events. Typically the pump intake is placed at the midpoint or the lowest historical midpoint of the saturated screen length. The pump intake depth will be determined by the project manager and should be specified in the QAPP.

Both submersible and bladder pump need to be completely submerged to operate properly. Consult with the pump manufacturer to determine the minimum height of the water column above the pump for it to operate properly. This can range from 1 foot to more than 5 feet.

If possible the pump intake should be at least two feet above the bottom of the well, to minimize mobilization and uptake of particulates present in the well bottom.

Ideally, the pumping rate should be set so as not to cause significant drawdown in the well. Wells should be pumped at a rate that is equal to or less than the natural flow conditions of the aquifer in the screened interval to avoid drawing the water level down.

Small diameter bladder pumps are available for sampling small diameter wells which are becoming increasingly common in groundwater investigations.

Careful considerations should be given to placing pumps in wells that are excessively contaminated with free product (LNAPL or DNAPL) because it may be difficult to adequately decontaminate severely contaminated pumps in the field. When wells of this type are encountered, alternative sampling methods should be considered such as a peristaltic pump or bailer.

Peristaltic Pumps

Peristaltic pumps are generally not recommended for sampling volatile analytes because of the potential loss of analytes due to pump operation.

If a peristaltic pump is being considered to sample volatile analytes, the intended use of the data should be a primary consideration.

- Use of the pump may be acceptable if the additional sample error that may be introduced by the negative pressure/vacuum created by the pumps operation does not affect any project decision making. For example, if contaminant concentrations are far above regulatory levels and groundwater monitoring will continue, then a peristaltic pump could be used. However, the data should only be used to qualitatively evaluate the presence of the contaminants.

- A peristaltic pump should not be used if minor differences in the groundwater concentrations of volatile analytes could affect project decisions. For example, do not use a peristaltic pump when monitoring groundwater remediation to determine if cleanup goals have been achieved. In these cases sample equipment should be selected that will provide more accurate results.

Peristaltic pumps may be used to sample if the physical characteristics of the well limits other sample equipment options, such as when sampling smaller diameter wells. Small diameter tubing used with a peristaltic pump is a possible option. However, the tubing used in the rotor head of the peristaltic pump should be less than a foot in length since it is found to be more gas permeable and sorptive of organic compounds. This tubing should be replaced at each sample location. PharMed tubing is now recommend for use in the pump rotor head since it has been found to be less permeable to gas and vapors as compared to other soft tubing options.

Peristaltic pumps may also be used in low yielding wells that do not have sufficient water to operate a submersible pump.

Bailers

Even though bailers are not recommended for most groundwater sampling, they are useful in specific situations.

The use of bailers is discouraged because the repeated entry and removal of the bailer disturbs the water column and may mobilize sediment that is present in the well. The repeated disturbance to the water column can also aerate the water in the well casing.

However, in wells that are excessively contaminated with oily compounds, bailers can be an acceptable alternative to pumps. Bailers are easier to clean or can be disposable.

If a bailer is used to sample for volatile organic compounds, it should be a closed-top Teflon® bailer with a bottom-emptying sample device. The bailer should be lowered and raised smoothly at a constant rate and with as little disturbance to the water column as possible.

Passive Samplers

Although EAP does not have direct experience with passive samplers the devices are an emerging technology for evaluating volatile organics and other analytes in groundwater.

Passive samplers are no-purge sampling devices designed to collect samples from a specific depth within a well that is in ambient equilibrium with the adjacent groundwater. There are a variety of passive samplers, these include: devices that rely on sorption or diffusion onto or across the sampler medium to devices that recover grab samples at discrete depths.

If considering a passive sampling device for your project, consult with the manufacturer to determine if the technology is compatible with the project goals and site conditions.

Sampling Considerations for Volatile Analytes

The following are general considerations when collecting samples for volatile analytes. Please refer to Section 6.0 of this SOP for instructions on basic monitoring well sampling procedures (e.g. water level measurement, well purging).

- Whenever possible, wells should be sampled in order of increasing chemical concentrations (known or anticipated). This minimizes the possibility for cross-contamination of sample equipment.

- Protect the sample area from potential sources of airborne contaminants (e.g. dust, vapors from fuel cans, engine exhaust, etc.). Record on the field data sheets suspected but unavoidable extraneous VOC sources that are encountered when sampling.

- While in the field try to keep unfilled sample bottles in a cool place (e.g. shade, ice-filled cooler). This will minimize the loss of volatile analytes when filling the sample bottles.

- If collecting samples for multiple analytes, VOC samples (and other sensitive analytes) are typically collected first since these analytes are most sensitive to the sampling process. At low purge rates direct sun light and hot ambient air temperatures may cause groundwater in the tubing and flow cell to heat up. This may cause the groundwater to degas which will result in loss of volatile analytes. If possible shade the equipment from sunlight.

Sampling Procedures

Although the procedures used to fill sample bottles may seem a minor consideration, filling them improperly can jeopardize the careful work that went into properly purging a well to produce minimally-disturbed, representative samples. Improper sampling techniques can cause changes in sample composition due to agitation and exposure to air which can result in the loss of contaminants by volatilization or degassing.

The more sensitive the parameter being collected (e.g. VOCs and redox-sensitive metals), the more cautious and rigorous the filling procedures should be.

Filling VOC bottles

- Groundwater samples for VOC analysis are collected in 40-mL amber/clear glass bottles with Teflon® septa lids. Contact the laboratory to determine the number of bottles required for analysis.

- Samples may be collected after the well is fully purged. Purging and sample withdrawal should form a continuous process.

- Pumping rates for sample collection should be high enough to fill sample bottles efficiently and with minimal exposure to atmospheric conditions, but low enough to minimize sample alteration or aeration. The flow should be smooth and uniform.
    - The recommend pumping rate for collecting VOC samples is generally 250 mL/min or less.
    - If using a bladder pump, the pumping rate should be set to deliver a pulse of water long enough to fill one 40-mL VOC bottle.

- Before filling the sample bottles check for air bubbles in the sample line. Tap the sample line or gradually adjust the pumping rate to dislodge and remove any bubbles that are present.

- Wear clean disposable powder free gloves when collecting and preserving the samples.

- Keep sample bottles capped until it's time to fill them. This will minimize exposure of the sample bottle to extraneous VOC contamination.

- Do not pre-rinse or field rinse VOC bottles before sample collection.

- VOC samples require chemical preservation.

    - Most VOC samples will only require the addition of hydrochloric acid (HCl). Usually 0.25 mL of 1:1 HCl is enough to lower the pH of the sample to ≤ 2. The HCl is added to inhibit biodegradation of VOCs in the sample.

    - If sampling a municipal drinking water source, free chlorine may be present. Before sampling determine the presence of free chlorine with a field test kit. If free chlorine is present preserve the VOC sample with 25 mg of ascorbic acid. The ascorbic acid is added to remove the free chlorine which if present may cause the formation of trihalomethanes. Continue to preserve the sample with the 1:1 HCl.

- Samples should be collected with as little disturbance as possible. When filling a VOC bottle, tip the bottle at a slight angle and allow a slow steady stream of water to run down the inner wall (Figure B-1). This will minimize agitation, aeration, and volatilization of VOCs while sampling.

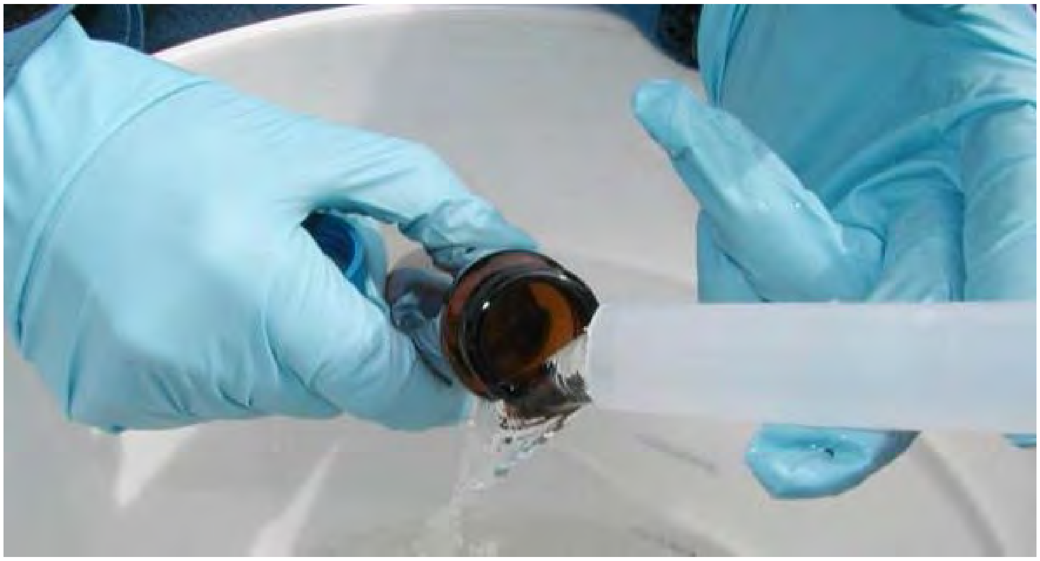


Figure B-1

- Carefully fill the bottle to just below the rim (Figure B-2).

Figure B-2

- If the sample bottle was not pre-preserved, add the preservative.
- Fill the cap with water and use it to top off the sample (Figure B-3).

Figure B-3

- Add just enough water to form a positive meniscus (Figure B-4). Take care to not over fill the bottle since you do not want to flush any preservative out of the bottle while topping it off.

Figure B-4

- Empty the cap of any remaining water before replacing it on the bottle.

- After securing the cap invert the bottle and tap it lightly to check for bubbles (Figure B-5 and B-6). Absolutely no bubbles or headspace should be present in the bottle. If any airspace remains, VOCs in the sample can volatilize and may be lost before analysis.

Figure B-5

Figure B-6 – Checking a filled VOC bottle for bubbles

- If any bubbles are present, carefully remove the cap and top off the bottle again with a minimal amount of well water as previously described to re-establish the meniscus. If bubbles are still present after topping off and recapping the bottle, set the sample aside. Collect a new sample using a clean bottle.

- If for some reason bubble free samples can't be obtained collect several samples and save the three with the fewest bubbles. Make a note on the field and laboratory forms indicating the samples contained one or more bubbles.

- Label the sample bottles and protect them in foam sleeves or bubble wrap before placing them in an iced filled cooler. Samples must remain at or below 6°C throughout handling, storage, and shipping. Never freeze the samples.

- Preserved VOC samples have a 14 day holding time.

Sampling Procedures for Semi-Volatiles and other Organics

These organics are typically less volatile than VOCs, however, they too are often susceptible to extraneous background contamination, possible cross-contamination, sorption and desorption reactions with sampling equipment and are usually analyzed at very low detection levels (µg/L). Some substances that fall under this category include: base/neutral/acids (BNAs or semi-volatiles), total petroleum hydrocarbons (TPH), polynuclear aromatic hydrocarbons (PAHs), herbicides, pesticides, polychlorinated biphenyls (PCBs), and polybromide diphenyl ether congeners (PBDEs). The following table lists sample containers, preservation, and holding times for commonly sampled organics.

Table 1. Sample Containers, Preservation and Holding Times

Parameter	Matrix	Minimum Quantity Required	Container	Preservative	Holding Time
VOCs	Groundwater	40 mL, no headspace	(3) 40 mL vials with septum	HCl. Ascorbic acid when chlorinated. Cool to ≤6°C. No headspace.	14 days
BNA (Semi-VOCs)	Groundwater	1 L	1 L amber glass bottle	Cool to ≤6°C	7 days
TPH-D	Groundwater	1 L	1 L narrow mouth glass bottle	Cool to ≤6°C	7 days unpreserved; 14 days preserved
PAH	Groundwater	1 L	1 L amber glass bottle	Cool to ≤6°C	7 days
Herbicides	Groundwater	1 L	1 L amber glass bottle	Cool to ≤6°C	7 days
Pesticides	Groundwater	1 to 4 L	1 L amber glass bottle	Cool to ≤6°C	7 days
PCBs	Groundwater	1 to 4 L	1 L amber glass bottle	Cool to ≤6°C	7 days
PBDEs	Groundwater	1 L	1 L amber glass bottle	Cool to ≤6°C	7 days

Sampling procedures for semi-volatiles and other organics are similar to those for VOCs.

- Equipment should be made of inert material to the extent possible.
- Samples may be collected once the well is fully purged.
- The pumping rate for larger sample containers is generally 0.5 L/min or less.

- Before filling sample bottles check for air bubbles in the sample line. Tap the sample line or gradually adjust the pumping rate to dislodge and remove any bubbles that are present.

- Collect samples in the order specified in the project QAPP.

- Do not pre-rinse or field rinse sample bottles for organic analysis.

- When filling a sample container tip it at a slight angle and allow a slow steady stream of water to run down the inner wall. This will minimize agitation and aeration while filling the container.

- Fill the bottle to the recommend volume. If the sample will be frozen, leave enough head-space to prevent the bottle from breaking due to ice expansion.

- These samples are not usually preserved or filtered; however, they should be cooled to 6^{o}C or less immediately after collection.

1 INTRODUCTION

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) describes the methods used for decontamination of field equipment used in the collection of environmental samples which may have contacted investigated media (including soil, groundwater, surface water, sediment, and other media). It is important to follow these procedures from a quality control (QC) perspective to ensure that environmental data generated in the field are of the highest quality and are not misrepresented or misinterpreted due to cross-contamination. Also, improperly decontaminated sampling equipment can lead to cross contamination and could expose field personnel to hazardous materials.

This SOP discusses the decontamination procedures to be used with reusable field equipment. Respective state or federal agency regulations may require specific types of equipment or procedures used in the decontamination of field equipment. The Project Manager should review applicable state/federal regulations (if any) prior to the start of field work and update this SOP per those regulations.

1.2 General Principles

Potential hazards associated with the planned tasks should be thoroughly evaluated prior to conducting field activities. The site-specific Health and Safety Plan (HASP) provides a description of potential hazards and associated safety and control measures.

Decontamination is accomplished by manually scrubbing, washing, or spraying equipment with detergent solutions, tap water, distilled/deionized water, steam and/or high pressure water or solvents. Generally this is conducted between each sampling site or collection points, unless sufficient sampling collecting tools are available. Waste decontamination materials, such as spent liquids and solids, are collected and managed as investigation-derived waste for later disposal.

Sampling personnel must wear powder-free nitrile gloves while performing the procedures described in this SOP. Specifically, nitrile gloves must be worn while preparing sample bottleware, preparing and decontaminating sampling equipment, collecting and processing samples, and packing samples. At a minimum, nitrile gloves must be changed prior to the collection of each sample or as necessary to prevent the possibility of cross-contamination with the sample, the sample bottleware, or the sampling equipment.

Consideration should be given to the order in which the samples are collected. In general, samples should be collected from areas suspected to be least impacted by contamination followed by areas suspected to be most impacted by contamination, thereby minimizing the potential for cross-contamination Prior to field activities, the field team should consider how investigation-derived waste (such as decontamination fluids) is to be handled.

1.3 Quality Assurance Planning Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific Quality Assurance Project Plan (QAPP). Proper quality assurance requirements should be provided which will allow for collection of equipment blank samples in order to determine the effectiveness of the decontamination procedures.

Solvent selection is an important consideration and should be evaluated for each scope of work, at each site. There are several factors which shall be considered. The solvent should not be an analyte of interest, the sampling equipment should be resistant to the solvent, and the solvent must evaporate or be water soluble or preferably both.

Pesticide-grade methanol is the solvent of choice for general organic analysis. Hexane, acetone, and isopropanol are also good choices for organic analysis. A 10% nitric acid in deionized water solution is the solvent of choice for general metals analysis. Nitric acid can be used on Teflon, plastics and glass. If used on metal equipment, the nitric acid will eventually corrode the metal and could introduce metals from the sampling equipment into the environmental samples. Dilute hydrochloric acid can also be used for metal analysis.

All Decontamination should be performed a safe distance away from the sampling area as to not interfere with sampling activities.

1.4 Health and Safety Considerations

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). All field activities will be conducted in conformance to this HASP.

At a minimum, the following precautions should be taken in the field during these cleaning operations:

- When conducting field cleaning or decontamination using laboratory detergent, safety glasses with splash shields or goggles, and latex gloves will be worn.

• No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations

2 RESPONSIBILITIES

2.1 Sampling Technician

It will be the responsibility of the sampling technician to be familiar with the decontamination procedures outlined within this SOP, the HASP, the QAPP, and the Sampling Plan. The sampling technician is responsible for the proper decontamination of all field equipment and proper documentation. The sampling technician is also responsible for ensuring that all decontamination producers are following by all subcontractors. Decontamination may be required on heavy equipment; it is the responsible of the sampling technician to ensure all equipment has been properly decontaminated.

2.2 Field Project Manager

It will be the responsibility of the field project manager to ensure that the sampling technician understands the decontamination producers and has access to all materials required for decontamination. The field project manager is also responsible for all waste generated during decontamination producers.

3 REQUIRED MATERIALS

In addition to those materials provided by the subcontractor, the project geologist/sampling engineer may require:

- Decontamination agents
- Chemical free paper towels
- Waste storage containers
- Cleaning storage containers
- Cleaning brushes
- Pressure sprayers (if required)
- Squeeze bottles
- Plastic sheeting
- Aluminum foil
- Health and safety equipment (as required by HASP)
- Project notebook/field sheets/pen

Sampling equipment which comes in direct contact with environmental samples during the sample collection process should be constructed of stainless steel, teflon, or glass, unless specified otherwise in the Project Sampling Plan or QAPP.

4 METHOD

4.1 General Method Description

It should be assumed that all sampling equipment, even new items, are contaminated until the proper decontamination procedures have been performed, unless, certificate of analysis is available and demonstrates the items are clean.

It is important to set up a decontamination cleaning station. This will vary depending on site acitivites and site access. Generally speaking, an decontamination area for small/hand held equipment cleaning should include a barrier (e.g. plastic sheeting) to work on, should decontamination tubs and/or buckets and rinse bottles in order of use on top of the barrier. Decontamination solution containing solutions and water should be gathered and put into accessible containers within easy reach of the decontamination tubs). Record the source of the water in the field logbook.

For decontamination of drilling rigs or backhoes/excavators, establish an area for decontamination that will meet the program and site-specific requirements for collection of decontamination fluids. If necessary, set up a decontamination pad. If containerization of decontamination fluids associated with decontaminating large equipment (such as drilling rigs and backhoes/excavators) is required, it is imperative to ensure that the subcontractor will have appropriate equipment onsite. This equipment may include a portable electric generator and a high-pressure steam-cleaner or steam-jenny. In addition, a decontamination pad or portable containment system should be used to collect fluids. The contractor shall conduct gross decontamination (such as removing general mud from large equipment) prior to arriving at site.

All equipment used for sampling, testing, or measuring, including excavating and drilling equipment, that comes in contact with potentially sampled media will be decontaminated prior to use unless the equipment is prepackaged and sealed by a manufacturer of environmental sampling equipment. Reusable sampling equipment will also be decontaminated between sampling locations. If disposable sampling equipment (clean prepackaged materials) is used, this equipment will not be decontaminated before use and will be disposed of properly after one use. Disposable equipment will not be used at more than one sampling location.

The following presents decontamination procedures for manual sampling equipment and heavy equipment.

4.2 Equipment Decontamination – Small Hand Held Equipment

The following general decontamination steps should be applied to all equipment prior to initial use (unless using clean prepackaged environmental sampling equipment) or that have been utilized to collect sample media for analytical purposes. Site-specific project control documents may specify modifications to these procedures and should be followed when applicable. It is important to note that no acids or solvents will be used to decontaminate any electrical or electronic instrumentation unless specified by the manufacturer.

a. Physically remove visible material from the sampling equipment to the extent practical before decontaminating the equipment with decontamination fluids. If this material appears to be impacted based on visual observation, instrument readings, or other credible indication, collect and manage this material in accordance proper procedures.
b. Immerse (to the extent practicable) the equipment in the cleaning solution and scrub the equipment thoroughly with a stiff brush until visible residual material is removed and the equipment is visibly clean. Circulate detergent solution through equipment that cannot be disassembled such as submersible pumps (ASTM, 1990).
c. Rinse the equipment thoroughly with potable water.
d. Rinse the equipment with organic desorbing agent (e.g., isopropyl alcohol). If samples are not being collected for analysis of organic compounds, omit this step (ASTM, 1990).
e. Rinse the equipment thoroughly with potable or DI water.
f. To the extent practicable, allow the equipment to air dry in a clean area (equipment does not need to be completely dry before reuse; under certain weather conditions, complete air drying is not possible).
g. Change the initial decontamination solution daily and/or between sites at a minimum and more frequently as needed. Collect decontamination solvents in a separate container from water/detergent solutions and properly containerize, store, and dispose of decontamination solutions.

If decontaminated equipment will not be used immediately, the equipment may be wrapped in aluminum foil (if used for organics only) or sealed in a plastic bag for storage. Decontamination activities, including date, time, and reagents used, should be documented in the field logbook and decontaminated sampling equipment should be labeled with this information as appropriate.

4.3 Equipment Decontamination – Decontamination of Heavy Equipment

The following steps for decontamination can be applied to heavy equipment.

a. Physically remove as much of the visible material as possible from the heavy equipment after use and prior to steam cleaning. If contaminated material is suspected as determined by visual observations, instrument readings, or other means, collect material in an appropriate container. Otherwise, return the material to the area where it originated.
b. Place the heavy equipment on the decontamination pad in the decontamination area. If wash water is to be collected, ensure that the collection mechanism functions properly and that the decontamination pad has no leaks.
c. Steam clean parts of the heavy machinery that come into contact with visible material (such as tires, bulldozer bucket, augers, and back of drill rig).
d. For any portion of the heavy equipment that comes into contact with the sampling media, decontaminate by following listed in Section 4.2.
e. Containerize fluids, if appropriate. Place solids in a drum or other appropriate container.

5 QUALITY CONTROL

Quality control requirements are dependent on project-specific sampling objectives. The QAPP will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

Equipment blanks and Field blanks are generally made by pouring laboratory-supplied deionized water into, over, or through the freshly decontaminated sampling equipment. Blanks should be labeled as a sample and submitted to the laboratory to be analyzed for the same parameters as the associated sample.

6 DOCUMENTATION

Various forms are required to ensure that adequate documentation is made of sample collection activities. These forms include:

- Boring logs
- Field log books
- Sample collection records
- Chain-of-custody records
- Shipping labels

The field team should document and log all field sampling decontamination methods. Repetitive decontamination of small items of equipment does not need to be logged each time the item is cleaned.

7 REFERENCES

ASTM. Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites: D 5088-90, 1990.

Appendix E Historical Free Product Gauging and Analytical Data Tables

Table E-1A. Summary of LNAPL Thickness Measurements (1999-2017)

Port of Seattle Terminal 30

Well	Jul-99	Dec-00	Jul-01	Feb-03	Feb-04	May-05	Aug-05	Oct-05	Nov-05	Dec-05	Apr-11	Nov-11	May-17	Jun-17	11/5/2017	11/16/2017	11/30/2017
MW-35	0.05	< 0.01	0.01	0.02	< 0.01	0.1	0.24	NM	0.01	0.02	0.01	NM	NM	< 0.01	0.01	NM	NM
MW-36	0.06	< 0.01	< 0.01	< 0.01	< 0.01	NM	< 0.01	NM	< 0.01	< 0.01	< 0.01	NM	NM	0.21	0.2	0.15	NM
MW-38	0.04	< 0.01	< 0.01	< 0.01	NM	NM	< 0.01	NM	< 0.01	0.03	< 0.01	NM	NM	NM	NM	NM	NM
MW-39	0.05	Present	0.04	< 0.01	< 0.01	NM	0.07	NM	0.04	0.05	< 0.01	NM	NM	NM	NM	NM	NM
MW-40	0.04	< 0.01	< 0.01	< 0.01	NM	NM	< 0.01	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
MW-49	0.32	< 0.01	< 0.01	< 0.01	< 0.01	0.03	< 0.01	NM	< 0.01	NM	< 0.01	NM	NM	NM	NM	NM	NM
MW-54	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NM	< 0.01	NM	< 0.01	NM	NM	NM	NM	NM	NM
MW-59	1.34	Present	0.93	0.4	0.99	1.07	0.93	NM	0.82	0.93	1.55	1.55	0.7	1.19	0.76	NM	NM
MW-63	< 0.01	< 0.01	< 0.01	< 0.01	NM	NM	0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
MW-64	0.07	< 0.01	< 0.01	< 0.01	NM	NM	0.16	NM	0.09	0.09	0.05	NM	NM	NM	0.01	NM	NM
RW-1	0.08	Present	0.15	0.1	< 0.01	NM	NM	0.84	0.21	0.03	0.01	NM	NM	NM	NM	NM	NM
RW-5	0.07	< 0.01	< 0.01	< 0.01	< 0.01	NM	NM	0.02	0.01	0	< 0.01	NM	NM	NM	NM	NM	NM
RW-9	< 0.01	< 0.01	< 0.01	< 0.01	NM	NM	NM	0.05	0.04	0.04	< 0.01	NM	< 0.01	NM	NM	NM	NM
RW-10	0.18	< 0.01	0.01	< 0.01	NM	NM	NM	< 0.01	< 0.01	< 0.01	NM	NM	NM	NM	NM	NM	NM
RW-11	0.01	Present	0.14	0.1	0.02	NM	NM	0.26	0.08	0.1	< 0.01	NM	NM	NM	NM	NM	NM
RW-12	0.15	< 0.01	0.26	0.1	< 0.01	NM	NM	1.13	0.49	0.24	0.31	0.41	1.62	1.66	1.45	NM	NM
MW-42											< 0.01	NM	< 0.01	NM	NM	NM	NM
MW-89											NM	NM	NM	NM	NM	< 0.01	0.03
MW-93											NM	NM	NM	NM	NM	< 0.01	NM
MW-36A											NM	NM	NM	NM	NM	< 0.01	NM
MW-39A											NM	NM	NM	NM	NM	< 0.01	NM

Notes:

Gray text indicates LNAPL was not gauged (NM) or was not detectable with interface probe (< 0.01 ft thickness)

Data 1999 to 2005 modified from AECOM Terminal 30 Supplemental Data Report Table 5-2

Table E-1B. Summary of LNAPL Thickness Measurements (1991-1994)

APPARENT PRODUCT THICKNESS (feet)
IN MONITORING WELLS (Page 1 of 2)
AUGUST 1991 - JANUARY 1994[1]

Date	Monitoring Wells										
	MW-34	MW-35	MW-36	MW-38	MW-43	MW-46A	MW-49	MW-54	MW-59	MW-62	MW-64
08/16/91	0.0	1.99	1.52	0.01	0.01	0.19	0.10	0.01	0.03	0.0	0.0
10/03/91	0.0	0.53	0.28	0.0	0.0	0.19	0.32	<0.01	0.03	0.0	0.0
10/24/91	0.22	0.72	2.53	0.51	0.02	0.0	0.84	1.29	<0.01	0.43	0.27
11/20/91	0.40	1.97	1.70	0.20	--	--	0.45	0.0	0.33	<0.01	0.09
12/04/91	<0.01	--	--	<0.01	--	0.0	0.73	<0.01	<0.01	0.0	0.01
01/08/92	--	0.88	0.21	--	--	0.0	0.0	0.0	<0.01	0.0	0.0
02/26/92	0.16	1.09	0.0	0.0	0.01	0.0	0.73	0.0	0.0	0.0	<0.01
03/12/92	0.13	0.09	0.13	0.0	--	0.0	0.0	0.0	--	--	0.0
04/29/92	0.0	1.06	0.01	0.0	0.0	0.0	0.08	0.0	0.0	0.0	0.0
05/20/92	0.0	0.96	0.15	0.0	0.15	0.15	0.15	0.0	0.0	0.0	0.0
07/02/92	0.0	1.25	0.42	0.0	--	0.0	0.31	0.0	0.0	0.0	0.0
08/14/92	0.02	1.09	2.40	--	0.0	--	0.93	0.0	0.40	0.0	--
09/18/92	0.12	2.16	1.61	0.15	0.01	--	0.20	0.0	0.78	0.0	0.10
10/29/92	0.36	1.14	2.24	9.25	--	0.0	1.71	0.0	0.88	--	0.26
11/25/92	0.38	1.14	1.11	0.26	0.0	0.0	0.74	0.0	0.27	0.0	0.12
01/27/93	0.25	0.25	0.01	0.10	--	0.0	0.31	0.0	0.61	0.0	0.02
02/26/93	0.10	1.99	0.0	0.11	0.02	0.01	0.38	0.0	0.50	0.0	0.10
03/31/93	0.18	0.09	0.01	2.66	--	--	0.31	0.0	0.65	0.0	0.01
04/15/93	0.18	0.0	0.0	<0.01	--	0.0	--	0.0	0.63	0.0	0.0
05/22/93	0.19	0.91	0.02	0.16	--	0.01	0.48	--	0.61	0.0	0.05
06/24/93	0.18	2.34	2.08	0.04	--	0.02	0.0	0.0	1.11	0.0	0.41
07/23/93	0.25	2.89	0.52	0.05	0.05	0.04	0.91	0.0	0.79	0.0	0.11
08/27/93	0.04	2.55	0.34	0.12	--	0.0	0.0	0.0	1.89	0.0	0.02
09/30/93	0.10	2.49	0.47	0.30	0.01	0.0	0.79	--	1.09	0.0	0.08
10/27/93	0.09	2.03	0.25	--	<0.01	<0.01	0.38	<0.01	1.31	0.02	0.02
11/18/93	0.25	0.76	0.26	0.40	0.06	0.01	0.53	0.02	1.30	0.08	0.03
01/07/94	0.19	0.21	0.15	0.19	<0.01	<0.01	0.40	0.0	0.55	0.0	0.05
01/08/98[3]	<0.01	0.14	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	1.82	<0.01	0.24

Notes appear on Page 2

Table E-2. Summary of Groundwater Petroleum Hydrocarbon Concentrations

Port of Seattle Terminal 30

	Date	GRO	DRO	MOR	Benzene	Toluene	Ethylbenzene	Xylenes	m, p-Xylene	o-Xylene
Screening Level		*0.8*	*0.5*	*0.5*	*23*	*15,000*	*2,100*	*1,000*	*1,000*	*1,000*
Units		*mg/L*	*mg/L*	*mg/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*
MW-17	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-17	5/9/2005	0.15	0.26		1.04	0.5 U	0.5 U	1 U		
MW-29	3/7/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-39	1/1/1999									
MW-39	10/13/2004	**1.7**	**120**	**28**	**28**	1 U	2.7		4.3	1 U
MW-42	10/13/2004	**0.85**	**0.9**	0.5 U	**120**	3	3.1		8.7	2.6
MW-42	5/9/2005	**4.47**	0.327		**769**	14	176	131		
MW-42	8/2/2005	**1.62**	**1.58**		**328**	9.56	35.1	35.4		
MW-42	11/29/2005	**3.8**	**2.12**		**763**	17.7	101	77.3		
MW-42	2/13/2006	**1.3**	0.25 U	0.5 U	**65**	2	12		28	4
MW-42	5/8/2006	**2.6**	0.31	0.5 U	**880**	19	110		53	9
MW-42	8/22/2006	**2.1**	0.25 U	0.5 U	**500**	15	73	47	40	7.9
MW-42	11/20/2006	**3.5**	0.25 U	0.5 U	**540**	14	100	61	52	9.1
MW-42	2/26/2007	**2**	0.25 U	0.5 U	530 J	13	87		37	6.8
MW-42	5/29/2007	**1**	0.25 U	0.5 U	**160**	5.6	19		11	3
MW-42	8/8/2007	**1.3**	0.25 U	0.5 U	**240**	9.1	27		15	4
MW-42	11/7/2007	**1.8**	0.25 U	0.5 U	**450**	13	29		18	4.8
MW-42	2/12/2008	0.42 NJ	0.25 U	0.5 U	16	1 U	5		2.4	1 U
MW-42	5/5/2008	**0.83**	0.25 U	0.5 U	**190**	6.7	2.5		3.4	1.8
MW-42	8/11/2008	**1.1**	0.25 U	0.5 U	**150**	6.2	11		5.9	2.2
MW-42	11/11/2008	0.67	0.25 U	0.5 U	**34**	1.8	5.6		3.5	1 U
MW-42	2/17/2009	0.66	0.25 U	0.5 U	**100**	3.6	3.6		2.1	1.1
MW-42	5/18/2009	1.9 J	0.25 U	0.5 U	**210**	9.5	8		5.5	2.5
MW-42	8/18/2009	**2.1**	0.25 U	0.5 U	**360**	14	16		12	5 U
MW-42	11/16/2009	**1.2**	0.25 U	0.5 U	52 J	6.1	4.9		6.5	2.4
MW-42	4/19/2011	**1.2**	0.23	0.25 U	**83**	7.1	3.4	6.3	2.9	0.7
MW-45	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	5/9/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-45	8/2/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-45	12/1/2005	0.05 U	0.243 U		0.5 U	0.5 U	0.5 U	1 U		
MW-45	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-45	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-45	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	11/7/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	2/12/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-45	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.5 U	0.5 U	1 U		
MW-46	12/1/2005	0.05 U	2.39 J		0.5 U	0.5 U	0.5 U	1 U		
MW-46	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-46	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-46	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	11/7/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	2/12/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U

Table E-2. Summary of Groundwater Petroleum Hydrocarbon Concentrations

Port of Seattle Terminal 30

	Date	GRO	DRO	MOR	Benzene	Toluene	Ethylbenzene	Xylenes	m, p-Xylene	o-Xylene
Screening Level		*0.8*	*0.5*	*0.5*	*23*	*15,000*	*2,100*	*1,000*	*1,000*	*1,000*
Units		*mg/L*	*mg/L*	*mg/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*
MW-46	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-46	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.5 U	0.5 U	1 U		
MW-49	3/7/2006	0.72	**2.1**	0.5 U	1 U	1 U	1.7	2 U	1 U	1 U
MW-49	11/7/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-49	2/12/2008	0.27 NJ	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-49	5/5/2008	0.35	0.44	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52	5/8/2006	0.27 N	**0.67**	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	8/22/2006	0.67	0.25 U	0.5 U	1 U	1 U	1.4	2 U	1 U	1 U
MW-52A	11/20/2006	0.37 NJ	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-52A	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	5/29/2007	0.48 NJ	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	8/8/2007	0.42 NJ	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	11/7/2007	0.61 NJ	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	2/12/2008	0.9 NJ	**0.75**	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	5/5/2008	0.69	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	8/11/2008	0.71	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	11/11/2008	0.32	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	2/17/2009	0.44	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	5/18/2009	0.5	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	8/18/2009	0.68	**0.54**	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	11/16/2009	0.29	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-52A	4/19/2011	0.26	0.4	0.25 U	0.5 U	0.5 U	0.5 U	1.3		
MW-53	3/7/2006	0.25 U	**1.7**	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-54	3/7/2006	**0.82**	0.25 U	0.5 U	1 U	1 U	1.3	2 U	1 U	1 U
MW-54	11/7/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-54	2/12/2008	0.73 NJ	**1.6**	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-54	5/5/2008	**1.5**	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-54	8/11/2008	**1.2**	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	1/1/1999									
MW-58	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	5/9/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-58	8/2/2005	0.05 U	0.368		0.5 U	0.5 U	0.5 U	1 U		
MW-58	11/29/2005	0.05 U	0.236 U		0.5 U	1.76	0.5 U	1 U		
MW-58	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	19	1 U		1 U	1 U
MW-58	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	2.3	1 U		1 U	1 U
MW-58	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-58	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-58	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	11/7/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	2/12/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	2/17/2009	0.35	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	5/18/2009	0.38	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-58	4/19/2011	0.41	0.19	0.25 U	0.5 U	1.5	0.67	1.5		
MW-58	11/8/2011									
MW-59	10/13/2004	**0.95**	**5**	1 U	1 U	1 U	1.1		1 U	1 U
MW-72	1/1/1999									
MW-72	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-72A	8/2/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-72A	11/29/2005	0.05 U	0.238 U		0.5 U	0.5 U	0.5 U	1 U		

Table E-2. Summary of Groundwater Petroleum Hydrocarbon Concentrations

Port of Seattle Terminal 30

	Date	GRO	DRO	MOR	Benzene	Toluene	Ethylbenzene	Xylenes	m, p-Xylene	o-Xylene
Screening Level		*0.8*	*0.5*	*0.5*	*23*	*15,000*	*2,100*	*1,000*	*1,000*	*1,000*
Units		*mg/L*	*mg/L*	*mg/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*
MW-72A	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-72A	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-72A	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-72A	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-72A	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-72A	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-72A	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76	10/13/2004	0.25 U	0.25 U	0.5 U						
MW-76	5/9/2005	0.0932	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-76	8/2/2005	0.0651	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-76	11/29/2005	0.128	0.238 U		0.5 U	0.5 U	0.5 U	1.19		
MW-76	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-76	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-76	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	8/18/2009	0.25 U	0.3	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	11/16/2009	0.28	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-76A	4/19/2011	0.13	0.34	0.25 U	0.5 U	0.5 U	0.5 U	1 U		
MW-77	3/7/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-77	11/7/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-77	2/12/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-77	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-77	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-78	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-78A	8/2/2005	0.098	0.25 U		0.539	0.5 U	0.5 U	1 U		
MW-79	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-79	5/9/2005	0.25 U	0.25 U		2.5 U	2.5 U	2.5 U	5 U		
MW-79A	8/2/2005	0.0806	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-81	10/13/2004	0.25 U	0.28 NJ	0.5 U						
MW-81	5/9/2005	0.0897	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-81	8/2/2005	0.0627	0.336		0.5 U	0.5 U	0.5 U	1 U		
MW-81	11/29/2005	0.138	0.458		0.5 U	0.5 U	0.5 U	1.02 J		
MW-81	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-81	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-81	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	11/7/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	2/12/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81A	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81A	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81A	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-81A	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.65 U	0.5 U	1 U		
MW-84	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84	5/9/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		

Table E-2. Summary of Groundwater Petroleum Hydrocarbon Concentrations

Port of Seattle Terminal 30

	Date	GRO	DRO	MOR	Benzene	Toluene	Ethylbenzene	Xylenes	m, p-Xylene	o-Xylene
Screening Level		*0.8*	*0.5*	*0.5*	*23*	*15,000*	*2,100*	*1,000*	*1,000*	*1,000*
Units		*mg/L*	*mg/L*	*mg/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*
MW-84	8/2/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-84	11/29/2005	0.05 U	0.236 U		0.5 U	0.5 U	0.5 U	1 U		
MW-84	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-84	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-84	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84A	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84A	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84A	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84A	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.65 U	0.5 U	1 U		
MW-84A	11/8/2011									
MW-84B	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84B	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84B	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-84B	4/19/2011	0.05 U	0.16	0.25 U	0.5 U	0.65 U	0.5 U	1 U		
MW-84B	11/8/2011									
MW-85	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85	5/9/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-85	8/2/2005	0.05 U	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-85	11/29/2005	0.05 U	0.24 U		0.5 U	0.5 U	0.5 U	1 U		
MW-85	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-85	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-85	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85A	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.65 U	0.5 U	1 U		
MW-85A	11/8/2011									
MW-85B	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85B	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85B	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85B	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85B	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85B	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85B	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-85B	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.65 U	0.5 U	1 U		
MW-85B	11/8/2011									
MW-86	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86A	8/2/2005	0.0981	0.27		0.5 U	0.5 U	0.5 U	1.24		
MW-86A	11/29/2005	0.105	**0.525**		0.5 U	0.5 U	0.5 U	1 U		
MW-86A	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86A	5/8/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86A	8/22/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-86A	11/20/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-86A	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86A	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86A	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U

Table E-2. Summary of Groundwater Petroleum Hydrocarbon Concentrations

Port of Seattle Terminal 30

	Date	GRO	DRO	MOR	Benzene	Toluene	Ethylbenzene	Xylenes	m, p-Xylene	o-Xylene
Screening Level		*0.8*	*0.5*	*0.5*	*23*	*15,000*	*2,100*	*1,000*	*1,000*	*1,000*
Units		*mg/L*	*mg/L*	*mg/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*
MW-86B	5/5/2008	0.38	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86B	8/11/2008	0.28	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86B	11/11/2008	0.27	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86B	2/17/2009	**0.91**	0.25 U	0.5 U	1 U	1 U	1		1 U	1 U
MW-86B	5/18/2009	0.47	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86B	8/18/2009	0.3	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86B	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86B	4/19/2011	0.21	0.087	0.25 U	0.5 U	1.5	0.88	1.8	1 U	0.5 U
MW-86B	11/8/2011									
MW-86C	5/5/2008	0.3	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86C	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86C	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86C	2/17/2009	0.31	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86C	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86C	8/18/2009	0.25 UJ	0.25 U	0.5 U	1 UJ	1 UJ	1 UJ		1 UJ	1 UJ
MW-86C	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-86C	4/19/2011	0.25	0.069	0.25 U	0.5 U	1.2	0.5 U	1.6	1 U	0.5 U
MW-86C	11/8/2011									
MW-87	10/13/2004	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87	5/9/2005	0.159	0.25 U		0.5 U	0.5 U	0.5 U	1 U		
MW-87	8/2/2005	0.199	0.44		0.5 U	0.5 U	0.5 U	1 U		
MW-87	11/29/2005	0.297	**1.37**		0.5 U	0.5 U	0.5 U	2.5		
MW-87	2/13/2006	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87	5/8/2006	0.29 N	**0.64**	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87	8/22/2006	0.3	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-87	11/20/2006	0.31 NJ	0.25 U	0.5 U	1 U	1 U	1 U	2 U	1 U	1 U
MW-87	2/26/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87	5/29/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87	8/8/2007	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87A	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.5 U	0.5 U	1 U		
MW-87A	11/8/2011									
MW-87B	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87B	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87B	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87B	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87B	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87B	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87B	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-87B	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.5 U	0.5 U	1 U		
MW-87B	11/8/2011									
MW-88	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-88	8/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-88	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-88	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.65 U	0.5 U	1 U		
MW-89	5/5/2008	**1.2**	0.25 U	0.5 U	1 U	1 U	1.5		1 U	1 U
MW-89	8/11/2008	**0.85**	0.25 U	0.5 U	1.4	1 U	1.1		1 U	1 U
MW-89	2/17/2009	0.4	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-89	5/18/2009	**0.84**	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-89	8/18/2009	**0.92**	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-89	11/16/2009	**1.1**	0.25 U	0.5 U	1 U	1.9	1.3		1 U	1 U
MW-89	4/19/2011	**0.88**	0.22	0.25 U	0.5 U	3.4	0.5 U	5.6	1.4	0.5 U
MW-90	5/5/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U

Table E-2. Summary of Groundwater Petroleum Hydrocarbon Concentrations

Port of Seattle Terminal 30

	Date	GRO	DRO	MOR	Benzene	Toluene	Ethylbenzene	Xylenes	m, p-Xylene	o-Xylene
Screening Level		*0.8*	*0.5*	*0.5*	*23*	*15,000*	*2,100*	*1,000*	*1,000*	*1,000*
Units		*mg/L*	*mg/L*	*mg/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*
MW-90	8/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-90	11/11/2008	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-90	2/17/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-90	5/18/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-90	8/18/2009	0.25 UJ	0.25 U	0.5 U	1 UJ	1 UJ	1 UJ		1 UJ	1 UJ
MW-90	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-90	4/19/2011	0.05 U	0.05 U	0.25 U	0.5 U	0.5 U	0.5 U	1 U		
MW-91	5/5/2008	0.61	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-91	8/11/2008	0.47	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-91	11/11/2008	0.27	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-91	2/17/2009	0.41	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-91	5/18/2009	0.51	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-91	8/18/2009	0.45	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-91	11/16/2009	0.25 U	0.25 U	0.5 U	1 U	1 U	1 U		1 U	1 U
MW-91	4/19/2011	0.17	0.05 U	0.25 U	0.5 UG	0.5 UG	0.9 G	1 UG		
RW-11A	5/5/2008	**0.89**	0.25 U	0.5 U	**47**	1 U	1.4		1 U	1 U
RW-11A	8/11/2008	**0.95**	0.25 U	0.5 U	**41**	1.4	1.4		1 U	1 U
RW-5A	5/5/2008	**1.3**	0.25 U	0.5 U	1 U	1 U	1.6		1 U	1 U

DRO: Diesel Range Organics

GRO: Gasoline Range Organics

MOR: Motor Oil Range Hydrocarbons

DRO, GRO and MOR results prior to 1998 analyzed by EPA Method 8015; analyses after 1998 by method NWTPH-Gx/Dx.

U: Non-detect at shown reporting limit

J: Estimated value or reporting limit

G: sample analyzed from container not approved for analytical method; result should be considered an estimate.

N: estimated or presumed presence of constituent.

No result indicates constituent not analyzed for

Bold with shading indicates result above screening level

Table E-3. Summary of Groundwater Field Parameters

Port of Seattle Terminal 30

Well	Date	Dissolved Oxygen	Oxidation Reduction Potential	pH	Specific Conductivity	Temperature	Water Level
		mg/L	*mV*	*std. units*	*umhos/cm*	*C*	*feet*
MW39	1/1/1999				602		
MW42	4/19/2011	0	-109	6.58	7,860	13.7	9.74
MW45	4/19/2011	0	-169	6.74	829	12.4	9.06
MW46	4/19/2011	0	-181	7.2	1,960	12.7	8.9
MW52A	4/19/2011	0	-170	6.77	1,150	12.8	8.93
MW58	1/1/1999				1,819		
MW58	4/19/2011	0	-118	6.38	900	14.3	10.98
MW58	11/8/2011	0.7	-161	6.88	846	15.36	10.6
MW72	1/1/1999				30,533		
MW76A	4/19/2011	0	-135	6.66	865	13.2	8.18
MW81A	4/19/2011	0	-127	6.59	900	13.8	8.59
MW84A	4/19/2011	0	-164	7.28	1,180	14.7	14.2
MW84A	11/8/2011	1.94	-168	7.59	1,040	14.4	13.03
MW84B	4/19/2011	0.86	-95	6.66	961	13	11.27
MW84B	11/8/2011	2.84	-130	6.92	983	15.8	11.16
MW85A	4/19/2011	2.58	-117	7.58	4,890	11.6	10.55
MW85A	11/8/2011	0.99	-155	7.63	6,370		11.01
MW85B	4/19/2011	0	-228	7.16	5,310	14	14
MW85B	11/8/2011	0.5	-187	7.56	3,700	14.2	13.12
MW86B	4/19/2011	3.45	-248	6.82	2,700	11.7	11.89
MW86B	11/8/2011	0.51	-218	6.96	1,850	14.85	12.21
MW86C	4/19/2011	0	-144	6.78	2,130	13	11.03
MW86C	11/8/2011	1.55	-181	7.05	2,290	14.21	11.66
MW87A	4/19/2011	0.72	7	6.73	2,460	12.3	9.86
MW87A	11/8/2011	0.38	-207	6.74	4,051	15.98	11.34
MW87B	4/19/2011	0	-191	7.45	869	14.5	13.84
MW87B	11/8/2011	0.31	-140	8.08	797	14.11	13.87
MW88	4/19/2011	0	-189	8.9	204	12.7	8.94
MW89	4/19/2011	0.64	-117	6.59	3,450	13.3	9.54
MW90	4/19/2011	0	-112	6.56	1,410	13.5	9.81
MW91	4/19/2011	0	-132	6.69	1,020	13.6	7.81

No result indicates that the field parameter was not analyzed for or not reported.

Table E-4. Summary of Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Well	Sample Date	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Screening Level (ug/L)		*NV*	*643*	*NV*	*25,900*	*0.018*	*0.018*	*0.018*	*NV*	*0.018*	*0.018*	*0.018*	*NV*	*90*	*3,460*	*0.018*	*4,940*	*NV*	*2,590*
MW-17	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-17	5/9/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-39	10/13/2004	14	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-42	10/13/2004	1.8	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.3	1 U	1 U
MW-42	5/9/2005	27.5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	37.5	10 U	10 U
MW-42	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	13.6	10 U	10 U
MW-42	11/29/2005	17	0.318	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U		0.0952 U	0.368	0.0952 U	21.3	0.19	0.0952 U
MW-42	2/13/2006	11	0.17	0.02 J	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.09	0.01 U	0.24	0.01 U	17	0.14	0.01 U
MW-42	5/8/2006	17 J	0.22 J	0.024 J	0.015 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1 J	0.019	0.28 J	0.01 U	30 J	0.12	0.031
MW-42	8/22/2006	7.8 B	0.15	0.016	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.074	0.012	0.19	0.01 U	11 B	0.074	0.022
MW-42	11/20/2006	18 B	0.19	0.02	0.022	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.097	0.012	0.26	0.01 U	18 B	0.14	0.022
MW-42	2/26/2007	20 B	0.21	0.025 J	0.02	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.13	0.012	0.32	0.01 U	18 B	0.16	0.026
MW-42	5/29/2007	0.57	0.084	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.032	0.01 U	0.087	0.01 U	1.2	0.015	0.021
MW-42	8/8/2007	6.2 J	0.15	0.013 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.015	0.01 U	0.066	0.017	0.18	0.01 U	9.3	0.053 J	0.039
MW-42	11/7/2007	8.3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.6	1 U	1 U
MW-42	2/12/2008	1	0.074	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.027	0.012	0.072	0.01 U	0.67 B	0.043	0.026
MW-42	5/5/2008	0.9	0.15	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.041	0.014	0.13	0.01 U	0.63	0.028	0.026
MW-42	8/11/2008	6.3 B	0.22	0.02 J	0.02	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.09	0.02	0.21	0.01 U	4.7 B	0.11	0.03
MW-42	11/11/2008	7.1 B	0.18 B	0.01 U	0.042 B	0.01 B	0.01 U	0.01 U	0.01 U	0.01 U	0.015 B	0.01 U	0.077 B	0.05 B	0.26 B	0.01 U	4.6 B	0.2 B	0.06 B
MW-42	2/17/2009	1.2	0.11	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.046	0.016	0.13	0.01 U	2.1	0.059	0.029
MW-42	5/18/2009	4.1	0.15	0.01 U	0.011	0.01 U	0.01 U	0.01 U	0.015 U	0.01 U	0.01 U	0.01 U	0.073	0.014	0.17	0.01 U	3.4	0.083	0.028
MW-42	8/18/2009	8.2	0.23	0.025 J	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.087	0.013	0.23	0.01 U	6.7	0.1 B	0.024
MW-42	11/16/2009	8.2	0.2	0.025 J	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.11	0.012	0.24	0.01 U	4	0.13	0.025
MW-42	4/19/2011		0.34	0.62	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.5	0.018 U	1.8	0.18	0.05 U
MW-45	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-45	5/9/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-45	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-45	12/1/2005	0.0943 U	0.623	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U		0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U
MW-45	2/13/2006	0.02	0.38	0.01 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.06	0.01 U	0.01 U
MW-45	5/8/2006	0.026	0.24	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.01 U	0.01 U	0.019	0.01 U	0.01 U	0.059 B	0.01 U	0.016
MW-45	8/22/2006	0.01 U	0.53	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
MW-45	11/20/2006	0.01 U	0.76	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02	0.01 U	0.051	0.01 U	0.01 U	0.01 U	0.01 U
MW-45	2/26/2007	0.01 U	3.8	0.021	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.48	0.01 U	0.98	0.01 U	0.01 U	0.3	0.01 U
MW-45	5/29/2007	0.01 U	0.91	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.056	0.01 U	0.12	0.01 U	0.03	0.023	0.01 U
MW-45	8/8/2007	0.01 U	0.46	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.022	0.01 U	0.01 U
MW-45	11/7/2007	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-45	2/12/2008	0.01 U	0.41	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.017	0.01 U	0.01 U	0.01 U	0.01 U
MW-45	5/5/2008	0.01 U	0.18	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.042	0.01 U	0.01 U
MW-45	8/11/2008	0.01 U	0.25	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.03 B	0.01 U	0.01 U
MW-45	11/11/2008	0.055 B	0.41 B	0.01 U	0.027 B	0.015 B	0.01 U	0.01 U	0.01 U	0.01 U	0.014 B	0.01 U	0.02 B	0.069 B	0.11 B	0.01 U	0.093 B	0.17 B	0.058 B
MW-45	2/17/2009	0.014	0.44	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.025	0.01 U	0.035	0.01 U	0.048	0.01 U	0.01 U
MW-45	5/18/2009	0.021	0.13	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.014 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.01 U	0.082	0.01 U	0.01 U
MW-45	8/18/2009	0.015	0.3	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.021	0.01 U	0.01 U
MW-45	11/16/2009	0.019	0.31	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.018	0.01 U	0.022	0.01 U	0.017	0.01 U	0.01 U
MW-45	4/19/2011		0.52	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.05 U	0.018 U	0.05 U	0.05 U	0.05 U

Table E-4. Summary of Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Well	Sample Date	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Screening Level (ug/L)		*NV*	*643*	*NV*	*25,900*	*0.018*	*0.018*	*0.018*	*NV*	*0.018*	*0.018*	*0.018*	*NV*	*90*	*3,460*	*0.018*	*4,940*	*NV*	*2,590*
MW-46	12/1/2005	0.0952 U	0.118	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U		0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U
MW-46	2/13/2006	0.01	0.02	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02	0.01	0.01 U
MW-46	5/8/2006	0.01 U	0.017	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.024	0.01 U	0.01 U	0.01 U	0.019	0.022
MW-46	8/22/2006	0.01 U	0.052	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.047	0.01 U	0.01 U	0.01 U	0.049	0.034
MW-46	11/20/2006	0.01 U	0.061	0.01 U	0.019	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.044	0.01 U	0.01 U	0.01 U	0.063	0.036
MW-46	2/26/2007	0.01 U	0.032	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.036	0.01 U	0.01 U	0.01 U	0.029	0.033
MW-46	5/29/2007	0.01 U	0.027	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.031	0.01 U	0.01 U	0.018	0.031	0.029
MW-46	8/8/2007	0.014	0.032	0.01 U	0.014	0.016	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.01 U	0.01 U	0.076	0.01 U	0.01 U	0.018	0.054	0.059
MW-46	11/7/2007	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-46	2/12/2008	0.01 U	0.03	0.01 U	0.013	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.042	0.01 U	0.01 U	0.01 U	0.046	0.04
MW-46	5/5/2008	0.01	0.074	0.01 U	0.023	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.051	0.01 U	0.01 U	0.024	0.064	0.05
MW-46	8/11/2008	0.01 U	0.12	0.01 U	0.04	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05	0.01	0.01 U	0.03 B	0.12	0.06
MW-46	11/11/2008	0.026 B	0.079 B	0.01 U	0.06 B	0.018 B	0.014 B	0.012 B	0.01 U	0.012 B	0.02 B	0.01 U	0.01 U	0.065 B	0.015 B	0.01 U	0.059 B	0.12 B	0.058 B
MW-46	2/17/2009	0.012	0.098	0.01 U	0.022	0.012	0.017	0.015	0.011	0.016	0.017	0.01 U	0.01 U	0.066	0.032	0.01 U	0.1	0.11	0.072
MW-46	5/18/2009	0.01 U	0.021	0.01 U	0.01 U	0.016	**0.028**	**0.019**	0.035 U	**0.02**	**0.025**	**0.022**	0.01 U	0.04	0.01 U	**0.03**	0.032	0.018	0.044
MW-46	8/18/2009	0.01 U	0.033	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.017	0.01 U	0.01 U	0.017	0.015 U	0.018
MW-46	11/16/2009	0.01 U	0.062	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02	0.01 U	0.01 U	0.014	0.029	0.02
MW-46	4/19/2011		0.05 U	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.05 U	0.018 U	0.05 U	0.05 U	0.05 U
MW-49	11/7/2007	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-49	2/12/2008	0.12	0.34	0.022	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.01	0.078	0.01 U	0.081 B	0.066	0.016
MW-49	5/5/2008	0.082	0.32	0.028	0.015	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.014	0.01 U	0.01 U	0.015	0.085	0.01 U	0.093	0.052	0.013
MW-52	5/8/2006	0.16	0.15	0.016	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.066	0.036	0.21	0.01 U	0.01 U	0.19	0.027
MW-52A	8/22/2006	19 B	0.83	0.12	0.078	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.31	0.021	0.92	0.01 U	0.44 B	0.58 J	0.019
MW-52A	11/20/2006	0.72 B	0.12	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.016	0.01 U	0.055	0.01 U	0.078 B	0.028	0.01 U
MW-52A	2/26/2007	2.6 B	0.21	0.026 J	0.014	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.084	0.01 U	0.22	0.01 U	0.11 B	0.18	0.01 U
MW-52A	5/29/2007	3	0.45	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.13	0.01	0.43	0.01 U	0.32	0.15	0.01
MW-52A	8/8/2007	7.6	0.55	0.074 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.19	0.01 U	0.63	0.01 U	0.32	0.34	0.01 U
MW-52A	11/7/2007	3.9	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-52A	2/12/2008	11	0.63	0.08	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.22	0.012	0.7	0.01 U	0.5 B	0.52	0.017
MW-52A	5/5/2008	11	0.63	0.087	0.026	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.18	0.013	0.72	0.01 U	0.82	0.41	0.011
MW-52A	8/11/2008	6.5	0.6	0.09	0.05	**0.02**	0.01	**0.02**	0.02	**0.02**	**0.03**	**0.02**	0.26	0.03	0.75	**0.02**	0.38 B	0.51	0.03
MW-52A	11/11/2008	0.037 B	0.18 J	0.028 J	0.091 J	0.13 B	0.074 B	0.058 B	0.032	0.058 B	0.092 B	0.015	0.043 J	0.31 J	0.29 J	**0.031**	0.17 B	0.64 J	0.26 J
MW-52A	2/17/2009	0.096	0.28	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.14	0.011	0.39	0.01 U	0.23 J	0.28	0.01
MW-52A	5/18/2009	8.6	0.6	0.092	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.24	0.011	0.66	0.01 U	0.38	0.41 J	0.013
MW-52A	8/18/2009	12	0.8	0.12 J	0.023 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.3	0.01 U	0.86	0.01 U	0.31	0.44	0.01 U
MW-52A	11/16/2009	0.075	0.19	0.029 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.095	0.01 U	0.23	0.01 U	0.074	0.19	0.01 U
MW-52A	4/19/2011		0.94	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	1.2	0.018 U	0.05 U	0.8	0.05 U
MW-54	11/7/2007	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-54	2/12/2008	0.026	0.54	0.04	0.046	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.23	0.043	0.7	0.01 U	0.38 B	0.048	0.041
MW-54	5/5/2008	0.056	0.94	0.1	0.11	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.54	0.062	2	0.01 U	0.68	0.089	0.045
MW-54	8/11/2008	0.03	0.99	0.1 J	0.11	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.59	0.06	1.8	0.01 U	0.71 B	0.06	0.04
MW-58	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-58	5/9/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-58	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-58	11/29/2005	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 UJ	0.0943 UJ	0.0943 UJ	0.0943 UJ	0.0943 UJ	0.0943 UJ	0.0943 U		0.0943 UJ	0.0943 U	0.0943 U	0.0943 U	0.0943 UJ	0.0943 UJ

Table E-4. Summary of Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Well	Sample Date	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Screening Level (ug/L)		*NV*	*643*	*NV*	*25,900*	*0.018*	*0.018*	*0.018*	*NV*	*0.018*	*0.018*	*0.018*	*NV*	*90*	*3,460*	*0.018*	*4,940*	*NV*	*2,590*
MW-58	2/13/2006	0.02	0.88	0.01	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.12 B	0.05	0.01 U	0.05	0.01	0.1 B
MW-58	5/8/2006	0.01	0.77	0.013	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.073	0.054	0.01 U	0.01 U	0.016	0.064
MW-58	8/22/2006	0.01 U	0.12	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.051	0.01	0.01 U	0.01 U	0.011	0.046
MW-58	11/20/2006	0.01 U	0.28	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05	0.01	0.01 U	0.01 U	0.011	0.041
MW-58	2/26/2007	0.01 U	0.74	0.01 U	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1	0.051	0.01 U	0.01 U	0.011	0.08
MW-58	5/29/2007	0.01 U	0.12	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.034	0.014	0.01 U	0.012	0.01 U	0.03
MW-58	8/8/2007	0.01 U	0.23	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.045	0.012	0.01 U	0.013	0.01 U	0.039
MW-58	11/7/2007	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-58	2/12/2008	0.023	0.64	0.016	0.015	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02	0.12	0.14	0.01 U	0.089 B	0.032	0.099
MW-58	5/5/2008	0.23	2.2	0.051	0.4	**0.054**	0.01 U	0.012	0.01 U	0.01 U	**0.04**	0.01 U	0.088	1	0.76	0.01 U	1.4	0.68	0.7
MW-58	8/11/2008	0.1 B	1.8	0.04	0.45	**0.02**	0.01 U	0.01 U	0.01 U	0.01 U	**0.03**	0.01 U	0.09	0.91	0.63	0.01 U	0.59 B	0.55	0.59
MW-58	11/11/2008	0.13 B	2.7 B	0.032 J	0.93 B	0.08 B	0.01 U	0.01 U	0.01 U	0.01 U	0.08 B	0.01 U	0.21 B	2.1 B	0.79 B	0.01 U	0.84 B	1.2 B	1.3 B
MW-58	2/17/2009	0.34	4.4	0.072	0.5	**0.046**	0.01 U	0.01 U	0.01 U	0.01 U	**0.043**	0.01 U	0.46	1.6	1.9	0.01 U	2.3	1.6	1.1
MW-58	5/18/2009	0.11	3.2	0.07	0.55	**0.063**	0.01 U	0.01 U	0.01 U	0.01 U	**0.059**	0.01 U	0.26	2	1.5	0.01 U	0.7	1.2	1.3
MW-58	8/18/2009	0.029	1.8	0.031 J	0.3	**0.042**	0.01 U	0.01 U	0.01 U	0.01 U	**0.046**	0.01 U	0.098	1.3	0.72	0.01 U	0.28	0.4	0.84
MW-58	11/16/2009	0.061	3	0.042 J	0.3	**0.049**	0.01 U	0.01 U	0.01 U	0.01 U	**0.058**	0.01 U	0.25	1.4	1.2	0.01 U	0.61	0.57	0.93
MW-58	4/19/2011		4.9	0.12	0.45	**0.084**	0.018 U	0.018 U	0.05 U	0.018 U	**0.081**	0.018 U		1.9	2.7	0.018 U	1.1	2	1.3
MW-58	11/8/2011	0.1 U	1.8	0.1 U	0.27	**0.053**	0.01 U	0.01	0.1 U	0.01 U	**0.057**	0.01 U		1.1	1	0.01 U	0.1 U	0.59	0.85
MW-58	4/19/2012	2.5 U	2.5 U	2.5 U	2.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U		2.5 U	2.5 U	0.5 U	2.5 U	3.3	2.5 U
MW-59	10/13/2004	60	2.6	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.1	1 U	5	1 U	1 U	6	1 U
MW-72	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-72A	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-72A	11/29/2005	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U		0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U	0.0952 U
MW-72A	2/13/2006	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.01 U
MW-72A	5/8/2006	0.015	1.7	0.024	0.019	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.014	0.58	0.03	0.01 U	0.092 B	0.01 U	0.44
MW-72A	8/22/2006	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
MW-72A	11/20/2006	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
MW-72A	2/26/2007	0.01 U	0.2	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.058	0.01 U	0.01 U	0.01 U	0.01 U	0.07
MW-72A	5/29/2007	0.01 U	1	0.017	0.019	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.031	0.48	0.034	0.01 U	0.046	0.022	0.33
MW-72A	8/8/2007	0.01 U	0.024	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.033	0.01 U	0.01 U
MW-76	11/29/2005	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U		0.123	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.111
MW-76	2/13/2006	0.01 U	0.04	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.03	0.01 U	0.01 U
MW-76	5/8/2006	0.01 U	0.026	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
MW-76	8/22/2006	0.01 U	0.026	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
MW-76	11/20/2006	0.01 U	0.049	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.058 B	0.01 U	0.01 U
MW-76	2/26/2007	0.01 U	0.046	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
MW-76	5/29/2007	0.01 U	0.019	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.022	0.01 U	0.01 U
MW-76	8/8/2007	0.011	0.032	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.025	0.01 U	0.01 U
MW-76A	5/5/2008	1.3	0.99	0.2	0.05	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.15	0.011	1.6	0.01 U	0.28	0.52	0.014
MW-76A	8/11/2008	0.4 B	0.93	0.18 J	0.03	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.08	0.02	1.3	0.01 U	0.1 B	0.18	0.02
MW-76A	11/11/2008	0.013 B	0.59 B	0.1 J	0.026 J	0.017 B	0.01 U	0.01 U	0.01 U	0.01 U	0.013 B	0.01 U	0.02 U	0.025 J	0.4 B	0.01 U	0.12 J	0.067 J	0.024 J
MW-76A	2/17/2009	0.035	0.48	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.048	0.01 U	0.67	0.01 U	0.063 J	0.045	0.01 U
MW-76A	5/18/2009	0.045 J	1.5	0.23	0.053	0.01 U	0.01 U	0.01 U	0.014 U	0.01 U	0.01 U	0.01 U	0.16	0.01 U	1.7	0.01 U	0.11	0.17	0.016
MW-76A	8/18/2009	0.092	1.5	0.39 J	0.05	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2	0.01 U	2.1	0.01 U	0.2 U	0.38	0.011
MW-76A	11/16/2009	0.022	0.54	0.12 J	0.037	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.049	0.01 U	0.68	0.01 U	0.052	0.095	0.012

Table E-4. Summary of Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Well	Sample Date	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Screening Level (ug/L)		*NV*	*643*	*NV*	*25,900*	*0.018*	*0.018*	*0.018*	*NV*	*0.018*	*0.018*	*0.018*	*NV*	*90*	*3,460*	*0.018*	*4,940*	*NV*	*2,590*
MW-76A	4/19/2011		1.8	0.05 U	0.043	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	2.2	0.018 U	0.05 U	0.72	0.05 U
MW-77	11/7/2007	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-77	2/12/2008	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
MW-77	5/5/2008	0.01 U	0.016	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.063	0.01 U	0.01 U
MW-77	8/11/2008	0.02	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.08 B	0.01 U	0.01 U
MW-78	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-78A	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-79	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-79	5/9/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-79A	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-81	11/29/2005	2.91	19.8	0.151	2.01	**0.477**	0.0943 U	0.0943 U	0.0943 U	0.0943 U	**0.33**	0.0943 U		9.15	9.81	0.0943 U	5.04	13.2	10
MW-81	2/13/2006	1.4	28 J	0.19	0.7	**0.19**	0.1 U	0.1 U	0.1 U	0.1 U	**0.12**	0.1 U	6.8	2.9	9.4	0.1 U	8.2	1.3	1.7
MW-81	5/8/2006	3.6	30	0.28	1.4	**0.26**	0.1 U	0.1 U	0.1 U	0.1 U	**0.19**	0.1 U	11	4.1	15	0.1 U	11	9.7	2.4
MW-81	8/22/2006	1.7	38	0.1 U	2.7	**0.59**	0.1 U	**0.12**	0.1 U	**0.11**	**0.37**	0.1 U	12	14	20	0.1 U	0.23	25	5.7
MW-81	11/20/2006	1.5	17	0.1 J	1	**0.53**	**0.12**	**0.16**	0.1 U	**0.18**	**0.33**	0.1 U	4.3	4.9	7	0.1 U	4.2	6	2.8
MW-81	2/26/2007	0.61 B	14	0.1 U	0.36	**0.12**	0.1 U	0.1 U	0.1 U	0.1 U	**0.11**	0.1 U	3.5	1.4	5.8	0.1 U	3.4 B	1.2	0.76
MW-81	5/29/2007	2.6	20	0.14 J	1.5	**0.46**	**0.09**	**0.16**	0.02	**0.08**	**0.24**	0.01 U	6.4	4.7	8.8	**0.02**	2.7	10	2.6
MW-81	8/8/2007	1.5	23	0.15	1.7	**0.52**	0.1 U	**0.1**	0.1 U	**0.1**	**0.31**	0.1 U	7.1	8.6	11	0.1 U	0.39	14	4.3
MW-81	11/7/2007	4.7	24	1 U	2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	9.3	8.2	13	1 U	3.1 J	18	4.3
MW-81	2/12/2008	3.1	18	0.13	0.46	**0.24**	0.1 U	**0.16**	0.1 U	0.1 U	**0.14**	0.1 U	4.5	1.5	6.8	0.1 U	8.4	3.2	0.85
MW-81	5/5/2008	0.77	16	0.1 U	0.97	**0.34**	0.1 U	**0.11**	0.1 U	0.1 U	**0.2**	0.1 U	5.3	3.5	8.5	0.1 U	1.2	7	2.2
MW-81	8/11/2008	1.4	30	0.18	2.4 J	**0.72**	0.3 J	0.3 J	0.06 J	0.3 J	0.76 J	0.03 J	9.8	9.9	16	0.06 J	0.12 B	24	6.2 J
MW-81	11/11/2008	0.73 B	6 B	0.038 J	0.19 B	0.027 B	0.01 U	0.01 U	0.01 U	0.01 U	0.022 B	0.01 U	1.1 B	0.48 B	1.7 B	0.01 U	5.5 B	1.1 B	0.28 B
MW-81A	5/18/2009	0.01 U	0.019	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.17	0.01 U	0.01 U
MW-81A	8/18/2009	0	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.034	0.01 U	0.01 U
MW-81A	11/16/2009	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.01 U
MW-81A	4/19/2011		0.05 U	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.05 U	0.018 U	0.05 U	0.05 U	0.05 U
MW-84	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-84	5/9/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-84	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-84	11/29/2005	0.0943 U	1.44	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U		0.208	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.272
MW-84	2/13/2006	0.02	3	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.09 B	0.01	0.01 U	0.03	0.01 U	0.15 B
MW-84	5/8/2006	0.01 U	1.4	0.016	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.039	0.01 U	0.01 U	0.01 U	0.015	0.064
MW-84	8/22/2006	0.01 U	1.7	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.013	0.058	0.01 U	0.01 U	0.01 U	0.01 U	0.09
MW-84	11/20/2006	0.01 U	1.4	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.06	0.01 U	0.01 U	0.01 U	0.01 U	0.1
MW-84	2/26/2007	0.01 U	2.1	0.01 U	0.012	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.068	0.012	0.01 U	0.01 U	0.01 U	0.1
MW-84	5/29/2007	0.01 U	2.5	0.01 U	0.014	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.083	0.012	0.01 U	0.08	0.015	0.12
MW-84	8/8/2007	0.014	1.5	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.076	0.01 U	0.01 U	0.033	0.01 U	0.13
MW-84A	5/18/2009	0.61	160	0.51	1	0.013	0.01 U	0.01 U	0.014 B	0.01 U	0.014	0.01 U	0.92	0.58	5.9	0.01 U	1.5	2.8	0.36
MW-84A	8/18/2009	1 U	110	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3.2	1 U	1 U	1.7 B	1 U
MW-84A	11/16/2009	0.025	54	0.28	0.18	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.01 U	0.16	1	0.01 U	0.083	0.63	0.12
MW-84A	4/19/2011		1.2	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.05 U	0.018 U	0.05 U	0.05 U	0.05 U
MW-84A	11/8/2011	0.1 U	1	0.1 U	0.1 U	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U		0.1 U	0.1 U	0.01 U	0.1 U	0.1 U	0.1 U
MW-84B	5/18/2009	0.013	0.69	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.075	0.018	0.01 U
MW-84B	8/18/2009	0.01 U	0.47	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.014	0.01 U	0.01 U

Table E-4. Summary of Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Well	Sample Date	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Screening Level (ug/L)		*NV*	*643*	*NV*	*25,900*	*0.018*	*0.018*	*0.018*	*NV*	*0.018*	*0.018*	*0.018*	*NV*	*90*	*3,460*	*0.018*	*4,940*	*NV*	*2,590*
MW-84B	11/16/2009	0.01 U	1.2	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.013	0.01 U	0.01 U
MW-84B	4/19/2011		87	0.5	0.092	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.13	0.24	0.018 U	0.05 U	0.41	0.077
MW-84B	11/8/2011	0.1 U	100	0.54	0.11	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U		0.12	0.25	0.01 U	0.1 U	0.69	0.1 U
MW-85	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-85	5/9/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-85	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-85	11/29/2005	0.0943 U	0.266	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U		0.164	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.128
MW-85	2/13/2006	0.01 U	0.29	0.01 U	0.01	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.16 B	0.01 U	0.01 U	0.02	0.01 U	0.11 B
MW-85	5/8/2006	0.01 U	0.7	0.012	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2	0.01 U	0.01 U	0.01 U	0.01 U	0.13
MW-85	8/22/2006	0.01 U	0.037	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1	0.01 U	0.01 U	0.01 U	0.01 U	0.058
MW-85	11/20/2006	0.01 U	0.016	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.073	0.01 U	0.01 U	0.01 U	0.01 U	0.05
MW-85	2/26/2007	0.01 U	0.12	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.076	0.01 U	0.01 U	0.01 U	0.01 U	0.051
MW-85	5/29/2007	0.01 U	0.23	0.01 U	0.01 U	**0.019**	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.12	0.01 U	0.01 U	0.012	0.013	0.085
MW-85	8/8/2007	0.011	0.026	0.01 U	0.01 U	0.017	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.12	0.01 U	0.01 U	0.022	0.01 U	0.084
MW-85A	5/5/2008	0.022	0.043	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.017	0.012	0.01 U	0.015	0.019	0.027
MW-85A	8/11/2008	0.03	0.13	0.03	0.13	**0.08**	**0.07**	**0.06**	0.08	**0.11**	**0.12**	**0.08**	0.08	0.12	0.12	**0.08**	0.03 B	0.13	0.13
MW-85A	11/11/2008	0.031 B	0.17 B	0.01 U	0.025 B	0.012 B	0.01 U	0.01 U	0.01 U	0.01 U	0.014 B	0.01 U	0.015 B	0.049 B	0.084 B	0.01 U	0.21 B	0.13 B	0.061 B
MW-85A	2/17/2009	0.012	0.026	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.016	0.019	0.01 U	0.073	0.031	0.028
MW-85A	5/18/2009	0.012	0.022	0.01 U	0.011	**0.027**	**0.028**	**0.031**	0.034 U	**0.02**	**0.036**	**0.023**	0.01 U	0.058	0.014	**0.032**	0.044	0.052	0.076
MW-85A	8/18/2009	0.01 U	0.041	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.017	0.017	0.01 U	0.025	0.017 U	0.025
MW-85A	11/16/2009	0.01 U	0.03	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.028	0.013	0.013
MW-85A	4/19/2011		0.05 U	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.05 U	0.018 U	0.05 U	0.05 U	0.05 U
MW-85A	11/8/2011	0.1 U	0.1 U	0.1 U	0.1 U	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U		0.1 U	0.1 U	0.01 U	0.1 U	0.1 U	0.1 U
MW-85B	5/5/2008	3.3	15	0.16	0.27	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.52	0.29	8.7	0.01 U	15	6.1	0.12
MW-85B	8/11/2008	1.4 B	9	0.07	0.25	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.5	0.25	5.1	0.01 U	8.2 B	4.6	0.11
MW-85B	11/11/2008	5.3 B	22 B	0.24	0.61 B	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	1.3 B	0.5 B	12 B	0.01 U	26 B	12 B	0.24 B
MW-85B	2/17/2009	1.1	14	0.11	0.24	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.67	0.31	8.3	0.01 U	11	6.5	0.14
MW-85B	5/18/2009	0.72	16	0.18	0.34	0.01 U	0.01 U	0.01 U	0.014 U	0.01 U	0.01 U	0.01 U	0.53	0.3	7.8	0.01 U	1.9	7.3	0.14
MW-85B	8/18/2009	0.14	9.5	0.1	0.17	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.31	0.19	4.8	0.01 U	1.2	2.1	0.092
MW-85B	11/16/2009	0.087	8.6	0.092	0.08	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.18	0.17	1.9	0.01 U	0.44	0.011	0.079
MW-85B	4/19/2011		10	0.16	0.23	0.018 U	0.018 U	0.018 U	0.1 U	0.018 U	0.018 U	0.018 U		0.31	6.1	0.018 U	0.1	5.4	0.13
MW-85B	11/8/2011	0.1 U	12	0.15	0.33	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U		0.34	7.6	0.01 U	0.39	8.4	0.14
MW-86	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-86A	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-86A	11/29/2005	0.0943 U	0.749	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U		0.272	0.0943 U	0.0943 U	0.102	0.0943 U	0.298
MW-86A	2/13/2006	0.01	0.32	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.16 B	0.01 U	0.01 U	0.04	0.03	0.16 B
MW-86A	5/8/2006	0.01 U	0.28	0.01 U	0.021	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2	0.01 U	0.01 U	0.01 U	0.01 U	0.2
MW-86A	8/22/2006	0.01 U	0.22	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.18	0.01 U	0.01 U	0.01 U	0.01 U	0.18
MW-86A	11/20/2006	0.01 U	0.032	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.062	0.01 U	0.01 U	0.01 U	0.01 U	0.087
MW-86A	2/26/2007	0.01 U	0.074	0.01 U	0.021	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.091	0.01 U	0.01 U	0.01 U	0.01 U	0.12
MW-86A	5/29/2007	0.014	0.17	0.01 U	0.014	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.13	0.01 U	0.01 U	0.02	0.01 U	0.17
MW-86A	8/8/2007	0.015	0.09	0.01 U	0.013	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.096	0.01 U	0.01 U	0.033	0.01 U	0.15
MW-86B	5/5/2008	0.5	6.4	0.055	0.17	**0.026**	0.01 U	0.01 U	0.01 U	0.01 U	**0.019**	0.01 U	0.13	0.97	0.84	0.01 U	1.3	0.25	0.64
MW-86B	8/11/2008	0.02 B	3.3	0.03 J	0.09	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.04	0.54	0.34	0.01 U	0.11 B	0.06	0.37
MW-86B	11/11/2008	0.035 B	5.4 B	0.048 J	0.2 B	**0.034**	0.01 U	0.01 U	0.01 U	0.01 U	**0.027**	0.01 U	0.054	0.81 B	0.62 B	0.01 U	0.16 B	0.11 B	0.56 B

Table E-4. Summary of Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Well	Sample Date	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Screening Level (ug/L)		*NV*	*643*	*NV*	*25,900*	*0.018*	*0.018*	*0.018*	*NV*	*0.018*	*0.018*	*0.018*	*NV*	*90*	*3,460*	*0.018*	*4,940*	*NV*	*2,590*
MW-86B	2/17/2009	0.026	5.1	0.073	0.2	**0.025**	0.01 U	0.01 U	0.01 U	0.01 U	**0.019**	0.01 U	0.13	0.32	1.2	0.01 U	0.12	0.2	0.55
MW-86B	5/18/2009	0.065	6.1	0.07	0.33	**0.03**	0.01 U	0.01 U	0.01 U	0.01 U	**0.024**	0.01 U	0.16	1.2	1.8	0.01 U	0.17	0.69	0.75
MW-86B	8/18/2009	0.021	4.2	0.054 J	0.22	**0.024**	0.01 U	0.01 U	0.01 U	0.01 U	**0.021**	0.01 U	0.056	0.85	1.1	0.01 U	0.068	0.083	0.59
MW-86B	11/16/2009	0.01 U	5.7	0.057	0.18	**0.026**	0.01 U	0.01 U	0.01 U	0.01 U	**0.026**	0.01 U	0.056	0.83	1.4	0.01 U	0.048	0.03	0.57
MW-86B	4/19/2011		5.1	0.063	0.18	**0.026**	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.9	0.86	0.018 U	0.05 U	0.16	0.58
MW-86B	11/8/2011	0.1 U	6.9	0.1 U	0.31	**0.027**	0.01 U	0.01 U	0.1 U	0.01 U	**0.019**	0.01 U		0.89	2.3	0.01 U	0.12	0.64	0.65
MW-86B	4/19/2012	2.5 U	7.8	2.5 U	2.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U		2.5 U	2.5 U	0.5 U	2.5 U	2.5 U	2.5 U
MW-86C	5/5/2008	0.35	4.2	0.048	0.12	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.13	0.31	0.74	0.01 U	1.2	0.24	0.3
MW-86C	8/11/2008	0.02 B	2.8	0.02 J	0.06	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.03	0.37	0.17	0.01 U	0.06 B	0.14	0.3
MW-86C	11/11/2008	0.011 B	3.3 B	0.025 J	0.15 B	0.049 B	0.023 B	0.035 B	0.013	0.027 B	0.05 B	0.01 U	0.019 B	0.51 B	0.3 B	0.014	0.058 B	0.38 B	0.43 B
MW-86C	2/17/2009	0.1	4.4	0.049	0.16	**0.021**	0.013	0.011	0.01 U	0.012	**0.025**	0.01 U	0.16	0.73	0.99	0.01 U	0.52	0.15	0.57
MW-86C	5/18/2009	0.091	2.7	0.029	0.091	0.01 U	0.01 U	0.01 U	0.014 U	0.01 U	0.01 U	0.01 U	0.063	0.34	0.54	0.01 U	0.32	0.31	0.3
MW-86C	8/18/2009	0.014	3.8	0.031 J	0.11	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.049	0.33	0.72	0.01 U	0.052	0.07	0.29
MW-86C	11/16/2009	0.034	5	0.033 J	0.098	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.061	0.52	0.76	0.01 U	0.078	0.027	0.37
MW-86C	4/19/2011		4.2	0.054	0.15	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.42	1.3	0.018 U	1.3	0.73	0.34
MW-86C	11/8/2011	0.1 U	5.6	0.1 U	0.18	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U		0.46	1.8	0.01 U	0.17	0.45	0.38
MW-87	10/13/2004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-87	5/9/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-87	8/2/2005	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-87	11/29/2005	0.0943 U	0.445	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U	0.0943 U		0.0943 U	0.392	0.0943 U	0.0943 U	0.0943 U	0.0943 U
MW-87	2/13/2006	0.02	0.2	0.02 J	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02	0.01 U	0.15	0.01 U	0.06	0.01 U	0.01 U
MW-87	5/8/2006	0.024	0.2	0.02	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.016	0.01 U	0.14	0.01 U	0.044 B	0.01 U	0.01 U
MW-87	8/22/2006	0.01 U	0.3	0.042	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.024	0.011	0.25	0.01 U	0.05 B	0.01 U	0.01 U
MW-87	11/20/2006	0.01 U	0.15	0.011 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.09	0.01 U	0.059 B	0.01 U	0.01 U
MW-87	2/26/2007	0.01 U	0.11	0.012 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.084	0.01 U	0.01 U	0.01 U	0.01 U
MW-87	5/29/2007	0.014	0.12	0.014 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.012	0.094	0.01 U	0.078	0.01 U	0.01 U
MW-87	8/8/2007	0.024	0.12	0.016 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.087	0.01 U	0.078	0.01 U	0.01 U
MW-87A	5/5/2008	0.013	0.17	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.025	0.01 U	0.054	0.01 U	0.011
MW-87A	8/11/2008	0.02 B	0.03	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05 B	0.01 U	0.01
MW-87A	11/11/2008	0.01 U	0.022 B	0.01 U	0.049 B	**0.025**	0.012	0.014	0.01 U	0.014	**0.026**	0.01 U	0.01 U	0.053 B	0.017 B	0.01 U	0.055 B	0.058 B	0.047 B
MW-87A	2/17/2009	0.01	0.012	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.05	0.01 U	0.01 U
MW-87A	5/18/2009	0.036	0.027	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.014	0.01 U	0.01 U	0.01 U	0.16	0.01 U	0.01 U
MW-87A	8/18/2009	0.021	0.072	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.015	0.01 U	0.027	0.01 U	0.01 U
MW-87A	11/16/2009	0.015	0.063	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.017	0.01 U	0.01 U
MW-87A	4/19/2011		0.18	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.069	0.018 U	0.05 U	0.05 U	0.05 U
MW-87A	11/8/2011	0.1 U	0.41	0.1 U	0.1 U	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U		0.1 U	0.1 U	0.01 U	0.1 U	0.1 U	0.1 U
MW-87B	5/5/2008	0.076	3.5	0.044	0.16	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.5	1.4	2.1	0.01 U	0.23	0.28	0.57
MW-87B	8/11/2008	0.15 B	0.47	0.01 U	0.11	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05	0.16	0.3	0.01 U	0.2 B	0.63	0.1
MW-87B	11/11/2008	0.075 B	0.52 B	0.012 J	0.068 B	0.012	0.01 U	0.01 U	0.01 U	0.01 U	**0.023**	0.01 U	0.074	0.27 B	0.41 B	0.01 U	0.067 B	0.96 B	0.18 B
MW-87B	2/17/2009	0.52	1.4	0.017	0.15	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.29	0.44	1	0.01 U	0.84	2.4	0.26
MW-87B	5/18/2009	0.25	0.7	0.01 U	0.082	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.13	0.27	0.47	0.01 U	0.47	1.4	0.16
MW-87B	8/18/2009	0.078	0.32	0.01 U	0.047	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.031	0.15	0.25	0.01 U	0.087	0.74 B	0.087
MW-87B	11/16/2009	0.22	0.89	0.012	0.14	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.07	0.42	0.76	0.01 U	0.26	2.5	0.25
MW-87B	4/19/2011		2.2	0.031	0.39	**0.019**	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		1.6	1.5	0.018 U	0.57	5.1	0.87
MW-87B	11/8/2011	0.1	2.8	0.1 U	0.2	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U		0.78	1	0.01 U	0.1	6.7	0.49

Table E-4. Summary of Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Well	Sample Date	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
Screening Level (ug/L)		*NV*	*643*	*NV*	*25,900*	*0.018*	*0.018*	*0.018*	*NV*	*0.018*	*0.018*	*0.018*	*NV*	*90*	*3,460*	*0.018*	*4,940*	*NV*	*2,590*
MW-88	5/18/2009	0.022	0.84	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.014 B	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.069	0.14	0.01 U
MW-88	8/18/2009	0.018	0.72	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.021	0.01 U
MW-88	11/16/2009	0.01 U	0.92	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.01 U
MW-88	4/19/2011		0.55	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.05 U	0.018 U	0.05 U	0.05 U	0.05 U
MW-89	5/5/2008	0.54	2.3	0.085	0.19	0.015	0.01 U	0.01 U	0.01 U	0.01 U	0.016	0.01 U	0.39	0.22	1.3	0.01 U	1.5	0.94	0.19
MW-89	8/11/2008	0.14	1.9	0.05 J	0.16	**0.04**	**0.04**	**0.04**	0.04	**0.04**	**0.07**	**0.04**	0.17	0.16	0.61	**0.04**	0.53 B	0.57	0.16
MW-89	2/17/2009	0.052	1.6	0.033 J	0.079	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.078	0.11	0.44	0.01 U	0.24	0.37	0.1
MW-89	5/18/2009	0.021	0.91	0.02	0.038	0.011	0.01 U	0.01 U	0.015 U	0.01 U	0.014	0.01 U	0.054	0.1	0.24	0.01 U	0.15	0.015	0.1
MW-89	8/18/2009	0.016	1.2	0.031 J	0.072	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.01 U	0.081	0.1	0.45	0.01 U	0.2	0.17	0.098
MW-89	11/16/2009	0.064	0.99	0.027	0.026	0.015	0.01 U	0.01 U	0.01 U	0.01 U	**0.02**	0.01 U	0.09	0.15	0.27	0.01 U	0.25	0.01 U	0.16
MW-89	4/19/2011		1.2	0.053	0.064	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.11	0.66	0.018 U	0.05 U	0.27	0.087
MW-90	5/5/2008	0.01 U	0.053	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.09	0.01 U	0.01 U
MW-90	8/11/2008	0.03 B	0.02	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.03 B	0.01 U	0.01 U
MW-90	11/11/2008	0.036 B	0.063 B	0.01 U	0.045 B	0.012 B	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.029 B	0.011 B	0.01 U	0.072 B	0.07 B	0.03 B
MW-90	2/17/2009	0.013	0.028	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.056	0.01 U	0.01 U
MW-90	5/18/2009	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.032	0.01 U	0.01 U
MW-90	8/18/2009	0.01 U	0.057	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.063	0.01 U	0.02	0.012	0.01 U
MW-90	11/16/2009	0.01 U	0.02	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.011	0.01 U	0.04	0.01 U	0.01 U
MW-90	4/19/2011		0.05 U	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.05 U	0.018 U	0.05 U	0.05 U	0.05 U
MW-91	5/5/2008	0.01 U	0.31	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.014	0.01 U	0.079	0.01 U	0.41	0.033	0.01 U
MW-91	8/11/2008	0.01 U	0.15	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.03	0.01 U	0.14 B	0.01	0.01 U
MW-91	11/11/2008	0.014 B	0.15 B	0.01 U	0.021 B	0.012 B	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.036 B	0.017 B	0.01 U	0.15 B	0.098 B	0.032 B
MW-91	2/17/2009	0.023	0.23	0.013	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.04	0.01 U	0.053	0.021	0.01 U
MW-91	5/18/2009	0.019 U	0.5	0.027 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.074	0.01 U	0.32	0.011	0.01 U
MW-91	8/18/2009	0.014 J	0.3	0.021 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.059	0.01 U	0.19	0.018 U	0.01 U
MW-91	11/16/2009	0.01 U	0.22	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.019	0.01 U	0.075	0.01 U	0.01 U
MW-91	4/19/2011		0.28	0.05 U	0.05 U	0.018 U	0.018 U	0.018 U	0.05 U	0.018 U	0.018 U	0.018 U		0.05 U	0.066	0.018 U	0.05 U	0.05 U	0.05 U
RW-11A	5/5/2008	4.7	0.45	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.16	0.019	0.97	0.01 U	0.59	0.17	0.025
RW-11A	8/11/2008	10 J	0.51 J	0.1 J	0.02 J	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.27 J	0.01 UJ	1 J	0.01 UJ	1.6 J	0.4 J	0.01 UJ
RW-5A	5/5/2008	0.01 U	0.26	0.014	0.028	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.033	0.04	0.073	0.01 U	0.35	0.01 U	0.054

All results micrograms per liter (ug/L)

PAH: Polyaromatic Hydrocarbon; SVOC: Semi-Volailte Organic Compound

U: Non-detect at indicated reporting limit

E: Estimated value, poor peak resolution

J: Estimated value

B: Constituent detected in blank

NV: No value

Table E-5. Summary of Centrifuged and Filtered Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Constituent	**Analyte Comment**		**Screening Level**	**MW58**		**MW84A**	**MW84B**	**MW85A**	**MW85B**	**MW86B**		**MW86C**	**MW87A**	**MW87B**
		Sample Date		Sample	Reanalysis	Sample	Sample	Sample	Sample	Sample	Reanalysis	Sample	Sample	Sample
2-Methylnaphthalene	Semi-Volatile	11/8/2011	*NV*	0.1 U		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.1
2-Methylnaphthalene	Field Filtered 0.45-micron	4/19/2012	*NV*	0.24						0.15 U				
2-Methylnaphthalene	Semi-Volatile	4/19/2012	*NV*	2.5 U						2.5 U				
2-Methylnaphthalene	Lab-Filtered 0.7-micron	4/19/2012	*NV*	2.5 U						2.5 U				
Acenaphthene	PAH Compound	11/8/2011	*643*	1.8		1	100	0.1 U	12	6.9	5.5 E	5.6	0.41	2.8
Acenaphthene	Centrifuged	11/8/2011	*643*	1.6	1.3	0.9	81 J	17	10	4.2	3.8 E	5.4	0.27	0.84
Acenaphthene	PAH Compound	4/19/2012	*643*	2.5 U						7.8				
Acenaphthene	Field Filtered 0.45-micron	4/19/2012	*643*	2.8						4.5				
Acenaphthene	Lab-Filtered 0.7-micron	4/19/2012	*643*	6.4						6.9				
Acenaphthylene	PAH Compound	11/8/2011	*NV*	0.1 U		0.1 U	0.54	0.1 U	0.15	0.1 U	0.11	0.1 U	0.1 U	0.1 U
Acenaphthylene	Centrifuged	11/8/2011	*NV*	0.1 U	0.1 U	0.1 U	0.45	0.1	0.14	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthylene	PAH Compound	4/19/2012	*NV*	2.5 U						2.5 U				
Acenaphthylene	Field Filtered 0.45-micron	4/19/2012	*NV*	0.054						0.067				
Acenaphthylene	Lab-Filtered 0.7-micron	4/19/2012	*NV*	2.5 U						2.5 U				
Anthracene	PAH Compound	11/8/2011	*25,900*	0.27		0.1 U	0.11	0.1 U	0.33	0.31	0.37	0.18	0.1 U	0.2
Anthracene	Centrifuged	11/8/2011	*25,900*	0.24	0.15	0.1 U	0.1 U	0.1 U	0.29	0.21	0.23	0.18	0.1 U	0.14
Anthracene	PAH Compound	4/19/2012	*25,900*	2.5 U						2.5 U				
Anthracene	Field Filtered 0.45-micron	4/19/2012	*25,900*	0.05 U						0.05 U				
Anthracene	Lab-Filtered 0.7-micron	4/19/2012	*25,900*	2.5 U						2.5 U				
Benzo(a)anthracene	PAH Compound	11/8/2011	*0.018*	**0.053**		0.01 U	0.01 U	0.01 U	0.01 U	**0.027**	**0.025**	0.01 U	0.01 U	0.01 U
Benzo(a)anthracene	Centrifuged	11/8/2011	*0.018*	**0.041**	**0.038**	0.01 U	0.01 U	0.01 U	0.01 U	**0.022**	**0.031**	0.01 U	0.01 U	0.01 U
Benzo(a)anthracene	PAH Compound	4/19/2012	*0.018*	0.5 U						0.5 U				
Benzo(a)anthracene	Field Filtered 0.45-micron	4/19/2012	*0.018*	0.01 U						0.01 U				
Benzo(a)anthracene	Lab-Filtered 0.7-micron	4/19/2012	*0.018*	0.5 U						0.5 U				
Benzo(a)pyrene	PAH Compound	11/8/2011	*0.018*	0.01 U		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(a)pyrene	Centrifuged	11/8/2011	*0.018*	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(a)pyrene	PAH Compound	4/19/2012	*0.018*	0.5 U						0.5 U				
Benzo(a)pyrene	Field Filtered 0.45-micron	4/19/2012	*0.018*	0.01 U						0.01 U				
Benzo(a)pyrene	Lab-Filtered 0.7-micron	4/19/2012	*0.018*	0.5 U						0.5 U				
Benzo(b)fluoranthene	PAH Compound	11/8/2011	*0.018*	0.01		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(b)fluoranthene	Centrifuged	11/8/2011	*0.018*	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(b)fluoranthene	PAH Compound	4/19/2012	*0.018*	0.5 U						0.5 U				
Benzo(b)fluoranthene	Field Filtered 0.45-micron	4/19/2012	*0.018*	0.01 U						0.01 U				
Benzo(b)fluoranthene	Lab-Filtered 0.7-micron	4/19/2012	*0.018*	0.5 U						0.5 U				
Benzo(g,h,i)perylene	PAH Compound	11/8/2011	*NV*	0.1 U		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.01 U	0.1 U	0.1 U	0.1 U
Benzo(g,h,i)perylene	Centrifuged	11/8/2011	*NV*	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.01 U	0.1 U	0.1 U	0.1 U
Benzo(g,h,i)perylene	PAH Compound	4/19/2012	*NV*	2.5 U						2.5 U				
Benzo(g,h,i)perylene	Field Filtered 0.45-micron	4/19/2012	*NV*	0.05 U						0.05 U				
Benzo(g,h,i)perylene	Lab-Filtered 0.7-micron	4/19/2012	*NV*	2.5 U						2.5 U				
Benzo(k)fluoranthene	PAH Compound	11/8/2011	*0.018*	0.01 U		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(k)fluoranthene	Centrifuged	11/8/2011	*0.018*	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Benzo(k)fluoranthene	PAH Compound	4/19/2012	*0.018*	0.5 U						0.5 U				
Benzo(k)fluoranthene	Field Filtered 0.45-micron	4/19/2012	*0.018*	0.01 U						0.01 U				
Benzo(k)fluoranthene	Lab-Filtered 0.7-micron	4/19/2012	*0.018*	0.5 U						0.5 U				
Chrysene	PAH Compound	11/8/2011	*0.018*	**0.057**		0.01 U	0.01 U	0.01 U	0.01 U	**0.019**	**0.018**	0.01 U	0.01 U	0.01 U
Chrysene	Centrifuged	11/8/2011	*0.018*	**0.04**	**0.036**	0.01 U	0.01 U	0.01 U	0.01 U	0.016	**0.023**	0.01 U	0.01 U	0.01 U
Chrysene	PAH Compound	4/19/2012	*0.018*	0.5 U						0.5 U				
Chrysene	Field Filtered 0.45-micron	4/19/2012	*0.018*	0.01 U						0.01 U				
Chrysene	Lab-Filtered 0.7-micron	4/19/2012	*0.018*	0.5 U						0.5 U				

Table E-5. Summary of Centrifuged and Filtered Groundwater PAH and SVOC Concentrations

Port of Seattle Terminal 30

Constituent	Analyte Comment	Sample Date	Screening Level	MW58		MW84A	MW84B	MW85A	MW85B	MW86B		MW86C	MW87A	MW87B
				Sample	Reanalysis	Sample	Sample	Sample	Sample	Sample	Reanalysis	Sample	Sample	Sample
Dibenzo(a,h)anthracene	PAH Compound	11/8/2011	*0.018*	0.01 U		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dibenzo(a,h)anthracene	Centrifuged	11/8/2011	*0.018*	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dibenzo(a,h)anthracene	PAH Compound	4/19/2012	*0.018*	0.5 U						0.5 U				
Dibenzo(a,h)anthracene	Field Filtered 0.45-micron	4/19/2012	*0.018*	0.01 U						0.01 U				
Dibenzo(a,h)anthracene	Lab-Filtered 0.7-micron	4/19/2012	*0.018*	0.5 U						0.5 U				
Fluoranthene	PAH Compound	11/8/2011	*90*	1.1		0.1 U	0.12	0.1 U	0.34	0.89	1.1	0.46	0.1 U	0.78
Fluoranthene	Centrifuged	11/8/2011	*90*	0.93	0.92	0.1 U	0.11	0.1 U	0.31	0.74	0.79	0.44	0.1 U	0.56
Fluoranthene	PAH Compound	4/19/2012	*90*	2.5 U						2.5 U				
Fluoranthene	Field Filtered 0.45-micron	4/19/2012	*90*	0.05 U						0.05 U				
Fluoranthene	Lab-Filtered 0.7-micron	4/19/2012	*90*	2.5 U						2.5 U				
Fluorene	PAH Compound	11/8/2011	*3,460*	1		0.1 U	0.25	0.1 U	7.6	2.3	2.5 E	1.8	0.1 U	1
Fluorene	Centrifuged	11/8/2011	*3,460*	0.89	0.69	0.1 U	0.22	0.1 U	6.5	1.7	1.7	2	0.1 U	0.66
Fluorene	PAH Compound	4/19/2012	*3,460*	2.5 U						2.5 U				
Fluorene	Field Filtered 0.45-micron	4/19/2012	*3,460*	0.63						1				
Fluorene	Lab-Filtered 0.7-micron	4/19/2012	*3,460*	3.2						2.5 U				
Indeno(1,2,3-cd)pyrene	PAH Compound	11/8/2011	*0.018*	0.01 U		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Indeno(1,2,3-cd)pyrene	Centrifuged	11/8/2011	*0.018*	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Indeno(1,2,3-cd)pyrene	PAH Compound	4/19/2012	*0.018*	0.5 U						0.5 U				
Indeno(1,2,3-cd)pyrene	Field Filtered 0.45-micron	4/19/2012	*0.018*	0.01 U						0.01 U				
Indeno(1,2,3-cd)pyrene	Lab-Filtered 0.7-micron	4/19/2012	*0.018*	0.5 U						0.5 U				
Naphthalene	PAH Compound	11/8/2011	*4,940*	0.1 U		0.1 U	0.1 U	0.1 U	0.39	0.12	0.14	0.17	0.1 U	0.1
Naphthalene	Centrifuged	11/8/2011	*4,940*	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.3	0.1 U	0.1 U	0.15	0.1 U	0.1 U
Naphthalene	PAH Compound	4/19/2012	*4,940*	2.5 U						2.5 U				
Naphthalene	Field Filtered 0.45-micron	4/19/2012	*4,940*	1.1						0.05 U				
Naphthalene	Lab-Filtered 0.7-micron	4/19/2012	*4,940*	2.5 U						2.5 U				
Phenanthrene	PAH Compound	11/8/2011	*NV*	0.59		0.1 U	0.69	0.1 U	8.4	0.64	0.74	0.45	0.1 U	6.7
Phenanthrene	Centrifuged	11/8/2011	*NV*	0.52	0.17	0.1 U	0.6	0.15	7.3	0.43	0.47	0.91	0.1 U	2.3
Phenanthrene	PAH Compound	4/19/2012	*NV*	3.3						2.5 U				
Phenanthrene	Field Filtered 0.45-micron	4/19/2012	*NV*	0.076						0.063				
Phenanthrene	Lab-Filtered 0.7-micron	4/19/2012	*NV*	2.6						2.5 U				
Pyrene	PAH Compound	11/8/2011	*2,590*	0.85		0.1 U	0.1 U	0.1 U	0.14	0.65	0.77	0.38	0.1 U	0.49
Pyrene	Centrifuged	11/8/2011	*2,590*	0.8	0.72	0.1 U	0.1 U	0.1 U	0.14	0.55	0.61	0.37	0.1 U	0.35
Pyrene	PAH Compound	4/19/2012	*2,590*	2.5 U						2.5 U				
Pyrene	Field Filtered 0.45-micron	4/19/2012	*2,590*	0.05 U						0.05 U				
Pyrene	Lab-Filtered 0.7-micron	4/19/2012	*2,590*	2.5 U						0.5 U				

Lab filtration used a 0.7-micron filter
Field filtration used a 0.45-micron filter
All results micrograms per liter (ug/L)
PAH: Polyaromatic Hydrocarbon; SVOC: Semi-Volailte Organic Compound
U: Non-detect at indicated reporting limit
E: Estimated value, poor peak resolution
NV: No value
Analyte comment "PAH Compound" indicates that the sample split was analyzed without filter or centrifuge sample preparation.

Appendix F

Permits

pscleanair.org
Puget Sound Clean Air Agency

PUGET SOUND CLEAN AIR AGENCY

1904 3rd Ave, Ste 105
Seattle WA 98101-3317
(206) 689-4052 Fax: (206) 343-7522 <www.pscleanair.org>

NOTICE OF CONSTRUCTION AND APPLICATION FOR APPROVAL

Incomplete applications delay Agency review, so please fill out your application thoroughly

Soil & Groundwater Remediation — Form SGR

AGENCY USE ONLY: DATE ____________ REG NO.___________ NOC NO.________

Facility Information

Facility Name as it appears on outside of building: SSA Marine, Terminal 30
Site Address (incl. city, state, zip) 1901 East Marginal Way South, Seattle, Washington
Site Contact Kelly Garber | Site Phone # 206-654-3511 | Email Kelly.Garber@SSAMarine.com

Applicant/Invoicing Information

Company Port of Seattle | Applicant Catherine Chu
Phone # (206) 787-3549 | E-mail chu.c@portseattle.org | Fax #
Mailing Address (incl. city, state, zip) 2711 Alaskan Way; Seattle, Washington 98121

TYPE OF BUSINESS
(Check one)
☐ NEW ☒ EXISTING

STATUS OF EQUIPMENT
(Check one)
☒ NEW ☐ EXISTING ☐ ALTERED ☐ RELOCATION

PROCESS EQUIPMENT
DESCRIPTION: air sparging/soil vapor extraction system
NO. OF UNITS; 2 MAKE AND MODEL TBD
CONNECTED TO: subsurface vapor extraction and air sparge wells

CONTROL EQUIPMENT (Must Meet 90% Destruction Efficiency):
_____ Vapor Carbon Vessels (Two in Series) ______ Catalytic Oxidizer x Thermal Oxidizer
_____ Internal Combustion Engine _____ Other(Specify)________________

Enclose a narrative that addresses procedures for continued proper operation and maintenance of selected control equipment (i.e., monitoring carbon bed exhaust for breakthrough, monitoring temperature of thermal oxidizer, etc.).

Planned Start Date for Construction | Planned Start Date for Operation

GAS STREAM CHARACTERISTICS OF CONTROL EQUIPMENT

	Temperature(°F)	Static Pressure (psig)	Flow Rate(acfm)
INLET	100	2 to 3	300 to 480
OUTLET	1400 to 1600	0	1200 to 2000

AIR CONTAMINANT EMISSION WORST CASE ESTIMATE (Attach separate sheet with calculations)

POLLUTANT	UNCONTROLLED LB/DAY	UNCONTROLLED LB/YEAR	UNCONTROLLED LB/LIFETIME	CONTROL EFFICIENCY	CONTROLLED LBS/LIFETIME
see attached					
TOTAL PETROLEUM HYDROCARBONS					

AMOUNT OF SOIL TO BE REMEDIATED: NA
FLOW RATE (gpm): NA
ESTIMATED DURATION OF PROJECT: 10 years

Days of Operation (Circle) [✓ S M T W T F S]
Daily Hours of Operation 24 hours per day
From ________am to _________ pm

EXHAUST STACK PARAMETERS

Stack Height Above Ground (ft)	Stack Internal Diameter at Exit (ft)	CFM Exhausted	Velocity (ft/sec)
13	1.75 (TBD)	340 to 500	TBD

FLOW DIAGRAM & PLOT PLAN

FLOW DIAGRAM INSTRUCTIONS
(a) FLOW DIAGRAM MAY BE SCHEMATIC. ALL EQUIPMENT SHOULD BE SHOWN WITH EXISTING EQUIPMENT SO INDICATED.
(b) SHOW FLOW DIAGRAM OF PROCESS.
(c) INDICATE ALL POINTS IN PROCESS WHERE GASEOUS OR PARTICULATE POLLUTANTS ARE EMITTED.
(d) FLOW CHART CAN BE ATTACHED SEPARATELY IF NECESSARY. (DRAWINGS MAY BE SUBMITTED INSTEAD, IF DESIRED).
(e) ATTACH A PLOT PLAN SHOWING NEAREST PUBLIC ACCESS.

See Attached. The final permit application will include the details on the model selected. The model will be selected by the Contractor based on specifications for operations.

Certification

I, the undersigned, do hereby certify that the information contained in this application is, to the best of my knowledge, accurate and complete.

DRAFT
Signature ______________________ Date ______________________

DRAFT
Type or Print Name and Title ______________________ Phone ______________________

Your application will not be processed unless you mail a $1,150 filing fee payment *along with the application*. Additional fees may apply after the application is reviewed. To pay by credit card, check here ☐ and an accounting technician will contact you.

Estimate of Uncontrolled and Controlled VOC and TPH Emissions
Terminal 30 AS/SVE System - Port of Seattle

	Soil Vapor Data					Maximum Average Concentration ug/m3	Uncontrolled Emissions at 340 cfm lb/year	SQER lb/year	Controlled Emissions	
	MW-36A 10/26/2017 ug/m3	MW-39A 10/26/2017 ug/m3	MW-42 10/25/2017 ug/m3	MW-59 10/25/2017 ug/m3	MW-93 10/26/2017 ug/m3				At 99% DRE lb/year	At 98% DRE lb/year
Volatile Organic Compounds (TO-15 Method) - Detected Compounds Only										
Benzene	160 U	140,000	14,000	160 U	3,700 U	31,604	352.3	6.62	3.5	**7.0**
Cyclohexane	23,000	2,900,000 E	280,000	3,400 U	530,000	747,280	8329.6	287985	83.3	166.6
Cyclopentane	140 U	270,000	14,000	140 U	13,000	59,456	662.7	NA	6.6	13.3
Ethylbenzene	220 U	9,300	5,600 U	220 U	5,000 U	4,068	45.3	76.8	0.5	0.9
Hexane	21,000	3,200,000 E	300,000	1,800 U	670,000	838,560	9347.0	33580	93.5	186.9
Pentane	30,000	3,300,000 E	330,000	1,500	940,000	920,300	10258.1	NA	102.6	205.2
Propene	500	8,600 U	8,900 U	350 U	7,900 U	5,250	58.5	NA	0.6	1.2
Air Petroleum Hydrocarbons (MA-APH)										
EC5-8 aliphatics	2,700,000 E	86,000,000 E	12,000,000	420,000	14,000,000 E	23,024,000	256637.4	NA	2,566.4	5,132.7
EC9-12 aliphatics	270,000	1,000,000	910,000 U	190,000	800,000 U	634,000	7066.9	NA	70.7	141.3
EC9-10 aromatics	25,000 U	620,000 U	650,000 U	25,000 U	570,000 U	378,000	4213.4	NA	42.1	84.3
					Total VOCs	lbs/year	29053.6	1000	290.5	581.1
						tons/year	14.5		0.1	0.3
					Total TPH	lbs/year	267917.7	1000	**2,679.2**	**5,358.4**
						tons/year	133.96		1.3	2.7

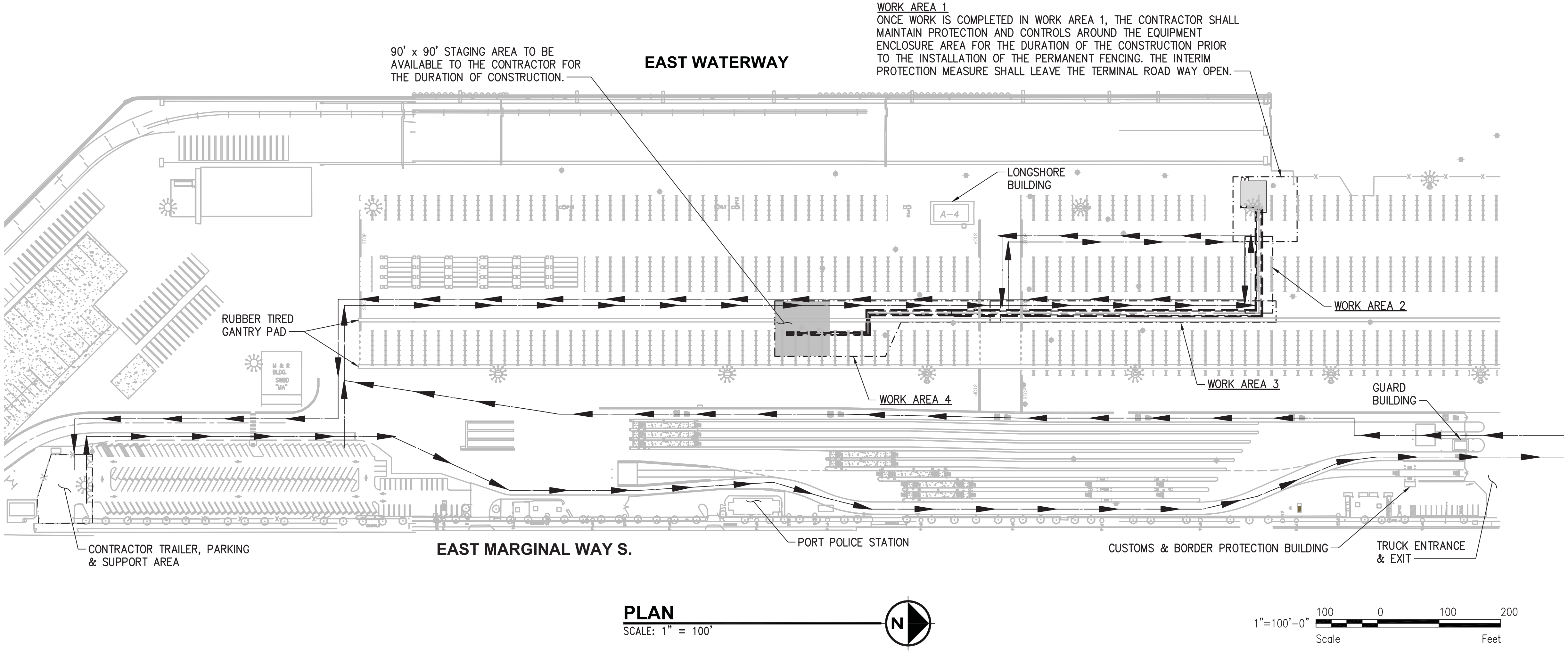
Notes:
E - exceeded the calibration range
U - not detected above the reporting limit
Bold = detection
ug/m3 = micrograms per cubic meter
SQER - Small Quantity Emission Rate (ambient ASIL modelling not required if treated emission rates are below SQER and cannot be performed for total VOCs or TPH)
DRE - Destruction Removal Efficiency
SQER for TPH is not a regulated value. This is simply the SQER for VOCs applied to TPH

NOTES

1. THE STAGING AREA IN WORK AREA 4 AND EQUIPMENT ENCLOSURE AREA IN WORK AREA 1 SHALL BE AVAILABLE TO THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
2. EXCEPT AS STATED IN NOTE 1, CONTRACTOR SHALL OCCUPY ONLY A SINGLE WORK AREA AT ANY ONE TIME TO MINIMIZE DISRUPTION TO TERMINAL OPERATIONS.
3. EXCEPT AS STATED IN NOTE 1, CONTRACTOR SHALL FINISH WORK IN A WORK AREA PRIOR TO MOVING TO AN ADJACENT WORK AREA.
4. CONTRACTOR'S SCHEDULE SHALL CLEARLY IDENTIFY WHEN THEY WILL OCCUPY EACH WORK AREA. THIS SCHEDULE SHALL BE APPROVED BY THE ENGINEER AND TENANT PRIOR TO ANY SITE WORK.
5. CONTRACTOR SHALL NOT HAVE ANY TRUCKS QUEUED FOR LOADING OR UNLOADING IN ANY AREAS OF THE SITE OUTSIDE OF THE ACTIVE WORK AREA.

LEGEND

←	APPROXIMATE LOCATION & DIRECTION OF ALLOWABLE CONSTRUCTION TRAFFIC.
-·-·-	CONTRACTOR WORK AREAS.



PLAN
SCALE: 1" = 100'

CALL 2 DAYS BEFORE YOU DIG
1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH: CRETE/MOFFATT & NICHOL
DESIGNER: JCS
DRAWN BY: CJG
SCALE: AS NOTED
DATE: 5/12/18
CHECKED BY: JCS
CHECKED/APPROVED BY: MGB

MICHAEL G. BYERS 30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER: CATHERINE CHU
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEAPORT FACILITIES
PROJECT NAME: TERMINAL 30 CLEANUP
SHEET TITLE: SITE CONTROLS & CONTRACTOR WORK AREAS

POS WORK PROJECT NUMBER
WP-U00212
CONSULTANT'S PROJECT NUMBER
9834
POS PROJECT TRACKING NUMBER
30-1801 G4

File: Q:\SEA\9834\CADD_Active_SheetSet\301801G004; Plotted: 5/24/2018 2:31 PM by SZARVADI, ANDRA; Saved: 5/23/2018 12:24 PM by ASZARVADI

Appendix G

Calculations and Design Data

CRETE Consulting Incorporated
108 South Washington Street, Suite 300
Seattle, WA 98104

TO: Grant Hainsworth – CRETE Consulting Inc

FROM: Jamie Stevens – CRETE Consulting Inc.

PROJECT: Terminal 30 Cleanup Action

SUBJECT: Summary of the Terminal 30 Cleanup Action Design Data Field Work

DATE: December 1, 2017

CC:

This technical memorandum provides a summary of the design data field work conducted in October 2017 at the Terminal 30 project site (T-30) in Seattle, Washington. This data was collected to inform the T-30 Engineering Design Report (EDR) for the planned cleanup action. The design field work activities included:

1) Installation and replacement of groundwater monitoring wells that will be used as performance groundwater monitoring wells during operation of the Air Sparging/Soil Vapor Extraction (AS/SVE) system;
2) Light Non-Aqueous Phase Liquid (LNAPL) product removal at MW-36;
3) Collection of soil vapor samples from groundwater wells to support permitting and vapor treatment design;
4) Ground penetrating radar (GPR) survey along the AS/SVE trench alignment; and,
5) Collection of topographical survey details of the ground surface and elevation details of utilities within in the AS/SVE system alignment.

A summary of the design field work associated with each activity is described below. Results of the analytical data collected are summarized in the tables included in Attachment 1. Key field reports and analytical laboratory reports are included in Attachment 2.

1. Performance Groundwater Monitoring Wells (MW-36A,MW-39A, and MW-93)

On October 15, 2017 three new performance wells were installed, well repairs were made at MW-36, and attempts were made to decommission MW-39. Field work was conducted by Pacific Groundwater Group and drilling was performed by Cascade drilling. Analytical samples were analyzed by Friedman and Bruya in Seattle, WA.

Three new Performance Wells

- A hollow stem auger drilling rig was used to install three new wells: MW-36A (to replace MW-36), MW-39A (to replace MW-39), and MW-93. Soil samples were collected at the water table for TPH analyses. Analytical results are summarized on Table 1 (Attachment 1) and copies of boring logs and analytical reports are included in Attachment 2.

Repairs at MW-36

- During the May 2017 Interim Groundwater Monitoring Event, well MW-36 was observed to be damaged. MW-36 has been dislodged within the monument. Monitoring well logs are not available for this well; however, the total well depth is reported at 13 feet below ground surface (bgs). The total depth during the May 2017 event was found to be 11.7 feet bgs, suggesting sediment has accumulated at the bottom of the well.

- A licensed driller inspected the casing top and flush-mount monument at MW-36. The concrete did not have obvious structural flaws, but the PVC casing was worn at the top causing the shallow J-plug in the well to have a poor quality seal. Also, the flush mount bolt holes were partially stripped. Repairs at MW-36 included: the flush mount rubber seal and bolts were replaced and a new deeper J-plug was installed to form a water-tight seal.

Decommission of MW-39

- During the May 2017 Interim Groundwater Monitoring Event, well MW-39 was observed to be damaged. MW-39 was found to have a damaged PVC casing and the surface seal did not appear to be intact.
- Field work on October 15, 2017 intended to decommission well MW-39, however decommissioning unsuccessful due to the amount of rebar in the high-strength concrete surrounding the well monument. Attempts to use a jack-hammer to remove the rebar/concrete were unsuccessful. Only four to five inches of material could be removed after 2 hours. The auger bit was not wider than the steel flush mount, so over drilling the well was not possible. In order to complete the work so that it would not obstruct SSA operations and in consultation with the licensed well drillers (Cascade), the PVC well casing was filled with bentonite chips and hydrated. The monument and broken concrete area were filled with concrete and troweled to a smooth traffic surface. The top of PVC casing location was marked in the concrete should future decommissioning by overdrilling be required.

2. LNAPL Product Removal at MW-36

During the May 2017 Interim Groundwater Monitoring Event, 0.13 feet of LNAPL was observed in MW-36 in May and 0.21 feet was observed in June. Previous LNAPL measurements include a thickness of 0.06 feet in July 1999 and sheen was observed in April 2011. No measurable product was recorded during the August 2005, November 2005, and December 2005 gauging events. It is believed that free product is present because of the unusually high water levels that picked up LNAPL from the soil column above the water table and that this does not reflect the migration of LNAPL from upgradient of MW-36. Field work was conducted by Pacific Groundwater Group and LNAPL product removal was conducted by MarVac.

LNAPL gauging and recovery was completed at MW-36 on October 15, 2017. LNAPL was measured from 9.77 to 10.05 ft. below the top-of-casing (0.28 ft thickness). Approximately 0.5 gallons of LNAPL product was recovered from the well using a peristaltic pump.

3. Collection of Soil Vapor Samples

The SVE system will discharge vapors to the atmosphere during operation. To evaluate the need for vapor treatment prior to discharge and to better understand petroleum composition, soil vapor samples from 2 existing and 3 new monitoring wells (MW-42, 39A, 36A, 93 and MW-59) were collected on October 25 and 26, 2017 for analysis of volatile organic carbons (VOCs, Method TO-15) and Massachusetts Department of Environmental Protection Air-Phase Petroleum Hydrocarbons (MA APH). Field work was conducted by CRETE and analytical samples were analyzed by Friedman and Bruya in Seattle, WA.

The wells were capped and purged to remove 3 to 5 casing volumes of air prior to collecting the vapor sample using a Summa canister. Samples were collecting following Ecology sub slab sampling method guidance[1]. Analytical results are summarized on Table 2 (Attachment 1) and copies analytical reports and the sampling SOP are included in Attachment 2.

4. GPR Survey Along the AS/SVE System Alignment

A GPR survey along the footprint of the AS/SVE system alignment was conducted on October 25 and 26 2017. The survey results have been incorporated in the drawings and design elements have been updated to avoid any documented subsurface conflicts that were identified during the survey. The GPR work was performed by APS with oversight by CRETE.

5. Topographic Survey

In addition to the GPR survey above, a updated topographic survey was conducted throughout October to provide current information on surface elevations of key features in the AS/SVE system alignment. Surveying was completed by the Port of Seattle.

Attachment 1 – Data Summary Tables
Attachment 2 – Analytical Reports and SOPs

---

[1] https://fortress.wa.gov/ecy/publications/documents/0909047.pdf

Attachment 1 – Data Summary Tables

Table 1: Soil Sample Results

Terminal 30 Cleanup Action - Design Field Data

	MW-36A-S-10	MW-39A-S-9	MW-93-S-8
	10/14/2017	10/14/2017	10/14/2017
	mg/kg	mg/kg	mg/kg
BETX			
Benzene	0.02 U	**9.6**	**0.8**
Ethylbenzene	**1.3**	**11**	**25**
Toluene	**0.46**	**24**	**3.48**
Total Xylenes	**2.2**	**18**	**23**
TPH			
Gasoline Range TPH	**220**	**3500**	**3000**
Motor Oil Range TPH	250 U	**21000**	**18000**
Diesel Range TPH	**560**	**32000**	**42000**
Extractable Petroleum Hydrocarbons by NWEPH			
Aliphatic Hydrocarbon (C8-C10)	24.6 U*	**1,270** D*	**1,640** D*
Aliphatic Hydrocarbon (C10-C12)	12.3 U	**2,730** D	**3,550** D
Aliphatic Hydrocarbon (C12-C16)	**26.7**	**9,150** D	**10,500** D
Aliphatic Hydrocarbon (C16-C21)	**25.5**	**5,420** D	**6,240** D
Aliphatic Hydrocarbon (C21-C34)	12.3 U	**1,850** D	**1,920** D
Aromatic Hydrocarbon (C8-C10)	12.3 U*	**145** *	**115** *
Aromatic Hydrocarbon (C10-C12)	12.3 U*	**602** *	**539** *
Aromatic Hydrocarbon (C12-C16)	12.3 U	**1,950** D	**2,450** D
Aromatic Hydrocarbon (C16-C21)	12.3 U	**2,720** D	**3,910** D
Aromatic Hydrocarbon (C21-C34)	12.3 U	**961** D	**355** D
Volatile Petroleum Hydrocarbons by NWVPH			
Aliphatic Hydrocarbon (C5-C6)	**30.8** D	**578** D	**347** D
Aliphatic Hydrocarbon (C6-C8)	**46.7** D	**1,030** D	**706** D
Aliphatic Hydrocarbon (C8-C10)	**17.4** D*	**196** D*	**175** D*
Aliphatic Hydrocarbon (C10-C12)	**21.6** D	**389** D	**438** D
Aromatic Hydrocarbon (C8-C10)	**32.8** D	**437** D	**337** D
Aromatic Hydrocarbon (C10-C12)	**120** D	**1,230** D	**846** D
Aromatic Hydrocarbon (C12-C13)	5.96 U,Q	6.27 U,Q	4.68 U,Q
Naphthalene	**5.73** Q*	**17.3** Q*	**12.8** Q*
Methyl tert-butyl ether (MTBE)	**1.22** Q*	**2.17** Q*	**1.33** Q*

Notes:

U - not detected above the reporting limit

Q - analyte with a continuing calibration that does not meet acceptance criteria

* - flagged value is not within established control limits

Lab reports incorrectly call MW-39A as MW-39, soil samples collected from the replacement well installed on 10/14/17

Bold = detection

Table 2: Soil Vapor Results

Terminal 30 Cleanup Action - Design Field Data

		MW-36A	MW-39A	MW-42	MW-59	MW-93
		10/26/2017	10/26/2017	10/25/2017	10/25/2017	10/26/2017
		ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
Volatile Organic Compounds (TO-15 Method)						
Parameter Name	CAS Number					
1,1,1-Trichloroethane	71-55-6	270 U	6,800 U	7,100 U	270 U	6,300 U
1,1,2,2-Tetrachloroethane	79-34-5	340 U	8,600 U	8,900 U	340 U	7,900 U
1,1,2-Trichloroethane	79-00-5	270 U	6,800 U	7,100 U	270 U	6,300 U
1,1-Dichloroethane	75-34-3	200 U	5,100 U	5,300 U	200 U	4,700 U
1,1-Dichloroethene	75-35-4	200 U	5,000 U	5,200 U	200 U	4,600 U
1,2,3-Trimethylbenzene	526-73-8	1,200 U	31,000 U	32,000 U	1,200 U	28,000 U
1,2,4-Trichlorobenzene	120-82-1	370 U	9,300 U	9,600 U	370 U	8,500 U
1,2,4-Trimethylbenzene	95-63-6	1,200 U	31,000 U	32,000 U	1,200 U	28,000 U
1,2-Dibromoethane	106-93-4	380 U	9,600 U	10,000 U	380 U	8,800 U
1,2-Dichlorobenzene	95-50-1	600 U	15,000 U	16,000 U	600 U	14,000 U
1,2-Dichloroethane	107-06-2	200 U	5,100 U	5,300 U	200 U	4,700 U
1,2-Dichloropropane	78-87-5	230 U	5,800 U	6,000 U	230 U	5,300 U
1,3,5-Trimethylbenzene	108-67-8	1,200 U	31,000 U	32,000 U	1,200 U	28,000 U
1,3-Butadiene	106-99-0	110 U	2,800 U	2,900 U	110 U	2,500 U
1,3-Dichlorobenzene	541-73-1	600 U	15,000 U	16,000 U	600 U	14,000 U
1,4-Dichlorobenzene	106-46-7	300 U	7,500 U	7,800 U	300 U	6,900 U
1,4-Dioxane	123-91-1	180 U	4,500 U	4,700 U	180 U	4,100 U
1-Butanol	71-36-3	3,000 U	76,000 U	79,000 U	3,000 U	70,000 U
2-Butanone	78-93-3	1,500 U	37,000 U	38,000 U	1,500 U	34,000 U
2-Hexanone	591-78-6	2,000 U	51,000 U	53,000 U	2,000 U	47,000 U
2-Pentanone	107-87-9	1,800 U	44,000 U	46,000 U	1,800 U	41,000 U
3-Hexanone	589-38-8	2,000 U	51,000 U	53,000 U	2,000 U	47,000 U
3-Pentanone	96-22-0	1,800 U	44,000 U	46,000 U	1,800 U	41,000 U
Acetaldehyde	75-07-0	4,500 U	110,000 U	120,000 U	4,500 U	100,000 U
Acetone	67-64-1	2,400 U	59,000 U	62,000 U	2,400 U	55,000 U
Acetonitrile	75-05-8	840 U	21,000 U	22,000 U	840 U	19,000 U
Acrolein	107-02-8	460 U	11,000 U	12,000 U	460 U	11,000 U
Acrylonitrile	107-13-1	110 U	2,700 U	2,800 U	110 U	2,500 U
Benzene	71-43-2	160 U	**140,000**	**14,000**	160 U	3,700 U
Benzyl chloride	100-44-7	260 U	6,500 U	6,700 U	260 U	6,000 U
Bromoform	75-25-2	1,000 U	26,000 U	27,000 U	1,000 U	24,000 U
Bromomethane	74-83-9	190 U	4,900 U	5,000 U	190 U	4,500 U
Butanal	123-72-8	1,500 U	37,000 U	38,000 U	1,500 U	34,000 U
Carbon disulfide	75-15-0	3,100 U	78,000 U	81,000 U	3,100 U	72,000 U
Carbon tetrachloride	56-23-5	310 U	7,900 U	8,200 U	310 U	7,200 U
CFC-11	75-69-4	280 U	7,000 U	7,300 U	280 U	6,500 U
CFC-113	76-13-1	380 U	9,600 U	10,000 U	380 U	8,800 U
CFC-12	75-71-8	250 U	6,200 U	6,400 U	250 U	5,700 U
Chlorobenzene	108-90-7	230 U	5,800 U	6,000 U	230 U	5,300 U
Chlorodifluoromethane	75-45-6	180 U	4,400 U	4,600 U	180 U	4,100 U
Chloroethane	75-00-3	130 U	3,300 U	3,400 U	130 U	3,000 U
Chloroform	67-66-3	240 U	6,100 U	6,300 U	240 U	5,600 U
Chloromethane	74-87-3	100 U	2,600 U	2,700 U	100 U	2,400 U
cis-1,2-Dichloroethene	156-59-2	200 U	5,000 U	5,200 U	200 U	4,600 U
cis-1,3-Dichloropropene	10061-01-5	230 U	5,700 U	5,900 U	230 U	5,200 U

Table 2: Soil Vapor Results

Terminal 30 Cleanup Action - Design Field Data

		MW-36A	MW-39A	MW-42	MW-59	MW-93
		10/26/2017	10/26/2017	10/25/2017	10/25/2017	10/26/2017
		ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
Cyclohexane	100-82-7	**23,000**	**2,900,000 E**	**280,000**	3,400 U	**530,000**
Cyclopentane	287-92-3	140 U	**270,000**	**14,000**	140 U	**13,000**
Dibromochloromethane	124-48-1	430 U	11,000 U	11,000 U	430 U	9,800 U
Dichlorobromomethane	75-27-4	340 U	8,400 U	8,700 U	340 U	7,700 U
Ethanol	64-17-5	3,800 U	94,000 U	98,000 U	3,800 U	87,000 U
Ethylbenzene	100-41-4	220 U	**9,300**	5,600 U	220 U	5,000 U
F-114	76-14-2	350 U	8,700 U	9,100 U	350 U	8,000 U
Hexachlorobutadiene	87-68-3	530 U	13,000 U	14,000 U	530 U	12,000 U
Hexanal	66-25-1	2,000 U	51,000 U	53,000 U	2,000 U	47,000 U
Hexane	110-54-3	**21,000**	**3,200,000 E**	**300,000**	1,800 U	**670,000**
Iodomethane	74-88-4	290 U	7,300 U	7,500 U	290 U	6,700 U
Isobutene	115-11-7	460 U	11,000 U	12,000 U	460 U	11,000 U
Isoprene	78-79-5	140 U	3,500 U	3,600 U	140 U	3,200 U
Isopropyl alcohol	67-63-0	4,300 U	110,000 U	110,000 U	4,300 U	99,000 U
m, p-Xylene	179601-23-1	430 U	11,000 U	11,000 U	430 U	10,000 U
Methacrolein	78-85-3	1,400 U	36,000 U	37,000 U	1,400 U	33,000 U
Methyl isobutyl ketone	108-10-1	2,000 U	51,000 U	53,000 U	2,000 U	47,000 U
Methyl t-butyl ether	1634-04-4	900 U	23,000 U	23,000 U	900 U	21,000 U
Methyl vinyl ketone	78-94-4	570 U	14,000 U	15,000 U	570 U	13,000 U
Methylene chloride	75-09-2	43,000 U	1,100,000 U	1,100,000 U	43,000 U	1,000,000 U
Naphthalene	91-20-3	260 U	6,600 U	6,800 U	260 U	6,000 U
o-Xylene	95-47-6	220 U	5,400 U	5,600 U	220 U	5,000 U
Pentanal	495-85-2	1,800 U	44,000 U	46,000 U	1,800 U	41,000 U
Pentane	109-66-0	**30,000**	**3,300,000** E	**330,000**	1,500	**940,000**
Propene	115-07-1	**500**	8,600 U	8,900 U	350 U	7,900 U
Styrene	100-42-5	430 U	11,000 U	11,000 U	430 U	9,800 U
Tetrachloroethene	127-18-4	340 U	8,500 U	8,800 U	340 U	7,800 U
Toluene	108-88-3	190 U	4,700 U	4,900 U	190 U	4,300 U
trans-1,2-Dichloroethene	156-60-5	200 U	5,000 U	5,200 U	200 U	4,600 U
trans-1,3-Dichloropropene	10061-02-6	230 U	5,700 U	5,900 U	230 U	5,200 U
Trichloroethene	79-01-6	270 U	6,700 U	7,000 U	270 U	6,200 U
Vinyl acetate	108-05-4	3,500 U	88,000 U	92,000 U	3,500 U	81,000 U
Vinyl chloride	75-01-4	130 U	3,200 U	3,300 U	130 U	2,900 U
MA-APH Method						
APH EC5-8 aliphatics	---	**2,700,000** E	**86,000,000** E	**12,000,000**	**420,000**	**14,000,000** E
APH EC9-12 aliphatics	---	**270,000**	**1,000,000**	910,000 U	**190,000**	800,000 U
APH EC9-10 aromatics	---	25,000 U	620,000 U	650,000 U	25,000 U	570,000 U

Notes:

E - exceeded the calibration range

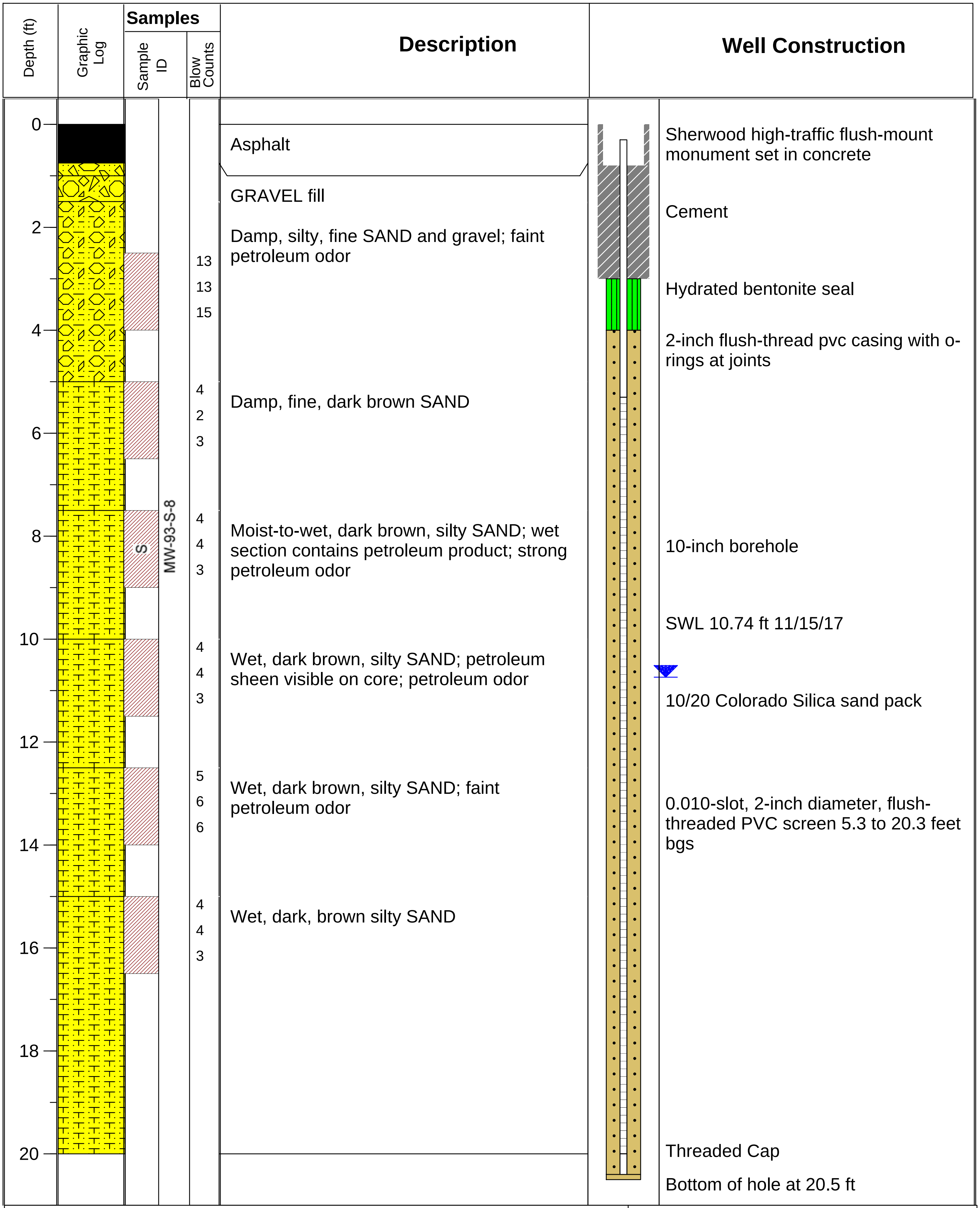
U - not detected above the reporting limit

Bold = detection

ug/m^3 = micrograms per cubic meter

MA-APH = Massachusetts Department of Environmental Protection Air-Phase Petroleum Hydrocarbons

Attachment 2 – Analytical Reports and SOPs



Asphalt

GRAVEL fill

Damp, silty, fine SAND and gravel; faint petroleum odor

Damp, fine, dark brown SAND

Moist-to-wet, dark brown, silty SAND; wet section contains petroleum product; strong petroleum odor

Wet, dark brown, silty SAND; petroleum sheen visible on core; petroleum odor

Wet, dark brown, silty SAND; faint petroleum odor

Wet, dark, brown silty SAND

Sherwood high-traffic flush-mount monument set in concrete

Cement

Hydrated bentonite seal

2-inch flush-thread pvc casing with o-rings at joints

10-inch borehole

SWL 10.74 ft 11/15/17

10/20 Colorado Silica sand pack

0.010-slot, 2-inch diameter, flush-threaded PVC screen 5.3 to 20.3 feet bgs

Threaded Cap

Bottom of hole at 20.5 ft

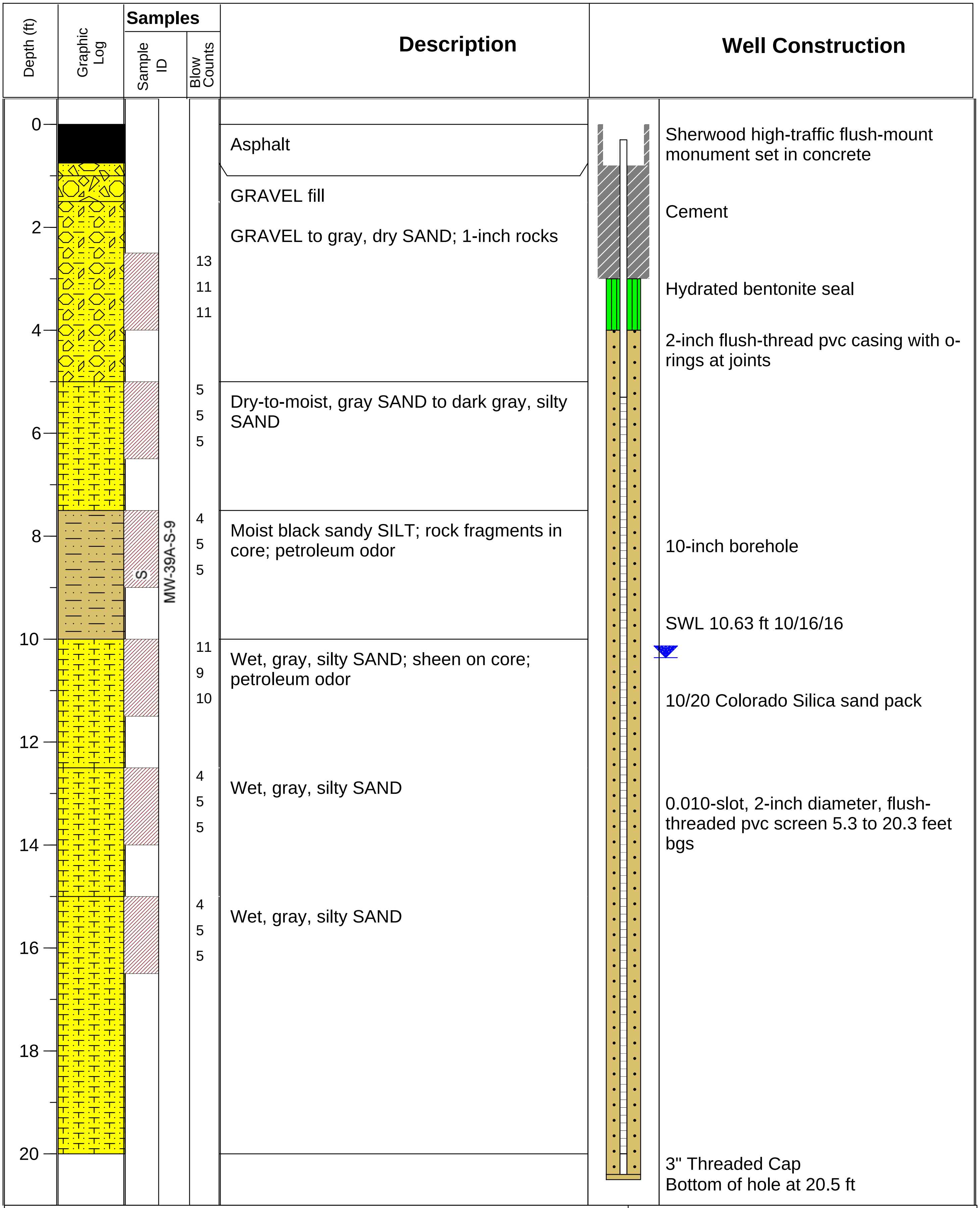
Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: NE-6 -24-4
Horizontal Loc.: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Koshlan Mayer-Blackwell

Drilling Firm: Cascade Drilling
Drilling Method: Hollow Stem Auger
Well Tag ID: BKA 413
DTW: 10.74 ft
MP Elevation: Not Surveyed
Datum: N/A
Date: 10/15/17

Figure
Boring Log and As-Built MW-93

Terminal 30
Well Replacement
JE1005.09

PgG



Description

Asphalt

GRAVEL fill

GRAVEL to gray, dry SAND; 1-inch rocks

Dry-to-moist, gray SAND to dark gray, silty SAND

Moist black sandy SILT; rock fragments in core; petroleum odor

Wet, gray, silty SAND; sheen on core; petroleum odor

Wet, gray, silty SAND

Wet, gray, silty SAND

Well Construction

Sherwood high-traffic flush-mount monument set in concrete

Cement

Hydrated bentonite seal

2-inch flush-thread pvc casing with o-rings at joints

10-inch borehole

SWL 10.63 ft 10/16/16

10/20 Colorado Silica sand pack

0.010-slot, 2-inch diameter, flush-threaded pvc screen 5.3 to 20.3 feet bgs

3" Threaded Cap
Bottom of hole at 20.5 ft

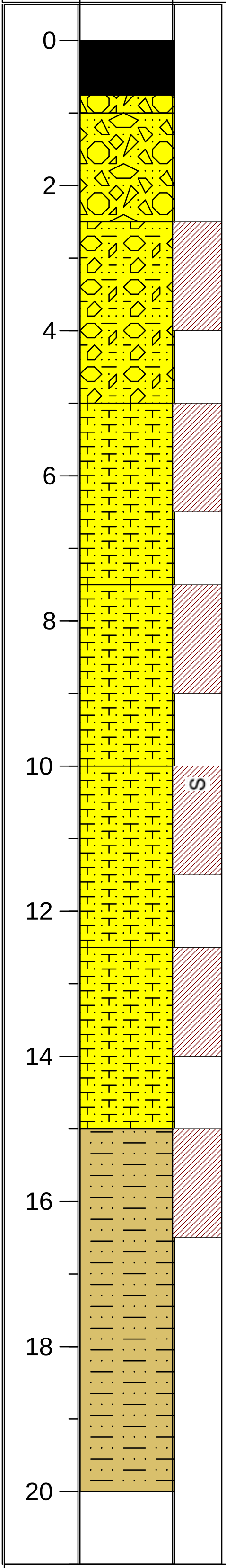
Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: NE-6 -24-4
Horizontal Loc.: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Koshlan Mayer-Blackwell

Drilling Firm: Cascade Drilling
Drilling Method: Hollow Stem Auger
Well Tag ID: BKA 414
DTW: 10.36 ft
MP Elevation: Not Surveyed
Datum: N/A
Date: 10/15/17

Figure
Boring Log and As-Built
MW-39A

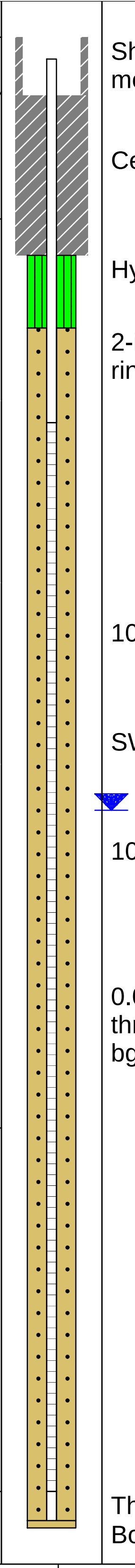
Terminal 30
Well Replacement
JE1005.09

PgG



Sample ID	Blow Counts	Description
		Asphalt
		GRAVEL fill
	13 13 11	Dry, gray,silty SAND fill; gravel and 1/2-inch rocks present; no petroleum odor
	9 10 10	Dry, gray, silty SAND; no petroleum odor
	4 4 6	Moist, gray, silty, coarse-to-fine SAND; organic wood debris; faint petroleum odor
MW-36A-S-10	6 7 6	Wet, gray, silty SAND; sheen on core; petroleum odor
	4 5 6	Wet, gray, brown silty SAND; faint petroleum odor
	4 5 5	Wet, gray/brown, sandy-to-clayey SILT

Well Construction



Sherwood high-traffic flush-mount monument set in concrete

Cement

Hydrated bentonite seal

2-inch flush-thread pvc casing with o-rings at joints

10-inch borehole

SWL 10.63 ft 10/16/16

10/20 Colorado Silica sand pack

0.010-slot, 2-inch diameter, flush-threaded pvc screen 5.3 to 20.4 feet bgs

Threaded Cap
Bottom of hole at 20.5 ft

Address: Port of Seattle T30
City, State: Seattle, WA
Client: Port of Seattle
TRS: T24N R04E S07; NE1/4
Horizontal Loc.: Not Surveyed
Consulting Firm: Pacific Groundwater Group
Logged by: Koshlan Mayer-Blackwell

Drilling Firm: Cascade Drilling
Drilling Method: Hollow Stem Auger
Well Tag ID: BKA 415
DTW: 10.63 ft
MP Elevation: Not Surveyed
Datum: N/A
Date: 10/15/16

Figure
Boring Log and As-Built MW-36A

Terminal 30
Well Replacement
JE1005.09

PgG

Subsurface Soil Sampling Using Geoprobe™ Methods	October 2017	**CRETE SOP No. 1012**
	Rev. # 0	
	Jamie Stevens	

1 PINTRODUCTION

The purpose of this SOP is to provide field personnel with an outline of the specific information needed to collect and document representative subsurface soil vapor samples. The recommended soil vapor sampling technique, as presented in this SOP, is based on the assumption that soil vapor samples should be representative of chemicals that may volatilize from the uppermost aquifer into the vadose zone or from soil contamination within the vadose zone.

This SOP includes soil vapor sampling from established monitoring points (such as existing soil vapor sampling points or existing groundwater monitoring wells). A typical sampling set up is shown on Figure 1.

2 Sampling Equipment and Materials

The following equipment and materials are necessary to properly soil vapor sampling from an established monitoring point:

- If using an existing well (such as a 2inch groundwater monitoring well) install a leak proof cap, such as a ‘ECO Plug’ for the correct diameter. The plug should include an air tight port for the tubing to go through.
- Summa canister sample manifold kit provided by laboratory
- Air pump and appropriate connection tubing, tee fittings, valves, and flow metering device for purging and sampling vapor ports.
- 1-liter Tedlar® bags to collect purged vapors if venting is not used.
- Sufficient number of Summa canisters and appropriate flow controllers to collect samples per the sampling and analysis plan.
- Equipment required for collection of samples using Summa canisters, including appropriate wrenches and pressure gauges.
- An accurate and reliable watch that has been properly set.
- A calculator.
- Field notebook, applicable sampling analysis plan, and Chain of Custody.
- Health-and-safety equipment and supplies (e.g., personal protective equipment [PPE]) as described in the relevant site health-and-safety plan (HSP).
- Shipping package for the Summa canisters.
- Meters to measure for oxygen, carbon dioxide and methane (typically a landfill gas meter) and a PID meter (for volatile organic compounds).

When leak testing is required, additional equipment and materials include:

- Leak test shroud of sufficient size to cover soil gas vapor probe and sampling train (including Summa canister).
- A soft gasket to seal the leak test shroud to the floor.
- Tracer gas (helium), supplied in a 20 cubic foot gas cylinder with flow regulator.

- Flow regulator with 1/8-inch barbed outlet and tubing to connect the helium gas cylinder to the shroud.
- MGD-2002 helium meter or equivalent.

3 Sampling Procedure

3.1 Preparation

- Prior to beginning, clear sampling locations for utilities, verify access agreements are in place, and obtain required permits, as appropriate.
- Assemble sampling train. The sampling train will be set up so that the Summa canister is in-line between the vapor port and the air pump, with a valve between the canister and the pump (see Figure 1 and Figure 2). Below are detailed manifold instructions specific to sample train manifolds provided by Friedman and Bruya laboratory in Seattle Washington. These general procedures would apply to most sample train configurations.

    1. Attach a section of FEP tubing to the well point
    2. Attach the other end of the well point tubing to a ¼ turn ball valve
    3. Connect the FEP tubing to the vinyl tee using a 1”-2” piece of silicon tubing on each end of the tee. The FEP tubing should be pushed up against the sample tee.
    4. Attach a piece of FEP tubing to the well point ¼ turn valve, a second piece as the sample line and a third piece as the purge line
    5. Attach a ¼ turn ball valve to the purge line
    6. Make sure the cap is on the sample canister flow controller and quickly open and close the sample canister to measure the initial vacuum. The initial vacuum should read 30” of Hg. If the vacuum is below 25” of Hg, do not use – contact the laboratory (206)285-8282
    7. Ensure the sample canister valve is closed and remove the flow controller end cap
    8. Attach the sample line tubing to the flow controller on the canister using a ¼” nut and a PTFE ferrule. Do not open the sample canister.
    9. Attach a pump or purge canister to the purge line ¼ turn valve using a short piece of FEP or other tubing
    10. If using a purge can, attach with a ¼” nut and a PTFE ferrule

- Verify the Summa canister number engraved on the canister matches the number listed on the certified clean tag to insure proper decontamination of the canister was completed. Fill out the sample tag.
- Verify the canister valve is closed tightly and remove the threaded cap at the inlet of the canister.
- Attach the flow controller to the inlet of the canister, the flow controller will have a built in pressure gauge.
- Connect the Summa canister/flow controller to one outlet of the tee fitting.
- Connect air pump to the other outlet of the tee fitting, insert a 1/4-inch shutoff valve between the tee fitting and the air pump.

Leak Testing

Where leak testing is required, a shroud will be placed over the vapor port and the Summa canister to keep tracer gas in contact with the vapor port and fittings.

The shroud consists of a plastic bin of a known volume. Two holes will be drilled near the top of the shroud, one for connection of the helium gas cylinder and one for connection of the air pump located outside the shroud. A third hole will be drilled near the base of the shroud to monitor the helium concentration inside during sampling.

3.2 Sampling Methodology Sample Collection

- Purge the vapor port and sampling train at approximately 100 ml/min using the air pump to ensure the sample is representative of subsurface conditions. Capture purged vapor in 1-liter Tedlar® bags at the outlet of the air pump and release the vapor outdoors or purge directly to a well vented location.

Volume of Tubing

Three-five tubing volumes should be removed. Use the following equation to calculate volume to be purged:

$$V = \pi \text{ x } r^2 \text{ x } l$$

Where:
V = Volume of tubing
r = the inner radius of the tubing being used [inches]
l = the length of the tubing being used [inches]
π = 3.14
(Convert to ml using 1-inch^3 = 16.387 ml to determine how long to purge port)

Volume and Purge Time for One Probe Volume

Three probe volumes should be removed Use the following equation to calculate the time required to purge one probe volume:

$$\frac{D^2 \text{ x } P_d \text{ x } 9.24}{P_r} = P_t$$

Where:
D = Diameter of probe, inches
P_d = Probe depth, feet
P_r = Pump rate, liters per minute
P_t = Purge time for one probe volume, seconds

- **Shut-In Test Procedure -** Shut-In Test procedures should be performed to ensure that there is no loss in the sample train. Below are detailed shut-in test procedures specific to sample train manifolds provided by Friedman and Bruya laboratory in Seattle Washington. These general procedures would apply to most sample train configurations.

1. Close the well point ¼ turn valve
2. Open the purge line ¼ turn valve
3. Open the purge canister or turn on purge line pump until the vacuum gauge on the sample canister reads 10" of Hg or greater.
4. Close the purge line ¼ turn valve
5. Let the system sit at >10" of Hg vacuum for a minimum of 5 minutes.
6. The manifold is not leaking if the reading on the vacuum gauge is unchanged after a minimum of 5 minutes.

Sample Collection

- Begin sample collection by closing the 1/4-inch shutoff valve between the Summa canister and the air pump and opening the valve on the Summa canister. Immediately record the pressure on the gauge as the "initial pressure" on the tag attached to the canister. Document the time and initial vacuum on the COC
- After sampling begins and the apparatus is verified to be operating correctly, leave the canister to fill.
- Record all sample information in the field book and/or applicable field forms including the following:
- Canister number and sample identification, Sample start date and times, Location of sample (distance from walls shown on building floor plan), Initial and final pressure of canister, Notes regarding leak test, if applicable.
- Return to check canisters periodically (depending on length of sample period), to ensure proper operation. It is necessary to check the canister prior to completion because the accuracy of the flow regulators can vary, causing the canisters to fill faster than expected.
- The final pressure at the end of sampling should be approximately -5 to -6 inches mercury (Hg). If the canister has already reached this point, sampling is complete, the canister valve should be closed, and the pressure recorded as the "final pressure" on the sample tag, the field book, and applicable field forms. Sample collection will be considered complete, regardless of final pressure, after the stated sample period has elapsed. Sample until the vacuum gauge reads 5" of Hg
  - 1L samples will take ~5 minutes; 6L samples will take ~30 minutes
- Record the exact pressure of the canister and time at the end of sampling on the sample tag for that canister, in the field book and on the applicable field forms.
- Verify that the canister valve is closed tightly, remove the flow controller, and replace the threaded cap at the top of the canister. Discard all sample tubing.
- Abandon vapor port by removing vapor screen and tubing, backfilling with glass bead, and patching with concrete.

Leak Testing

Before purging or sampling begins, place the leak test shroud over the vapor port/Summa canister sampling apparatus. The tubing from the tee connection above the canister will pass through the wall of the shroud to connect with the air pump outside.

Connect the helium cylinder to the leak test shroud using tubing from the flow regulator on the cylinder, through a hole in the wall of the shroud. Be sure to keep the cylinder in an upright position at all times.

Connect the helium meter to the leak test shroud using the hole near the base.

Use the flow regulator to slowly release helium into the leak test shroud until a predetermined concentration of helium is contained within the enclosed area. The helium concentration will be measured using the helium meter. Maintain helium concentrations throughout the sampling period by continuously bleeding cylinder gas into the shroud as needed.

Prior to collecting the canister sample, the vapor port will be purged as described in the previous section. Purged vapor contained in the Tedlar® bags will be field screened using the helium meter to ensure that the concentration of helium inside the bags is less than 5-percent of the shroud concentration. If leakage is detected, the vapor port seal will be enhanced and connections will be inspected and tightened. This process will be repeated until no significant leakage has been demonstrated.

After confirming no significant leakage, the 1/4-inch shutoff valve between the Summa canister and the air pump will be closed and the canister valve will be opened to begin collecting the sample.

3.3 Post-Sample Collection Procedures

Label all sample containers with the following information: sample identification, date and time sample was collected, the starting and ending canister pressure, the site name, and the company name. Include all this information in the field book plus the ending time of sample collection, and transfer pertinent information to the chain-of-custody record. Pack all Summa canisters in the original shipping containers, sealed with a custody seal, and send to the lab for analysis. The official holding time for this analysis is 30 days. However, attempt to get samples to the lab as soon as possible to allow lab time to conduct re-runs, dilutions, and low-level analyses, as necessary prior to sample expiration.

4 Analysis

The soil gas samples should be analyzed using EPA Methods TO-14 or TO-15, and when necessary/possible, low-level analysis or Selective Ion Mode (SIM) analysis to obtain the lowest achievable detection and reporting limits. Note the desired analytical methods on the Chain of Custody form, and be sure analysis for helium is specified for leak-tested samples. Additional analysis may be required based on the sampling program.

5 Decontamination

The equipment used for soil gas sampling does not require decontamination in the field. The Summa canisters will be individually cleaned and certified to 0.02 ppbv THC for the project-specific analyte list by the contract laboratory prior to shipment, or batch cleaned and certified. Sample manifold kits provided from the laboratory are decontaminated and purged for off-gassing. Insure that documentation of this certification is included on a tag attached to the canister and in the paperwork that accompanies the canister shipment from the lab.

6 Documentation

Record all field activities, environmental and building conditions, and sample documentation on the appropriate field forms and field notebook.

7 References

EPRI, Reference Handbook for Site Specific Assessment of Sub-Surface Vapor Intrusion to Indoor Air, March 2005.

Department of Environmental Protection, Commonwealth of Massachusetts, Indoor Air Sampling and Evaluation Guide, WSC Policy #02-430, Boston, Massachusetts, April 2002.

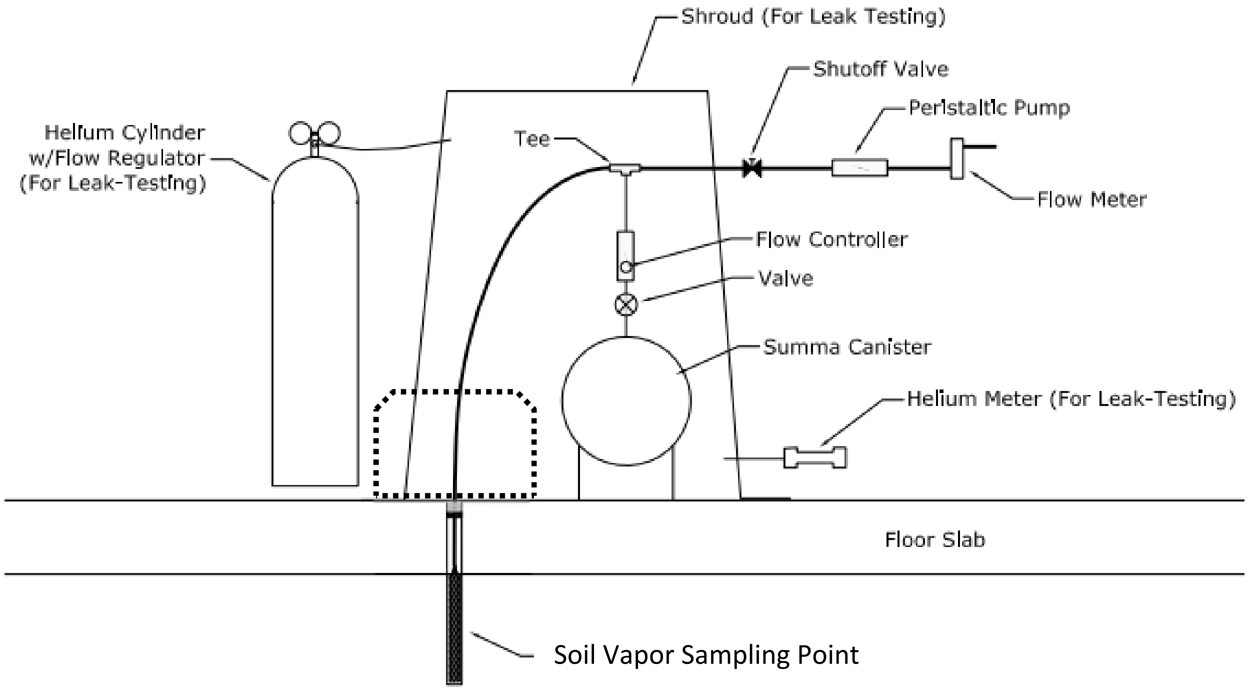
New Jersey Department of Environmental Protection, Vapor Intrusion Guidance, October 2005.

New York State Department of Health, Guidance for Evaluation Soil Vapor Intrusion in the State of New York, October 2006.

USEPA, Center for Environmental Research Information, Office of Research and Development, Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method To-14A, Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography, January 1999.

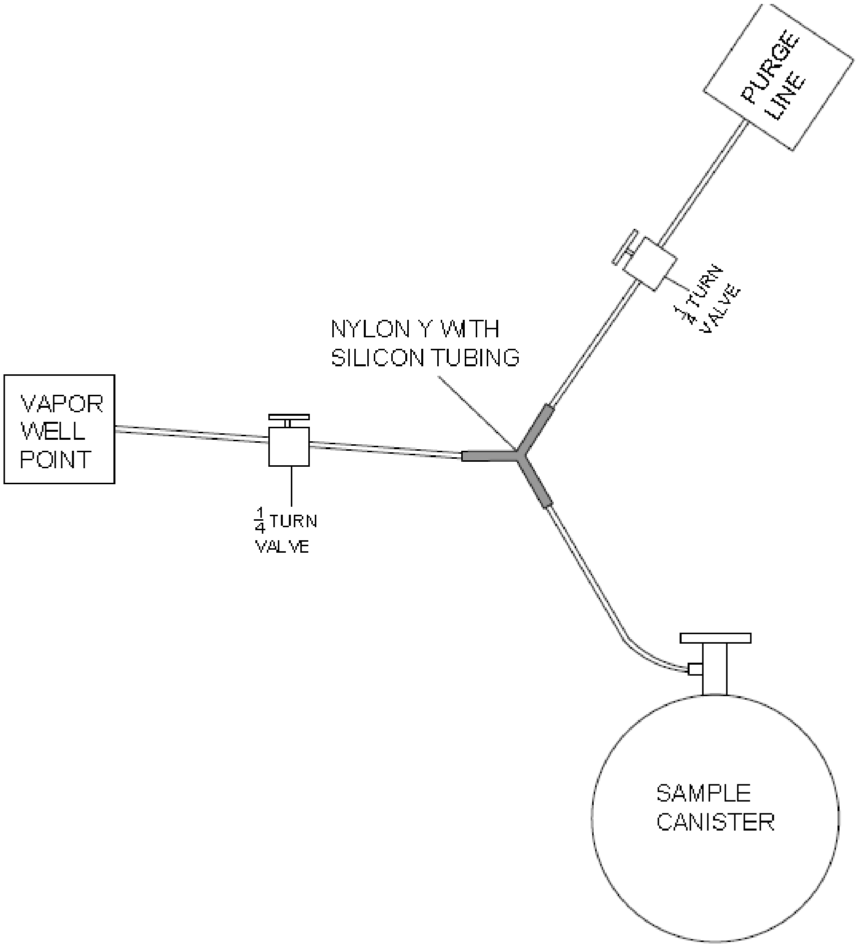
USEPA, Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway Form Groundwater and Soils, EPA530-F-02-052, November 2002.

Figure 1 – Typical Soil Vapor Sampling Train



Notes: Alternative shroud is shown as a dash line. A smaller shroud can be used around the surface of the sampling port.

Figure 2 – Typical Soil Vapor Sampling Train Layout



FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

November 2, 2017

Glen Wallace, Project Manger
Pacific Groundwater Group
2377 Eastlake Ave East
Seattle, WA 98102

Dear Mr Wallace:

Included are the results from the testing of material submitted on October 16, 2017 from the Terminal 30, F&BI 710236 project. There are 6 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
PGG1102R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on October 16, 2017 by Friedman & Bruya, Inc. from the Pacific Groundwater Group Terminal 30, F&BI 710236 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Pacific Groundwater Group
710236 -01	MW-39-S-9
710236 -02	MW-36A-S-10
710236 -03	MW-93-S-8

The samples were sent to Fremont Analytical for EPH and VPH analyses. The report is enclosed.

All quality control requirements were acceptable.

Date of Report: 11/02/17
Date Received: 10/16/17
Project: Terminal 30, F&BI 710236
Date Extracted: 10/17/17
Date Analyzed: 10/17/17

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 50-132)
MW-39-S-9 710236-01 1/100	9.6	24	11	18	3,500	90
MW-36A-S-10 710236-02	<0.02	0.46	1.3	2.2	220	129
MW-93-S-8 710236-03 1/10	0.80	3.48	25	23	3,000	ip
Method Blank 07-2236 MB	<0.02	<0.02	<0.02	<0.06	<5	75

Date of Report: 11/02/17
Date Received: 10/16/17
Project: Terminal 30, F&BI 710236
Date Extracted: 10/17/17
Date Analyzed: 10/17/17 and 10/31/17

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 53-144)
MW-39-S-9 710236-01 1/10	32,000	21,000 x	ip
MW-36A-S-10 710236-02	560	<250	89
MW-93-S-8 710236-03 1/10	42,000	18,000 x	141
Method Blank 07-2320 MB	<50	<250	90

Date of Report: 11/02/17
Date Received: 10/16/17
Project: Terminal 30, F&BI 710236

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 710239-26 (Duplicate)

Analyte	Reporting Units	Sample Result (Wet Wt)	Duplicate Result (Wet Wt)	RPD (Limit 20)
Benzene	mg/kg (ppm)	<0.02	<0.02	nm
Toluene	mg/kg (ppm)	<0.02	<0.02	nm
Ethylbenzene	mg/kg (ppm)	<0.02	<0.02	nm
Xylenes	mg/kg (ppm)	<0.06	<0.06	nm
Gasoline	mg/kg (ppm)	<5	<5	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	mg/kg (ppm)	0.5	71	66-121
Toluene	mg/kg (ppm)	0.5	73	72-128
Ethylbenzene	mg/kg (ppm)	0.5	80	69-132
Xylenes	mg/kg (ppm)	1.5	77	69-131
Gasoline	mg/kg (ppm)	20	100	61-153

Date of Report: 11/02/17
Date Received: 10/16/17
Project: Terminal 30, F&BI 710236

QUALITY ASSURANCE RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: 710265-02 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet Wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	mg/kg (ppm)	5,000	<50	84	86	64-133	2

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Diesel Extended	mg/kg (ppm)	5,000	86	58-147

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

Fremont Analytical

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Friedman & Bruya
Michael Erdahl
3012 16th Ave. W.
Seattle, WA 98119

RE: 710236
Work Order Number: 1710234

October 30, 2017

Attention Michael Erdahl:

Fremont Analytical, Inc. received 3 sample(s) on 10/16/2017 for the analyses presented in the following report.

Extractable Petroleum Hydrocarbons by NWEPH

Sample Moisture (Percent Moisture)

Volatile Petroleum Hydrocarbons by NWVPH

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

DoD/ELAP Certification #L17-135, ISO/IEC 17025:2005
ORELAP Certification: WA 100009-007 (NELAP Recognized)

CLIENT: Friedman & Bruya
Project: 710236
Work Order: 1710234

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1710234-001	MW-39-S-9	10/14/2017 3:00 PM	10/16/2017 2:43 PM
1710234-002	MW-36A-S-10	10/14/2017 12:00 PM	10/16/2017 2:43 PM
1710234-003	MW-93-S-8	10/14/2017 9:30 AM	10/16/2017 2:43 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

Case Narrative

WO#: **1710234**

Date: **10/30/2017**

CLIENT: Friedman & Bruya

Project: 710236

I. SAMPLE RECEIPT:

Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:

Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:

Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1710234**
Date Reported: **10/30/2017**

Client: Friedman & Bruya
Project: 710236
Lab ID: 1710234-001
Client Sample ID: **MW-39-S-9**

Collection Date: 10/14/2017 3:00:00 PM
Matrix: Soil

Extractable Petroleum Hydrocarbons by NWEPH

Batch ID: 18538 Analyst: SB

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Aliphatic Hydrocarbon (C8-C10)	1,270	452	D*	mg/Kg-dry	20	10/23/2017 6:44:00 PM
Aliphatic Hydrocarbon (C10-C12)	2,730	226	D	mg/Kg-dry	20	10/23/2017 6:44:00 PM
Aliphatic Hydrocarbon (C12-C16)	9,150	226	D	mg/Kg-dry	20	10/23/2017 6:44:00 PM
Aliphatic Hydrocarbon (C16-C21)	5,420	226	D	mg/Kg-dry	20	10/23/2017 6:44:00 PM
Aliphatic Hydrocarbon (C21-C34)	1,850	226	D	mg/Kg-dry	20	10/23/2017 6:44:00 PM
Aromatic Hydrocarbon (C8-C10)	145	11.3	*	mg/Kg-dry	1	10/20/2017 9:54:00 PM
Aromatic Hydrocarbon (C10-C12)	602	11.3	*	mg/Kg-dry	1	10/20/2017 9:54:00 PM
Aromatic Hydrocarbon (C12-C16)	1,950	226	D	mg/Kg-dry	20	10/23/2017 3:05:00 PM
Aromatic Hydrocarbon (C16-C21)	2,720	226	D	mg/Kg-dry	20	10/23/2017 3:05:00 PM
Aromatic Hydrocarbon (C21-C34)	961	226	D	mg/Kg-dry	20	10/23/2017 3:05:00 PM
Surr: 1-Chlorooctadecane	119	60 - 140		%Rec	1	10/21/2017 9:58:00 AM
Surr: o-Terphenyl	91.4	60 - 140		%Rec	1	10/20/2017 9:54:00 PM

NOTES:
* - Flagged value is not within established control limits.

Volatile Petroleum Hydrocarbons by NWVPH

Batch ID: 18561 Analyst: MW

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Aliphatic Hydrocarbon (C5-C6)	578	157	D	mg/Kg-dry	100	10/18/2017 7:19:42 PM
Aliphatic Hydrocarbon (C6-C8)	1,030	224	D	mg/Kg-dry	100	10/18/2017 7:19:42 PM
Aliphatic Hydrocarbon (C8-C10)	196	125	D*	mg/Kg-dry	100	10/18/2017 7:19:42 PM
Aliphatic Hydrocarbon (C10-C12)	389	134	D	mg/Kg-dry	100	10/18/2017 7:19:42 PM
Aromatic Hydrocarbon (C8-C10)	437	269	D	mg/Kg-dry	100	10/18/2017 7:19:42 PM
Aromatic Hydrocarbon (C10-C12)	1,230	53.7	D	mg/Kg-dry	100	10/18/2017 7:19:42 PM
Aromatic Hydrocarbon (C12-C13)	ND	6.27	Q	mg/Kg-dry	1	10/18/2017 9:21:53 PM
Naphthalene	17.3	0.448	Q*	mg/Kg-dry	1	10/18/2017 9:21:53 PM
Methyl tert-butyl ether (MTBE)	2.17	0.448	Q*	mg/Kg-dry	1	10/18/2017 9:21:53 PM
Surr: 1,4-Difluorobenzene	112	65 - 140	D	%Rec	100	10/18/2017 7:19:42 PM
Surr: Bromofluorobenzene	94.3	65 - 140	D	%Rec	100	10/18/2017 7:19:42 PM

NOTES:
Q - Indicates an analyte with a continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF).
* - Flagged value is not within established control limits.

Sample Moisture (Percent Moisture)

Batch ID: R39308 Analyst: CO

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Percent Moisture	12.9	0.500		wt%	1	10/18/2017 11:26:32 AM

Analytical Report

Work Order: **1710234**
Date Reported: **10/30/2017**

Client: Friedman & Bruya
Project: 710236
Lab ID: 1710234-002
Client Sample ID: MW-36A-S-10

Collection Date: 10/14/2017 12:00:00 PM
Matrix: Soil

Extractable Petroleum Hydrocarbons by NWEPH

Batch ID: 18538 Analyst: SB

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Aliphatic Hydrocarbon (C8-C10)	ND	24.6	*	mg/Kg-dry	1	10/21/2017 7:08:00 AM
Aliphatic Hydrocarbon (C10-C12)	ND	12.3		mg/Kg-dry	1	10/21/2017 7:08:00 AM
Aliphatic Hydrocarbon (C12-C16)	26.7	12.3		mg/Kg-dry	1	10/21/2017 7:08:00 AM
Aliphatic Hydrocarbon (C16-C21)	25.5	12.3		mg/Kg-dry	1	10/21/2017 7:08:00 AM
Aliphatic Hydrocarbon (C21-C34)	ND	12.3		mg/Kg-dry	1	10/21/2017 7:08:00 AM
Aromatic Hydrocarbon (C8-C10)	ND	12.3	*	mg/Kg-dry	1	10/20/2017 7:03:00 PM
Aromatic Hydrocarbon (C10-C12)	ND	12.3	*	mg/Kg-dry	1	10/20/2017 7:03:00 PM
Aromatic Hydrocarbon (C12-C16)	ND	12.3		mg/Kg-dry	1	10/20/2017 7:03:00 PM
Aromatic Hydrocarbon (C16-C21)	ND	12.3		mg/Kg-dry	1	10/20/2017 7:03:00 PM
Aromatic Hydrocarbon (C21-C34)	ND	12.3		mg/Kg-dry	1	10/20/2017 7:03:00 PM
Surr: 1-Chlorooctadecane	66.7	60 - 140		%Rec	1	10/21/2017 7:08:00 AM
Surr: o-Terphenyl	76.3	60 - 140		%Rec	1	10/20/2017 7:03:00 PM

NOTES:

* - Flagged value is not within established control limits.

* - Flagged value is not within established control limits.

Volatile Petroleum Hydrocarbons by NWVPH

Batch ID: 18561 Analyst: MW

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Aliphatic Hydrocarbon (C5-C6)	30.8	14.9	D	mg/Kg-dry	10	10/18/2017 5:58:22 PM
Aliphatic Hydrocarbon (C6-C8)	46.7	21.3	D	mg/Kg-dry	10	10/18/2017 5:58:22 PM
Aliphatic Hydrocarbon (C8-C10)	17.4	11.9	D*	mg/Kg-dry	10	10/18/2017 5:58:22 PM
Aliphatic Hydrocarbon (C10-C12)	21.6	12.8	D	mg/Kg-dry	10	10/18/2017 5:58:22 PM
Aromatic Hydrocarbon (C8-C10)	32.8	25.6	D	mg/Kg-dry	10	10/18/2017 5:58:22 PM
Aromatic Hydrocarbon (C10-C12)	120	5.11	D	mg/Kg-dry	10	10/18/2017 5:58:22 PM
Aromatic Hydrocarbon (C12-C13)	ND	5.96	Q	mg/Kg-dry	1	10/18/2017 8:00:27 PM
Naphthalene	5.73	0.426	Q*	mg/Kg-dry	1	10/18/2017 8:00:27 PM
Methyl tert-butyl ether (MTBE)	1.22	0.426	Q*	mg/Kg-dry	1	10/18/2017 8:00:27 PM
Surr: 1,4-Difluorobenzene	108	65 - 140	D	%Rec	10	10/18/2017 5:58:22 PM
Surr: Bromofluorobenzene	95.4	65 - 140	D	%Rec	10	10/18/2017 5:58:22 PM

NOTES:

Q - Indicates an analyte with a continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF).

* - Flagged value is not within established control limits.

Sample Moisture (Percent Moisture)

Batch ID: R39308 Analyst: CO

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Percent Moisture	22.0	0.500		wt%	1	10/18/2017 11:26:32 AM

Analytical Report

Work Order: **1710234**
Date Reported: **10/30/2017**

Client: Friedman & Bruya
Project: 710236
Lab ID: 1710234-003
Client Sample ID: MW-93-S-8

Collection Date: 10/14/2017 9:30:00 AM
Matrix: Soil

Extractable Petroleum Hydrocarbons by NWEPH

Batch ID: 18538 Analyst: SB

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Aliphatic Hydrocarbon (C8-C10)	1,640	442	D*	mg/Kg-dry	20	10/23/2017 7:27:00 PM
Aliphatic Hydrocarbon (C10-C12)	3,550	221	D	mg/Kg-dry	20	10/23/2017 7:27:00 PM
Aliphatic Hydrocarbon (C12-C16)	10,500	221	D	mg/Kg-dry	20	10/23/2017 7:27:00 PM
Aliphatic Hydrocarbon (C16-C21)	6,240	221	D	mg/Kg-dry	20	10/23/2017 7:27:00 PM
Aliphatic Hydrocarbon (C21-C34)	1,920	221	D	mg/Kg-dry	20	10/23/2017 7:27:00 PM
Aromatic Hydrocarbon (C8-C10)	115	11.0	*	mg/Kg-dry	1	10/20/2017 11:20:00 PM
Aromatic Hydrocarbon (C10-C12)	539	11.0	*	mg/Kg-dry	1	10/20/2017 11:20:00 PM
Aromatic Hydrocarbon (C12-C16)	2,450	221	D	mg/Kg-dry	20	10/23/2017 3:49:00 PM
Aromatic Hydrocarbon (C16-C21)	3,910	221	D	mg/Kg-dry	20	10/23/2017 3:49:00 PM
Aromatic Hydrocarbon (C21-C34)	355	221	D	mg/Kg-dry	20	10/23/2017 3:49:00 PM
Surr: 1-Chlorooctadecane	105	60 - 140		%Rec	1	10/21/2017 11:23:00 AM
Surr: o-Terphenyl	90.8	60 - 140		%Rec	1	10/20/2017 11:20:00 PM

NOTES:
* - Flagged value is not within established control limits.

Volatile Petroleum Hydrocarbons by NWVPH

Batch ID: 18561 Analyst: MW

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Aliphatic Hydrocarbon (C5-C6)	347	117	D	mg/Kg-dry	100	10/18/2017 6:39:00 PM
Aliphatic Hydrocarbon (C6-C8)	706	167	D	mg/Kg-dry	100	10/18/2017 6:39:00 PM
Aliphatic Hydrocarbon (C8-C10)	175	93.7	D*	mg/Kg-dry	100	10/18/2017 6:39:00 PM
Aliphatic Hydrocarbon (C10-C12)	438	100	D	mg/Kg-dry	100	10/18/2017 6:39:00 PM
Aromatic Hydrocarbon (C8-C10)	337	201	D	mg/Kg-dry	100	10/18/2017 6:39:00 PM
Aromatic Hydrocarbon (C10-C12)	846	40.1	D	mg/Kg-dry	100	10/18/2017 6:39:00 PM
Aromatic Hydrocarbon (C12-C13)	ND	4.68	Q	mg/Kg-dry	1	10/18/2017 8:41:06 PM
Naphthalene	12.8	0.335	Q*	mg/Kg-dry	1	10/18/2017 8:41:06 PM
Methyl tert-butyl ether (MTBE)	1.33	0.335	Q*	mg/Kg-dry	1	10/18/2017 8:41:06 PM
Surr: 1,4-Difluorobenzene	106	65 - 140	D	%Rec	100	10/18/2017 6:39:00 PM
Surr: Bromofluorobenzene	93.1	65 - 140	D	%Rec	100	10/18/2017 6:39:00 PM

NOTES:
Q - Indicates an analyte with a continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF).
* - Flagged value is not within established control limits.

Sample Moisture (Percent Moisture)

Batch ID: R39308 Analyst: CO

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Percent Moisture	15.8	0.500		wt%	1	10/18/2017 11:26:32 AM

Work Order: 1710234
CLIENT: Friedman & Bruya
Project: 710236

QC SUMMARY REPORT

Extractable Petroleum Hydrocarbons by NWEPH

Sample ID **MB-18538** SampType: **MBLK** Units: **mg/Kg** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MBLKS** Batch ID: **18538** Analysis Date: **10/20/2017** SeqNo: **759173**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aromatic Hydrocarbon (C8-C10)	ND	10.0									*
Aromatic Hydrocarbon (C10-C12)	ND	10.0									*
Aromatic Hydrocarbon (C12-C16)	ND	10.0									
Aromatic Hydrocarbon (C16-C21)	ND	10.0									
Aromatic Hydrocarbon (C21-C34)	ND	10.0									
Surr: o-Terphenyl	91.3		100.0		91.3	60	140				

NOTES:
* - Flagged value is not within established control limits.

Sample ID **LCS-18538** SampType: **LCS** Units: **mg/Kg** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **LCSS** Batch ID: **18538** Analysis Date: **10/20/2017** SeqNo: **759172**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aromatic Hydrocarbon (C8-C10)	155	10.0	250.0	0	62.1	70	130				S
Aromatic Hydrocarbon (C10-C12)	151	10.0	250.0	0	60.6	70	130				S
Aromatic Hydrocarbon (C12-C16)	180	10.0	250.0	0	71.9	70	130				
Aromatic Hydrocarbon (C16-C21)	228	10.0	250.0	0	91.4	70	130				
Aromatic Hydrocarbon (C21-C34)	188	10.0	250.0	0	75.2	70	130				
Surr: o-Terphenyl	74.2		100.0		74.2	60	140				

NOTES:
S - Outlying spike recovery observed (low bias). Samples will be qualified with a *.

Sample ID **1710234-002ADUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/20/2017** SeqNo: **759643**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aromatic Hydrocarbon (C8-C10)	ND	12.4						0		30	*
Aromatic Hydrocarbon (C10-C12)	ND	12.4						0		30	*
Aromatic Hydrocarbon (C12-C16)	ND	12.4						0		30	
Aromatic Hydrocarbon (C16-C21)	ND	12.4						0		30	
Aromatic Hydrocarbon (C21-C34)	ND	12.4						0		30	
Surr: o-Terphenyl	92.9		124.0		74.9	60	140		0		

QC SUMMARY REPORT

Extractable Petroleum Hydrocarbons by NWEPH

Sample ID **1710234-002ADUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/20/2017** SeqNo: **759643**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

NOTES:
* - Flagged value is not within established control limits.

Sample ID **1710234-002AMS** SampType: **MS** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/20/2017** SeqNo: **759644**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aromatic Hydrocarbon (C8-C10)	164	12.4	309.8	0	52.9	70	130				S
Aromatic Hydrocarbon (C10-C12)	172	12.4	309.8	0	55.5	70	130				S
Aromatic Hydrocarbon (C12-C16)	224	12.4	309.8	0	72.4	70	130				
Aromatic Hydrocarbon (C16-C21)	240	12.4	309.8	0	77.4	70	130				
Aromatic Hydrocarbon (C21-C34)	244	12.4	309.8	0	78.7	70	130				
Surr: o-Terphenyl	83.5		123.9		67.4	60	140				

NOTES:
S - Outlying spike recovery(ies) observed.

Sample ID **1710234-002AMSD** SampType: **MSD** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/20/2017** SeqNo: **759645**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aromatic Hydrocarbon (C8-C10)	208	12.3	306.6	0	67.7	70	130	163.8	23.6	30	S
Aromatic Hydrocarbon (C10-C12)	198	12.3	306.6	0	64.6	70	130	171.8	14.2	30	S
Aromatic Hydrocarbon (C12-C16)	227	12.3	306.6	0	74.0	70	130	224.4	1.10	30	
Aromatic Hydrocarbon (C16-C21)	275	12.3	306.6	0	89.7	70	130	239.8	13.7	30	
Aromatic Hydrocarbon (C21-C34)	226	12.3	306.6	0	73.9	70	130	243.8	7.38	30	
Surr: o-Terphenyl	86.6		122.6		70.7	60	140		0		

NOTES:
S - Outlying spike recovery(ies) observed.

Work Order: 1710234
CLIENT: Friedman & Bruya
Project: 710236

QC SUMMARY REPORT

Extractable Petroleum Hydrocarbons by NWEPH

Sample ID **MB-18538** SampType: **MBLK** Units: **mg/Kg** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MBLKS** Batch ID: **18538** Analysis Date: **10/21/2017** SeqNo: **759178**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C8-C10)	ND	20.0									*
Aliphatic Hydrocarbon (C10-C12)	ND	10.0									
Aliphatic Hydrocarbon (C12-C16)	ND	10.0									
Aliphatic Hydrocarbon (C16-C21)	ND	10.0									
Aliphatic Hydrocarbon (C21-C34)	ND	10.0									
Surr: 1-Chlorooctadecane	103		100.0		103	60	140				

NOTES:
* - Flagged value is not within established control limits.

Sample ID **LCS-18538** SampType: **LCS** Units: **mg/Kg** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **LCSS** Batch ID: **18538** Analysis Date: **10/21/2017** SeqNo: **759177**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C8-C10)	196	20.0	500.0	0	39.3	70	130				S
Aliphatic Hydrocarbon (C10-C12)	176	10.0	250.0	0	70.4	70	130				
Aliphatic Hydrocarbon (C12-C16)	259	10.0	250.0	0	103	70	130				
Aliphatic Hydrocarbon (C16-C21)	225	10.0	250.0	0	90.0	70	130				
Aliphatic Hydrocarbon (C21-C34)	245	10.0	250.0	0	97.9	70	130				
Surr: 1-Chlorooctadecane	92.9		100.0		92.9	60	140				

NOTES:
S - Outlying spike recovery observed (low bias). Samples will be qualified with a *.

Sample ID **1710234-002ADUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/21/2017** SeqNo: **759656**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C8-C10)	ND	24.8						0		30	*
Aliphatic Hydrocarbon (C10-C12)	13.6	12.4						7.018	63.9	30	
Aliphatic Hydrocarbon (C12-C16)	43.7	12.4						26.66	48.5	30	R
Aliphatic Hydrocarbon (C16-C21)	49.2	12.4						25.52	63.3	30	R
Aliphatic Hydrocarbon (C21-C34)	ND	12.4						0		30	
Surr: 1-Chlorooctadecane	97.0		124.0		78.2	60	140		0		

Work Order: 1710234
CLIENT: Friedman & Bruya
Project: 710236

QC SUMMARY REPORT

Extractable Petroleum Hydrocarbons by NWEPH

Sample ID **1710234-002ADUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/21/2017** SeqNo: **759656**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

NOTES:
R - High RPD due to suspected sample inhomogeneity. The method is in control as indicated by the Laboratory Control Sample (LCS).
* - Flagged value is not within established control limits.

Sample ID **1710234-002AMS** SampType: **MS** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/21/2017** SeqNo: **759657**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C8-C10)	189	24.8	619.6	11.26	28.6	70	130				S
Aliphatic Hydrocarbon (C10-C12)	177	12.4	309.8	7.018	55.0	70	130				S
Aliphatic Hydrocarbon (C12-C16)	288	12.4	309.8	26.66	84.3	70	130				
Aliphatic Hydrocarbon (C16-C21)	256	12.4	309.8	25.52	74.6	70	130				
Aliphatic Hydrocarbon (C21-C34)	234	12.4	309.8	0	75.7	70	130				
Surr: 1-Chlorooctadecane	96.9		123.9		78.2	60	140				

NOTES:
S - Outlying spike recovery(ies) observed.

Sample ID **1710234-002AMSD** SampType: **MSD** Units: **mg/Kg-dry** Prep Date: **10/17/2017** RunNo: **39446**
Client ID: **MW-36A-S-10** Batch ID: **18538** Analysis Date: **10/21/2017** SeqNo: **759658**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C8-C10)	217	24.5	613.1	11.26	33.6	70	130	188.7	14.0	30	S
Aliphatic Hydrocarbon (C10-C12)	206	12.3	306.6	7.018	64.9	70	130	177.4	14.9	30	S
Aliphatic Hydrocarbon (C12-C16)	346	12.3	306.6	26.66	104	70	130	287.7	18.4	30	
Aliphatic Hydrocarbon (C16-C21)	311	12.3	306.6	25.52	93.0	70	130	256.5	19.1	30	
Aliphatic Hydrocarbon (C21-C34)	244	12.3	306.6	0	79.7	70	130	234.4	4.08	30	
Surr: 1-Chlorooctadecane	103		122.6		84.3	60	140		0		

NOTES:
S - Outlying spike recovery(ies) observed.

QC SUMMARY REPORT

Extractable Petroleum Hydrocarbons by NWEPH

Sample ID **ARO-CCV-C-18538** SampType: **CCV** Units: **mg/Kg** Prep Date: **10/23/2017** RunNo: **39446**
Client ID: **CCV** Batch ID: **18538** Analysis Date: **10/23/2017** SeqNo: **759642**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aromatic Hydrocarbon (C8-C10)	108	10.0	100.0	0	108	80	120				
Aromatic Hydrocarbon (C12-C16)	106	10.0	100.0	0	106	80	120				
Aromatic Hydrocarbon (C16-C21)	96.9	10.0	100.0	0	96.9	80	120				
Aromatic Hydrocarbon (C21-C34)	95.0	10.0	100.0	0	95.0	80	120				
Surr: o-Terphenyl	35.2		40.00		87.9	60	140				

Sample ID **ALI-CCV-C-18538** SampType: **CCV** Units: **mg/Kg** Prep Date: **10/23/2017** RunNo: **39446**
Client ID: **CCV** Batch ID: **18538** Analysis Date: **10/23/2017** SeqNo: **759654**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C8-C10)	197	20.0	200.0	0	98.3	80	120				
Aliphatic Hydrocarbon (C10-C12)	98.0	10.0	100.0	0	98.0	80	120				
Aliphatic Hydrocarbon (C12-C16)	96.5	10.0	100.0	0	96.5	80	120				
Aliphatic Hydrocarbon (C16-C21)	96.6	10.0	100.0	0	96.6	80	120				
Aliphatic Hydrocarbon (C21-C34)	102	10.0	100.0	0	102	80	120				
Surr: 1-Chlorooctadecane	37.2		40.00		93.0	60	140				

Date: *10/30/2017*

Work Order: 1710234
CLIENT: Friedman & Bruya
Project: 710236

QC SUMMARY REPORT

Sample Moisture (Percent Moisture)

Sample ID **1710226-001ADUP** SampType: **DUP** Units: **wt%** Prep Date: **10/18/2017** RunNo: **39308**
Client ID: **BATCH** Batch ID: **R39308** Analysis Date: **10/18/2017** SeqNo: **756342**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Percent Moisture	43.6	0.500						42.28	3.12	20	

Sample ID **1710261-001ADUP** SampType: **DUP** Units: **wt%** Prep Date: **10/18/2017** RunNo: **39308**
Client ID: **BATCH** Batch ID: **R39308** Analysis Date: **10/18/2017** SeqNo: **756356**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Percent Moisture	36.2	0.500						41.19	13.0	20	

Work Order: 1710234
CLIENT: Friedman & Bruya
Project: 710236

QC SUMMARY REPORT

Volatile Petroleum Hydrocarbons by NWVPH

Sample ID **LCS-18561** SampType: **LCS** Units: **mg/Kg** Prep Date: **10/18/2017** RunNo: **39332**
Client ID: **LCSS** Batch ID: **18561** Analysis Date: **10/18/2017** SeqNo: **756915**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C5-C6)	34.2	1.75	30.00	0	114	70	130				
Aliphatic Hydrocarbon (C6-C8)	11.5	2.50	10.00	0	115	70	130				
Aliphatic Hydrocarbon (C8-C10)	13.1	1.40	10.00	0	131	70	130				S
Aliphatic Hydrocarbon (C10-C12)	12.5	1.50	10.00	0	125	70	130				
Aromatic Hydrocarbon (C8-C10)	43.7	3.00	40.00	0	109	70	130				
Aromatic Hydrocarbon (C10-C12)	9.30	0.600	10.00	0	93.0	70	130				
Aromatic Hydrocarbon (C12-C13)	12.1	7.00	10.00	0	121	70	130				
Naphthalene	5.57	0.500	10.00	0	55.7	70	130				S
Methyl tert-butyl ether (MTBE)	6.36	0.500	10.00	0	63.6	70	130				S
Surr: 1,4-Difluorobenzene	2.63		2.500		105	65	140				
Surr: Bromofluorobenzene	2.20		2.500		88.0	65	140				

NOTES:

S - Outlying spike recovery observed (Aliphatic C8-10; high bias). Detections will be qualified with a *.

S - Outlying spike recovery observed (Naphthalene, MTBE; low bias). Samples will be qualified with a *.

Sample ID **MB-18561** SampType: **MBLK** Units: **mg/Kg** Prep Date: **10/18/2017** RunNo: **39332**
Client ID: **MBLKS** Batch ID: **18561** Analysis Date: **10/18/2017** SeqNo: **756916**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C5-C6)	ND	1.75		0	0						
Aliphatic Hydrocarbon (C6-C8)	ND	2.50		0	0						
Aliphatic Hydrocarbon (C8-C10)	ND	1.40		0	0						
Aliphatic Hydrocarbon (C10-C12)	ND	1.50		0	0						
Aromatic Hydrocarbon (C8-C10)	ND	3.00		0	0						
Aromatic Hydrocarbon (C10-C12)	ND	0.600		0	0						
Aromatic Hydrocarbon (C12-C13)	ND	7.00		0	0						Q
Naphthalene	ND	0.500		0	0						Q*
Methyl tert-butyl ether (MTBE)	ND	0.500		0	0						Q*
Surr: 1,4-Difluorobenzene	2.58		2.500		103	65	140				
Surr: Bromofluorobenzene	2.14		2.500		85.7	65	140				

Work Order: 1710234
CLIENT: Friedman & Bruya
Project: 710236

QC SUMMARY REPORT

Volatile Petroleum Hydrocarbons by NWVPH

Sample ID **MB-18561** SampType: **MBLK** Units: **mg/Kg** Prep Date: **10/18/2017** RunNo: **39332**
Client ID: **MBLKS** Batch ID: **18561** Analysis Date: **10/18/2017** SeqNo: **756916**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

NOTES:
Q - Indicates an analyte with a continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF).
* - Flagged value is not within established control limits.

Sample ID **1710267-002BDUP** SampType: **DUP** Units: **mg/Kg-dry** Prep Date: **10/18/2017** RunNo: **39332**
Client ID: **BATCH** Batch ID: **18561** Analysis Date: **10/18/2017** SeqNo: **756912**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C5-C6)	4.17	1.87		0	0			3.767	10.2	25	
Aliphatic Hydrocarbon (C6-C8)	25.3	2.68		0	0			26.50	4.63	25	
Aliphatic Hydrocarbon (C8-C10)	56.6	1.50		0	0			55.64	1.79	25	*
Aliphatic Hydrocarbon (C10-C12)	98.2	1.61		0	0			94.15	4.17	25	E
Aromatic Hydrocarbon (C8-C10)	163	3.21		0	0			168.5	3.13	25	E
Aromatic Hydrocarbon (C10-C12)	281	0.642		0	0			291.8	3.75	25	E
Aromatic Hydrocarbon (C12-C13)	ND	7.49		0	0			0		25	Q
Naphthalene	10.1	0.535		0	0			10.66	5.86	25	Q*
Methyl tert-butyl ether (MTBE)	1.53	0.535		0	0			1.534	0	25	Q*
Surr: 1,4-Difluorobenzene	3.16		2.676		118	65	140		0		
Surr: Bromofluorobenzene	3.15		2.676		118	65	140		0		

NOTES:
Q - Indicates an analyte with a continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF).
E - Estimated value. The amount exceeds the linear working range of the instrument.
* - Flagged value is not within established control limits.

Sample ID **1710267-001BMS** SampType: **MS** Units: **mg/Kg-dry** Prep Date: **10/18/2017** RunNo: **39332**
Client ID: **BATCH** Batch ID: **18561** Analysis Date: **10/18/2017** SeqNo: **756909**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C5-C6)	43.8	1.91	32.81	10.26	102	70	130				
Aliphatic Hydrocarbon (C6-C8)	22.8	2.73	10.94	14.16	79.1	70	130				
Aliphatic Hydrocarbon (C8-C10)	22.5	1.53	10.94	6.924	142	70	130				S
Aliphatic Hydrocarbon (C10-C12)	26.4	1.64	10.94	15.27	102	70	130				

Work Order: 1710234
CLIENT: Friedman & Bruya
Project: 710236

QC SUMMARY REPORT

Volatile Petroleum Hydrocarbons by NWVPH

Sample ID **1710267-001BMS** SampType: **MS** Units: **mg/Kg-dry** Prep Date: **10/18/2017** RunNo: **39332**
Client ID: **BATCH** Batch ID: **18561** Analysis Date: **10/18/2017** SeqNo: **756909**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aromatic Hydrocarbon (C8-C10)	81.6	3.28	43.75	41.23	92.3	70	130				
Aromatic Hydrocarbon (C10-C12)	50.9	0.656	10.94	24.00	246	70	130				S
Aromatic Hydrocarbon (C12-C13)	ND	7.66	10.94	12.07	-110	70	130				SE
Naphthalene	9.86	0.547	10.94	1.587	75.6	70	130				
Methyl tert-butyl ether (MTBE)	6.83	0.547	10.94	1.568	48.2	70	130				S
Surr: 1,4-Difluorobenzene	3.04		2.734		111	65	140				
Surr: Bromofluorobenzene	2.88		2.734		105	65	140				

NOTES:
S - Outlying spike recovery(ies) observed.
E - Estimated value. The amount exceeds the linear working range of the instrument.

Sample ID **1710267-001BMSD** SampType: **MSD** Units: **mg/Kg-dry** Prep Date: **10/18/2017** RunNo: **39332**
Client ID: **BATCH** Batch ID: **18561** Analysis Date: **10/18/2017** SeqNo: **756910**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aliphatic Hydrocarbon (C5-C6)	37.5	1.91	32.81	10.26	83.1	70	130	43.76	15.3	30	
Aliphatic Hydrocarbon (C6-C8)	21.2	2.73	10.94	14.16	64.1	70	130	22.81	7.49	30	S
Aliphatic Hydrocarbon (C8-C10)	21.7	1.53	10.94	6.924	135	70	130	22.46	3.56	30	S
Aliphatic Hydrocarbon (C10-C12)	19.5	1.64	10.94	15.27	38.3	70	130	26.39	30.2	30	RS
Aromatic Hydrocarbon (C8-C10)	80.7	3.28	43.75	41.23	90.2	70	130	81.61	1.12	30	
Aromatic Hydrocarbon (C10-C12)	26.2	0.656	10.94	24.00	20.0	70	130	50.88	64.1	30	RS
Aromatic Hydrocarbon (C12-C13)	ND	7.66	10.94	12.07	-110	70	130	0		30	SE
Naphthalene	7.62	0.547	10.94	1.587	55.1	70	130	9.857	25.6	30	S
Methyl tert-butyl ether (MTBE)	6.12	0.547	10.94	1.568	41.6	70	130	6.834	11.1	30	S
Surr: 1,4-Difluorobenzene	3.18		2.734		116	65	140		0		
Surr: Bromofluorobenzene	2.53		2.734		92.5	65	140		0		

NOTES:
S - Outlying spike recovery(ies) observed.
R - High RPD observed.
E - Estimated value. The amount exceeds the linear working range of the instrument.

Fremont Analytical

Sample Log-In Check List

Client Name: **FB**

Work Order Number: **1710234**

Logged by: **Brianna Barnes**

Date Received: **10/16/2017 2:43:00 PM**

Chain of Custody

1. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
2. How was the sample delivered? FedEx

Log In

3. Coolers are present? Yes ☑ No ☐ NA ☐
4. Shipping container/cooler in good condition? Yes ☑ No ☐
5. Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact) Yes ☐ No ☑ Not Required ☐
6. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
7. Were all items received at a temperature of >0°C to 10.0°C* Yes ☑ No ☐ NA ☐
8. Sample(s) in proper container(s)? Yes ☑ No ☐
9. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
10. Are samples properly preserved? Yes ☑ No ☐
11. Was preservative added to bottles? Yes ☑ No ☐ NA ☐
    MeOH added to VOAs
12. Is there headspace in the VOA vials? Yes ☐ No ☐ NA ☑
13. Did all samples containers arrive in good condition(unbroken)? Yes ☑ No ☐
14. Does paperwork match bottle labels? Yes ☑ No ☐
15. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
16. Is it clear what analyses were requested? Yes ☑ No ☐
17. Were all holding times able to be met? Yes ☑ No ☐

Special Handling (if applicable)

18. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: ________ Date ________

By Whom: ________ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: ________

Client Instructions: ________

19. Additional remarks:

Item Information

Item #	Temp ºC
Cooler	4.1
Sample	3.5

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

1710234

SUBCONTRACT SAMPLE CHAIN OF CUSTODY

Send Report To Michael Erdahl

Company Friedman and Bruya, Inc.

Address 3012 16th Ave W

City, State, ZIP Seattle, WA 98119

Phone # (206) 285-8282 Fax # (206) 283-5044

SUBCONTRACTER Fremont

PROJECT NAME/NO. 710236

PO # F-118

REMARKS PGG Deliverable.
Please Email Results

Page # 1 of 1

TURNAROUND TIME
☒ Standard (2 Weeks)
☐ RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Return samples
☐ Will call with instructions

						ANALYSES REQUESTED										
Sample ID	Lab ID	Date Sampled	Time Sampled	Matrix	# of jars	Dioxins/Furans	EPH	VPH	Nitrate	Sulfate	Alkalinity	TOC-9060M				Notes
MW-39-S-9		10/14/17	1500	Soil	2		X	X								
MW-36A-S-10		↓	12:00	↓	2		X	X								
MW-93-S-8		↓	930	↓	2		X	X								

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Michael Erdahl	Friedman and Bruya	10/16/17	1224
Received by:	Brianna Barnes	FAI	10/16/17	1443
Relinquished by:				
Received by:				

710236

SAMPLE CHAIN OF CUSTODY

ME 10-16-~~13~~17 BI1 / VS3

Report To ~~Kosh~~ Glen Wallace
Company Pacific Groundwater Group
Address 2377 Eastlake Avenue East
City, State, ZIP Seattle, WA 98102
Phone 206 329 0141 Email glen@pgwg.com

SAMPLERS (*signature*) Koshlan Mayer-Blackwell

PROJECT NAME	PO #
Terminal 30	

REMARKS
* please contact glen wallace for details on analyses requested

INVOICE TO
Chris Keener
chris@pgwg.com

Page # 1 of 1

TURNAROUND TIME
☑ Standard Turnaround
☐ RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Archive Samples
☐ Other

						ANALYSES REQUESTED											
Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	NWTPH-Diesel	NWTPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM	BTEX	EPH	VPH		Notes
MW-39-S-9	01 A-F	10/14/17	15:00	Soil	6		✓	✓					✓	✓	✓		
MW-36A-S-10	02	10/14/17	12:00	Soil	6		✓	✓					✓	✓	✓		
MW-93-S-8	03	10/14/17	9:30	Soil	6		✓	✓					✓	✓	✓		

Samples received at 2 °C

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	KOSHLAN MAYER-BLACKWELL	PGG	10/16/2017	9:10 AM
Received by:	Michael Erdahl	F&B	↓	↓
Relinquished by:				
Received by:				

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

November 21, 2017

Jamie Stevens, Project Manager
Crete Consulting
108 S. Washington St., Suite 300
Seattle, WA 98104

Dear Ms Stevens:

Included are the results from the testing of material submitted on October 27, 2017 from the T-30, F&BI 710438 project. There are 17 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
CTC1121R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on October 27, 2017 by Friedman & Bruya, Inc. from the Crete Consulting T-30, F&BI 710438 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Crete Consulting
710438 -01	MW-39A
710438 -02	MW-93
710438 -03	MW-36A
710438 -04	MW-42
710438 -05	MW-59

The MA-APH EC5-8 aliphatics concentration for samples MW-39A, MW-93, and MW-36A exceeded the calibration range. In addition, the TO-15 cyclohexane concentration exceeded the calibration reange. The data were flagged accordingly.

All other quality control requirements were acceptable.

Analysis For Volatile Compounds By Method MA-APH

Client Sample ID:	MW-39A	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/26/17	Lab ID:	710438-01 1/12,500
Date Analyzed:	11/15/17	Data File:	111424.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	96	70	130

Compounds:	Concentration ug/m3
APH EC5-8 aliphatics	86,000,000 ve
APH EC9-12 aliphatics	1,000,000
APH EC9-10 aromatics	<620,000

Analysis For Volatile Compounds By Method MA-APH

Client Sample ID:	MW-93	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/26/17	Lab ID:	710438-02 1/11,500
Date Analyzed:	11/15/17	Data File:	111423.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	97	70	130

Compounds:	Concentration ug/m3
APH EC5-8 aliphatics	14,000,000 ve
APH EC9-12 aliphatics	<800,000
APH EC9-10 aromatics	<570,000

Analysis For Volatile Compounds By Method MA-APH

Client Sample ID:	MW-36A	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/26/17	Lab ID:	710438-03 1/500
Date Analyzed:	11/15/17	Data File:	111421.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	104	70	130

Compounds:	Concentration ug/m3
APH EC5-8 aliphatics	2,700,000 ve
APH EC9-12 aliphatics	270,000
APH EC9-10 aromatics	<25,000

Analysis For Volatile Compounds By Method MA-APH

Client Sample ID:	MW-42	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/25/17	Lab ID:	710438-04 1/13,000
Date Analyzed:	11/15/17	Data File:	111422.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	100	70	130

Compounds:	Concentration ug/m3
APH EC5-8 aliphatics	12,000,000
APH EC9-12 aliphatics	<910,000
APH EC9-10 aromatics	<650,000

Analysis For Volatile Compounds By Method MA-APH

Client Sample ID:	MW-59	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/25/17	Lab ID:	710438-05 1/500
Date Analyzed:	11/14/17	Data File:	111420.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	110	70	130

Compounds:	Concentration ug/m3
APH EC5-8 aliphatics	420,000
APH EC9-12 aliphatics	190,000
APH EC9-10 aromatics	<25,000

Analysis For Volatile Compounds By Method MA-APH

Client Sample ID:	Method Blank	Client:	Crete Consulting
Date Received:	Not Applicable	Project:	T-30, F&BI 710438
Date Collected:	11/14/17	Lab ID:	07-2560 mb
Date Analyzed:	11/14/17	Data File:	111410.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	98	70	130

Compounds:	Concentration ug/m3
APH EC5-8 aliphatics	<46
APH EC9-12 aliphatics	<70
APH EC9-10 aromatics	<50

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	MW-39A	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/26/17	Lab ID:	710438-01 1/12,500
Date Analyzed:	11/15/17	Data File:	111424.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	96	70	130

	Concentration			Concentration	
Compounds:	ug/m3	ppbv	Compounds:	ug/m3	ppbv
Chlorodifluoromethane	<4,400	<1,200	1-Butanol	<76,000	<25,000
Propene	<8,600	<5,000	Carbon tetrachloride	<7,900	<1,200
Dichlorodifluoromethane	<6,200	<1,200	Benzene	140,000	44,000
Chloromethane	<2,600	<1,200	Cyclohexane	2,900,000 ve	840,000 ve
F-114	<8,700	<1,200	2-Pentanone	<44,000	<12,000
Isobutene	<11,000	<5,000	3-Pentanone	<44,000	<12,000
Acetaldehyde	<110,000	<62,000	Pentanal	<44,000	<12,000
Vinyl chloride	<3,200	<1,200	1,2-Dichloropropane	<5,800	<1,200
1,3-Butadiene	<2,800	<1,200	1,4-Dioxane	<4,500	<1,200
Bromomethane	<4,900	<1,200	Bromodichloromethane	<8,400	<1,200
Chloroethane	<3,300	<1,200	Trichloroethene	<6,700	<1,200
Ethanol	<94,000	<50,000	cis-1,3-Dichloropropene	<5,700	<1,200
Acetonitrile	<21,000	<12,000	4-Methyl-2-pentanone	<51,000	<12,000
Acrolein	<11,000	<5,000	trans-1,3-Dichloropropene	<5,700	<1,200
Acrylonitrile	<2,700	<1,200	Toluene	<4,700	<1,200
Pentane	3,300,000 ve	1,100,000 ve	1,1,2-Trichloroethane	<6,800	<1,200
Trichlorofluoromethane	<7,000	<1,200	3-Hexanone	<51,000	<12,000
Acetone	<59,000	<25,000	2-Hexanone	<51,000	<12,000
2-Propanol	<110,000	<44,000	Hexanal	<51,000	<12,000
Isoprene	<3,500	<1,200	Tetrachloroethene	<8,500	<1,200
Iodomethane	<7,300	<1,200	Dibromochloromethane	<11,000	<1,200
1,1-Dichloroethene	<5,000	<1,200	1,2-Dibromoethane (EDB)	<9,600	<1,200
Methacrolein	<36,000	<12,000	Chlorobenzene	<5,800	<1,200
trans-1,2-Dichloroethene	<5,000	<1,200	Ethylbenzene	9,300	2,100
Cyclopentane	270,000	95,000	1,1,2,2-Tetrachloroethane	<8,600	<1,200
Methyl vinyl ketone	<14,000	<5,000	m,p-Xylene	<11,000	<2,500
Butanal	<37,000	<12,000	o-Xylene	<5,400	<1,200
Methylene chloride	<1,100,000 ca	<310,000 ca	Styrene	<11,000	<2,500
CFC-113	<9,600	<1,200	Bromoform	<26,000	<2,500
Carbon disulfide	<78,000	<25,000	Benzyl chloride	<6,500	<1,200
Methyl t-butyl ether	<23,000	<6,200	1,3,5-Trimethylbenzene	<31,000	<6,200
Vinyl acetate	<88,000	<25,000	1,2,4-Trimethylbenzene	<31,000	<6,200
1,1-Dichloroethane	<5,100	<1,200	1,3-Dichlorobenzene	<15,000	<2,500
cis-1,2-Dichloroethene	<5,000	<1,200	1,4-Dichlorobenzene	<7,500	<1,200
Hexane	3,200,000 ve	900,000 ve	1,2,3-Trimethylbenzene	<31,000	<6,200
Chloroform	<6,100	<1,200	1,2-Dichlorobenzene	<15,000	<2,500
2-Butanone (MEK)	<37,000	<12,000	1,2,4-Trichlorobenzene	<9,300	<1,200
1,2-Dichloroethane (EDC)	<5,100	<1,200	Naphthalene	<6,600	<1,200
1,1,1-Trichloroethane	<6,800	<1,200	Hexachlorobutadiene	<13,000	<1,200

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	MW-93	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/26/17	Lab ID:	710438-02 1/11,500
Date Analyzed:	11/15/17	Data File:	111423.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	97	70	130

	Concentration			Concentration	
Compounds:	ug/m3	ppbv	Compounds:	ug/m3	ppbv
Chlorodifluoromethane	<4,100	<1,100	1-Butanol	<70,000	<23,000
Propene	<7,900	<4,600	Carbon tetrachloride	<7,200	<1,100
Dichlorodifluoromethane	<5,700	<1,100	Benzene	<3,700	<1,100
Chloromethane	<2,400	<1,100	Cyclohexane	530,000	160,000
F-114	<8,000	<1,100	2-Pentanone	<41,000	<11,000
Isobutene	<11,000	<4,600	3-Pentanone	<41,000	<11,000
Acetaldehyde	<100,000	<57,000	Pentanal	<41,000	<11,000
Vinyl chloride	<2,900	<1,100	1,2-Dichloropropane	<5,300	<1,100
1,3-Butadiene	<2,500	<1,100	1,4-Dioxane	<4,100	<1,100
Bromomethane	<4,500	<1,100	Bromodichloromethane	<7,700	<1,100
Chloroethane	<3,000	<1,100	Trichloroethene	<6,200	<1,100
Ethanol	<87,000	<46,000	cis-1,3-Dichloropropene	<5,200	<1,100
Acetonitrile	<19,000	<11,000	4-Methyl-2-pentanone	<47,000	<11,000
Acrolein	<11,000	<4,600	trans-1,3-Dichloropropene	<5,200	<1,100
Acrylonitrile	<2,500	<1,100	Toluene	<4,300	<1,100
Pentane	940,000	320,000	1,1,2-Trichloroethane	<6,300	<1,100
Trichlorofluoromethane	<6,500	<1,100	3-Hexanone	<47,000	<11,000
Acetone	<55,000	<23,000	2-Hexanone	<47,000	<11,000
2-Propanol	<99,000	<40,000	Hexanal	<47,000	<11,000
Isoprene	<3,200	<1,100	Tetrachloroethene	<7,800	<1,100
Iodomethane	<6,700	<1,100	Dibromochloromethane	<9,800	<1,100
1,1-Dichloroethene	<4,600	<1,100	1,2-Dibromoethane (EDB)	<8,800	<1,100
Methacrolein	<33,000	<11,000	Chlorobenzene	<5,300	<1,100
trans-1,2-Dichloroethene	<4,600	<1,100	Ethylbenzene	<5,000	<1,100
Cyclopentane	13,000	4,600	1,1,2,2-Tetrachloroethane	<7,900	<1,100
Methyl vinyl ketone	<13,000	<4,600	m,p-Xylene	<10,000	<2,300
Butanal	<34,000	<11,000	o-Xylene	<5,000	<1,100
Methylene chloride	<1,000,000 ca	<290,000 ca	Styrene	<9,800	<2,300
CFC-113	<8,800	<1,100	Bromoform	<24,000	<2,300
Carbon disulfide	<72,000	<23,000	Benzyl chloride	<6,000	<1,100
Methyl t-butyl ether	<21,000	<5,700	1,3,5-Trimethylbenzene	<28,000	<5,700
Vinyl acetate	<81,000	<23,000	1,2,4-Trimethylbenzene	<28,000	<5,700
1,1-Dichloroethane	<4,700	<1,100	1,3-Dichlorobenzene	<14,000	<2,300
cis-1,2-Dichloroethene	<4,600	<1,100	1,4-Dichlorobenzene	<6,900	<1,100
Hexane	670,000	190,000	1,2,3-Trimethylbenzene	<28,000	<5,700
Chloroform	<5,600	<1,100	1,2-Dichlorobenzene	<14,000	<2,300
2-Butanone (MEK)	<34,000	<11,000	1,2,4-Trichlorobenzene	<8,500	<1,100
1,2-Dichloroethane (EDC)	<4,700	<1,100	Naphthalene	<6,000	<1,100
1,1,1-Trichloroethane	<6,300	<1,100	Hexachlorobutadiene	<12,000	<1,100

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	MW-36A	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/26/17	Lab ID:	710438-03 1/500
Date Analyzed:	11/15/17	Data File:	111421.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	104	70	130

Compounds:	Concentration ug/m3	ppbv	Compounds:	Concentration ug/m3	ppbv
Chlorodifluoromethane	<180	<50	1-Butanol	<3,000	<1,000
Propene	500	290	Carbon tetrachloride	<310	<50
Dichlorodifluoromethane	<250	<50	Benzene	<160	<50
Chloromethane	<100	<50	Cyclohexane	23,000	6,800
F-114	<350	<50	2-Pentanone	<1,800	<500
Isobutene	<460	<200	3-Pentanone	<1,800	<500
Acetaldehyde	<4,500	<2,500	Pentanal	<1,800	<500
Vinyl chloride	<130	<50	1,2-Dichloropropane	<230	<50
1,3-Butadiene	<110	<50	1,4-Dioxane	<180	<50
Bromomethane	<190	<50	Bromodichloromethane	<340	<50
Chloroethane	<130	<50	Trichloroethene	<270	<50
Ethanol	<3,800	<2,000	cis-1,3-Dichloropropene	<230	<50
Acetonitrile	<840	<500	4-Methyl-2-pentanone	<2,000	<500
Acrolein	<460	<200	trans-1,3-Dichloropropene	<230	<50
Acrylonitrile	<110	<50	Toluene	<190	<50
Pentane	30,000	10,000	1,1,2-Trichloroethane	<270	<50
Trichlorofluoromethane	<280	<50	3-Hexanone	<2,000	<500
Acetone	<2,400	<1,000	2-Hexanone	<2,000	<500
2-Propanol	<4,300	<1,700	Hexanal	<2,000	<500
Isoprene	<140	<50	Tetrachloroethene	<340	<50
Iodomethane	<290	<50	Dibromochloromethane	<430	<50
1,1-Dichloroethene	<200	<50	1,2-Dibromoethane (EDB)	<380	<50
Methacrolein	<1,400	<500	Chlorobenzene	<230	<50
trans-1,2-Dichloroethene	<200	<50	Ethylbenzene	<220	<50
Cyclopentane	<140	<50	1,1,2,2-Tetrachloroethane	<340	<50
Methyl vinyl ketone	<570	<200	m,p-Xylene	<430	<100
Butanal	<1,500	<500	o-Xylene	<220	<50
Methylene chloride	<43,000 ca	<12,000 ca	Styrene	<430	<100
CFC-113	<380	<50	Bromoform	<1,000	<100
Carbon disulfide	<3,100	<1,000	Benzyl chloride	<260	<50
Methyl t-butyl ether	<900	<250	1,3,5-Trimethylbenzene	<1,200	<250
Vinyl acetate	<3,500	<1,000	1,2,4-Trimethylbenzene	<1,200	<250
1,1-Dichloroethane	<200	<50	1,3-Dichlorobenzene	<600	<100
cis-1,2-Dichloroethene	<200	<50	1,4-Dichlorobenzene	<300	<50
Hexane	21,000	6,100	1,2,3-Trimethylbenzene	<1,200	<250
Chloroform	<240	<50	1,2-Dichlorobenzene	<600	<100
2-Butanone (MEK)	<1,500	<500	1,2,4-Trichlorobenzene	<370	<50
1,2-Dichloroethane (EDC)	<200	<50	Naphthalene	<260	<50
1,1,1-Trichloroethane	<270	<50	Hexachlorobutadiene	<530	<50

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	MW-42	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/25/17	Lab ID:	710438-04 1/13,000
Date Analyzed:	11/15/17	Data File:	111422.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

	%	Lower	Upper
Surrogates:	Recovery:	Limit:	Limit:
4-Bromofluorobenzene	99	70	130

	Concentration			Concentration	
Compounds:	ug/m3	ppbv	Compounds:	ug/m3	ppbv
Chlorodifluoromethane	<4,600	<1,300	1-Butanol	<79,000	<26,000
Propene	<8,900	<5,200	Carbon tetrachloride	<8,200	<1,300
Dichlorodifluoromethane	<6,400	<1,300	Benzene	14,000	4,400
Chloromethane	<2,700	<1,300	Cyclohexane	280,000	82,000
F-114	<9,100	<1,300	2-Pentanone	<46,000	<13,000
Isobutene	<12,000	<5,200	3-Pentanone	<46,000	<13,000
Acetaldehyde	<120,000	<65,000	Pentanal	<46,000	<13,000
Vinyl chloride	<3,300	<1,300	1,2-Dichloropropane	<6,000	<1,300
1,3-Butadiene	<2,900	<1,300	1,4-Dioxane	<4,700	<1,300
Bromomethane	<5,000	<1,300	Bromodichloromethane	<8,700	<1,300
Chloroethane	<3,400	<1,300	Trichloroethene	<7,000	<1,300
Ethanol	<98,000	<52,000	cis-1,3-Dichloropropene	<5,900	<1,300
Acetonitrile	<22,000	<13,000	4-Methyl-2-pentanone	<53,000	<13,000
Acrolein	<12,000	<5,200	trans-1,3-Dichloropropene	<5,900	<1,300
Acrylonitrile	<2,800	<1,300	Toluene	<4,900	<1,300
Pentane	330,000	110,000	1,1,2-Trichloroethane	<7,100	<1,300
Trichlorofluoromethane	<7,300	<1,300	3-Hexanone	<53,000	<13,000
Acetone	<62,000	<26,000	2-Hexanone	<53,000	<13,000
2-Propanol	<110,000	<45,000	Hexanal	<53,000	<13,000
Isoprene	<3,600	<1,300	Tetrachloroethene	<8,800	<1,300
Iodomethane	<7,500	<1,300	Dibromochloromethane	<11,000	<1,300
1,1-Dichloroethene	<5,200	<1,300	1,2-Dibromoethane (EDB)	<10,000	<1,300
Methacrolein	<37,000	<13,000	Chlorobenzene	<6,000	<1,300
trans-1,2-Dichloroethene	<5,200	<1,300	Ethylbenzene	<5,600	<1,300
Cyclopentane	14,000	5,000	1,1,2,2-Tetrachloroethane	<8,900	<1,300
Methyl vinyl ketone	<15,000	<5,200	m,p-Xylene	<11,000	<2,600
Butanal	<38,000	<13,000	o-Xylene	<5,600	<1,300
Methylene chloride	<1,100,000 ca	<320,000 ca	Styrene	<11,000	<2,600
CFC-113	<10,000	<1,300	Bromoform	<27,000	<2,600
Carbon disulfide	<81,000	<26,000	Benzyl chloride	<6,700	<1,300
Methyl t-butyl ether	<23,000	<6,500	1,3,5-Trimethylbenzene	<32,000	<6,500
Vinyl acetate	<92,000	<26,000	1,2,4-Trimethylbenzene	<32,000	<6,500
1,1-Dichloroethane	<5,300	<1,300	1,3-Dichlorobenzene	<16,000	<2,600
cis-1,2-Dichloroethene	<5,200	<1,300	1,4-Dichlorobenzene	<7,800	<1,300
Hexane	300,000	84,000	1,2,3-Trimethylbenzene	<32,000	<6,500
Chloroform	<6,300	<1,300	1,2-Dichlorobenzene	<16,000	<2,600
2-Butanone (MEK)	<38,000	<13,000	1,2,4-Trichlorobenzene	<9,600	<1,300
1,2-Dichloroethane (EDC)	<5,300	<1,300	Naphthalene	<6,800	<1,300
1,1,1-Trichloroethane	<7,100	<1,300	Hexachlorobutadiene	<14,000	<1,300

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	MW-59	Client:	Crete Consulting
Date Received:	10/27/17	Project:	T-30, F&BI 710438
Date Collected:	10/25/17	Lab ID:	710438-05 1/500
Date Analyzed:	11/14/17	Data File:	111420.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	110	70	130

	Concentration			Concentration	
Compounds:	ug/m3	ppbv	Compounds:	ug/m3	ppbv
Chlorodifluoromethane	<180	<50	1-Butanol	<3,000	<1,000
Propene	<350	<200	Carbon tetrachloride	<310	<50
Dichlorodifluoromethane	<250	<50	Benzene	<160	<50
Chloromethane	<100	<50	Cyclohexane	<3,400	<1,000
F-114	<350	<50	2-Pentanone	<1,800	<500
Isobutene	<460	<200	3-Pentanone	<1,800	<500
Acetaldehyde	<4,500	<2,500	Pentanal	<1,800	<500
Vinyl chloride	<130	<50	1,2-Dichloropropane	<230	<50
1,3-Butadiene	<110	<50	1,4-Dioxane	<180	<50
Bromomethane	<190	<50	Bromodichloromethane	<340	<50
Chloroethane	<130	<50	Trichloroethene	<270	<50
Ethanol	<3,800	<2,000	cis-1,3-Dichloropropene	<230	<50
Acetonitrile	<840	<500	4-Methyl-2-pentanone	<2,000	<500
Acrolein	<460	<200	trans-1,3-Dichloropropene	<230	<50
Acrylonitrile	<110	<50	Toluene	<190	<50
Pentane	1,500	520	1,1,2-Trichloroethane	<270	<50
Trichlorofluoromethane	<280	<50	3-Hexanone	<2,000	<500
Acetone	<2,400	<1,000	2-Hexanone	<2,000	<500
2-Propanol	<4,300	<1,700	Hexanal	<2,000	<500
Isoprene	<140	<50	Tetrachloroethene	<340	<50
Iodomethane	<290	<50	Dibromochloromethane	<430	<50
1,1-Dichloroethene	<200	<50	1,2-Dibromoethane (EDB)	<380	<50
Methacrolein	<1,400	<500	Chlorobenzene	<230	<50
trans-1,2-Dichloroethene	<200	<50	Ethylbenzene	<220	<50
Cyclopentane	<140	<50	1,1,2,2-Tetrachloroethane	<340	<50
Methyl vinyl ketone	<570	<200	m,p-Xylene	<430	<100
Butanal	<1,500	<500	o-Xylene	<220	<50
Methylene chloride	<43,000 ca	<12,000 ca	Styrene	<430	<100
CFC-113	<380	<50	Bromoform	<1,000	<100
Carbon disulfide	<3,100	<1,000	Benzyl chloride	<260	<50
Methyl t-butyl ether	<900	<250	1,3,5-Trimethylbenzene	<1,200	<250
Vinyl acetate	<3,500	<1,000	1,2,4-Trimethylbenzene	<1,200	<250
1,1-Dichloroethane	<200	<50	1,3-Dichlorobenzene	<600	<100
cis-1,2-Dichloroethene	<200	<50	1,4-Dichlorobenzene	<300	<50
Hexane	<1,800	<500	1,2,3-Trimethylbenzene	<1,200	<250
Chloroform	<240	<50	1,2-Dichlorobenzene	<600	<100
2-Butanone (MEK)	<1,500	<500	1,2,4-Trichlorobenzene	<370	<50
1,2-Dichloroethane (EDC)	<200	<50	Naphthalene	<260	<50
1,1,1-Trichloroethane	<270	<50	Hexachlorobutadiene	<530	<50

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	Method Blank	Client:	Crete Consulting
Date Received:	Not Applicable	Project:	T-30, F&BI 710438
Date Collected:	11/14/17	Lab ID:	07-2560 mb
Date Analyzed:	11/14/17	Data File:	111410.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	MP

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	98	70	130

	Concentration			Concentration	
Compounds:	ug/m3	ppbv	Compounds:	ug/m3	ppbv
Chlorodifluoromethane	<0.35	<0.1	1-Butanol	<6.1	<2
Propene	<0.69	<0.4	Carbon tetrachloride	<0.63	<0.1
Dichlorodifluoromethane	<0.49	<0.1	Benzene	<0.32	<0.1
Chloromethane	<0.21	<0.1	Cyclohexane	<6.9	<2
F-114	<0.7	<0.1	2-Pentanone	<3.5	<1
Isobutene	<0.92	<0.4	3-Pentanone	<3.5	<1
Acetaldehyde	<9	<5	Pentanal	<3.5	<1
Vinyl chloride	<0.26	<0.1	1,2-Dichloropropane	<0.46	<0.1
1,3-Butadiene	<0.22	<0.1	1,4-Dioxane	<0.36	<0.1
Bromomethane	<0.39	<0.1	Bromodichloromethane	<0.67	<0.1
Chloroethane	<0.26	<0.1	Trichloroethene	<0.54	<0.1
Ethanol	<7.5	<4	cis-1,3-Dichloropropene	<0.45	<0.1
Acetonitrile	<1.7	<1	4-Methyl-2-pentanone	<4.1	<1
Acrolein	<0.92	<0.4	trans-1,3-Dichloropropene	<0.45	<0.1
Acrylonitrile	<0.22	<0.1	Toluene	<0.38	<0.1
Pentane	<3	<1	1,1,2-Trichloroethane	<0.55	<0.1
Trichlorofluoromethane	<0.56	<0.1	3-Hexanone	<4.1	<1
Acetone	<4.8	<2	2-Hexanone	<4.1	<1
2-Propanol	<8.6	<3.5	Hexanal	<4.1	<1
Isoprene	<0.28	<0.1	Tetrachloroethene	<0.68	<0.1
Iodomethane	<0.58	<0.1	Dibromochloromethane	<0.85	<0.1
1,1-Dichloroethene	<0.4	<0.1	1,2-Dibromoethane (EDB)	<0.77	<0.1
Methacrolein	<2.9	<1	Chlorobenzene	<0.46	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1	Ethylbenzene	<0.43	<0.1
Cyclopentane	<0.29	<0.1	1,1,2,2-Tetrachloroethane	<0.69	<0.1
Methyl vinyl ketone	<1.1	<0.4	m,p-Xylene	<0.87	<0.2
Butanal	<2.9	<1	o-Xylene	<0.43	<0.1
Methylene chloride	<87 ca	<25 ca	Styrene	<0.85	<0.2
CFC-113	<0.77	<0.1	Bromoform	<2.1	<0.2
Carbon disulfide	<6.2	<2	Benzyl chloride	<0.52	<0.1
Methyl t-butyl ether	<1.8	<0.5	1,3,5-Trimethylbenzene	<2.5	<0.5
Vinyl acetate	<7	<2	1,2,4-Trimethylbenzene	<2.5	<0.5
1,1-Dichloroethane	<0.4	<0.1	1,3-Dichlorobenzene	<1.2	<0.2
cis-1,2-Dichloroethene	<0.4	<0.1	1,4-Dichlorobenzene	<0.6	<0.1
Hexane	<3.5	<1	1,2,3-Trimethylbenzene	<2.5	<0.5
Chloroform	<0.49	<0.1	1,2-Dichlorobenzene	<1.2	<0.2
2-Butanone (MEK)	<2.9	<1	1,2,4-Trichlorobenzene	<0.74	<0.1
1,2-Dichloroethane (EDC)	<0.4	<0.1	Naphthalene	<0.52	<0.1
1,1,1-Trichloroethane	<0.55	<0.1	Hexachlorobutadiene	<1.1	<0.1

Date of Report: 11/21/17
Date Received: 10/27/17
Project: T-30, F&BI 710438

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD APH

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
APH EC5-8 aliphatics	ug/m3	230	85	70-130
APH EC9-12 aliphatics	ug/m3	350	99	70-130
APH EC9-10 aromatics	ug/m3	251	103	70-130

Date of Report: 11/21/17
Date Received: 10/27/17
Project: T-30, F&BI 710438

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Chlorodifluoromethane	ppbv	10	104	70-130
Propene	ppbv	10	95	70-130
Dichlorodifluoromethane	ppbv	10	105	70-130
Chloromethane	ppbv	10	102	70-130
F-114	ppbv	10	103	70-130
Isobutene	ppbv	10	100	70-130
Acetaldehyde	ppbv	10	92	70-130
Vinyl chloride	ppbv	10	103	70-130
1,3-Butadiene	ppbv	10	105	70-130
Bromomethane	ppbv	10	103	70-130
Chloroethane	ppbv	10	90	70-130
Ethanol	ppbv	10	99	70-130
Acetonitrile	ppbv	10	105	70-130
Acrolein	ppbv	10	103	70-130
Acrylonitrile	ppbv	10	102	70-130
Pentane	ppbv	10	103	70-130
Trichlorofluoromethane	ppbv	10	101	70-130
Acetone	ppbv	10	110	70-130
2-Propanol	ppbv	10	104	70-130
Isoprene	ppbv	10	109	70-130
Iodomethane	ppbv	10	105	70-130
1,1-Dichloroethene	ppbv	10	105	70-130
Methacrolein	ppbv	10	116	70-130
trans-1,2-Dichloroethene	ppbv	10	105	70-130
Cyclopentane	ppbv	10	98	70-130
Methyl Vinyl Ketone	ppbv	10	98	70-130
Butanal	ppbv	10	120	70-130
Methylene chloride	ppbv	10	84	70-130
CFC-113	ppbv	10	99	70-130
Carbon disulfide	ppbv	10	102	70-130
Methyl t-butyl ether	ppbv	10	114	70-130
Vinyl acetate	ppbv	10	103	70-130
1,1-Dichloroethane	ppbv	10	96	70-130
cis-1,2-Dichloroethene	ppbv	10	101	70-130
Hexane	ppbv	10	96	70-130
Chloroform	ppbv	10	96	70-130
2-Butanone (MEK)	ppbv	10	107	70-130
1,2-Dichloroethane (EDC)	ppbv	10	99	70-130
1,1,1-Trichloroethane	ppbv	10	95	70-130
1-Butanol	ppbv	10	114	70-130
Carbon tetrachloride	ppbv	10	95	70-130

Date of Report: 11/21/17
Date Received: 10/27/17
Project: T-30, F&BI 710438

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ppbv	10	101	70-130
Cyclohexane	ppbv	10	99	70-130
2-Pentanone	ppbv	10	106	70-130
3-Pentanone	ppbv	10	100	70-130
Pentanal	ppbv	10	104	70-130
1,2-Dichloropropane	ppbv	10	100	70-130
1,4-Dioxane	ppbv	10	103	70-130
Bromodichloromethane	ppbv	10	99	70-130
Trichloroethene	ppbv	10	96	70-130
cis-1,3-Dichloropropene	ppbv	10	116	70-130
4-Methyl-2-pentanone	ppbv	10	109	70-130
trans-1,3-Dichloropropene	ppbv	10	122	70-130
Toluene	ppbv	10	118	70-130
1,1,2-Trichloroethane	ppbv	10	112	70-130
3-Hexanone	ppbv	10	105	70-130
2-Hexanone	ppbv	10	105	70-130
Hexanal	ppbv	10	108	70-130
Tetrachloroethene	ppbv	10	110	70-130
Dibromochloromethane	ppbv	10	114	70-130
1,2-Dibromoethane (EDB)	ppbv	10	114	70-130
Chlorobenzene	ppbv	10	97	70-130
Ethylbenzene	ppbv	10	102	70-130
1,1,2,2-Tetrachloroethane	ppbv	10	86	70-130
m,p-Xylene	ppbv	20	102	70-130
o-Xylene	ppbv	10	100	70-130
Styrene	ppbv	10	98	70-130
Bromoform	ppbv	10	94	70-130
Benzyl chloride	ppbv	10	109	70-130
1,3,5-Trimethylbenzene	ppbv	10	96	70-130
1,2,4-Trimethylbenzene	ppbv	10	100	70-130
1,3-Dichlorobenzene	ppbv	10	91	70-130
1,4-Dichlorobenzene	ppbv	10	96	70-130
1,2,3-Trimethylbenzene	ppbv	10	90	70-130
1,2-Dichlorobenzene	ppbv	10	97	70-130
1,2,4-Trichlorobenzene	ppbv	10	102	70-130
Naphthalene	ppbv	10	109	70-130
Hexachlorobutadiene	ppbv	10	92	70-130

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

710438

SAMPLE CHAIN OF CUSTODY ME 10-27-17

Page # 1 of 1

Report To Jamie Stevens

Company CRETE

Address 108 S. Washington

City, State, ZIP Seattle WA

Phone 206 799 2744 Email jamie.stevens@creteconsulting.com

SAMPLERS (*signature*) J. Steven

PROJECT NAME T.30

PO #

REMARKS

INVOICE TO J. Steven

TURNAROUND TIME
☒ Standard
☐ RUSH
Rush charges authorized by:

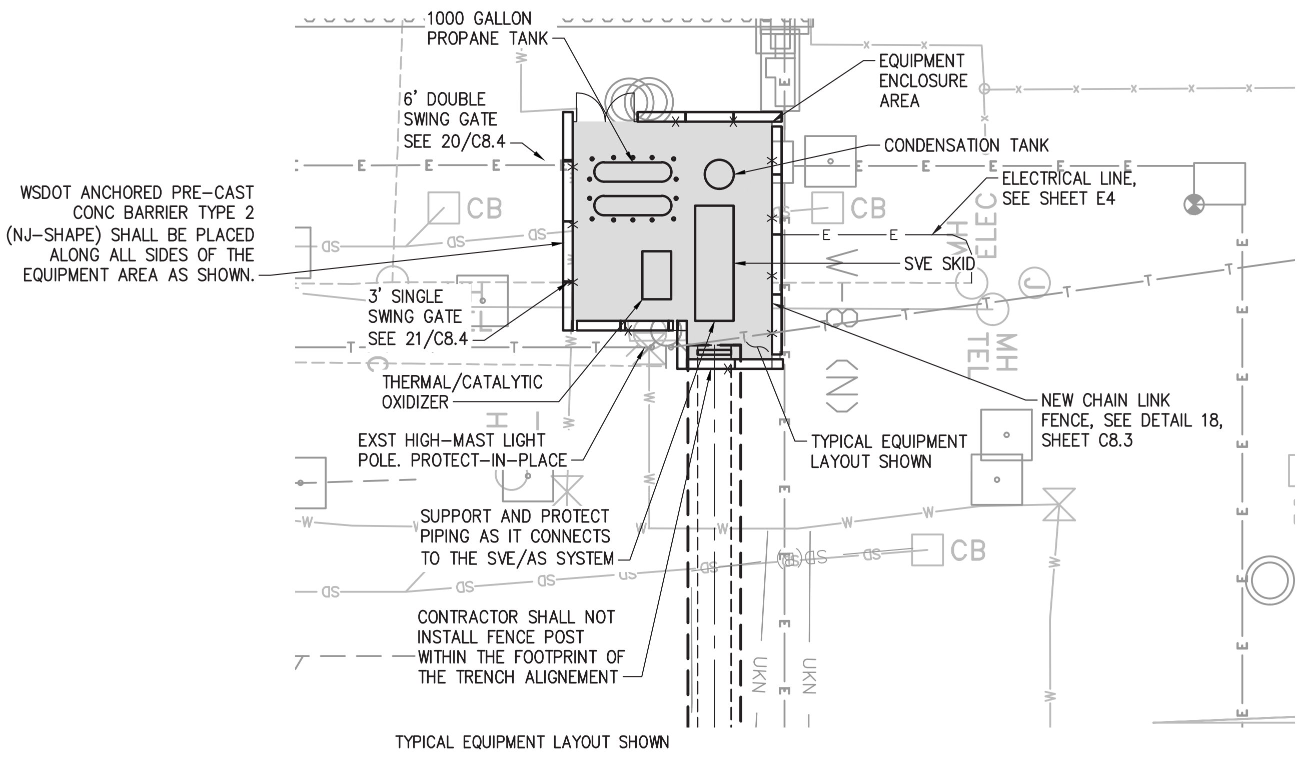
SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Archive Samples
☐ Other

ANALYSIS REQUESTED

Sample Name	Lab ID	Canister ID	Flow Contr. ID	Date Sampled	Field Initial Press. (Hg)	Field Initial Time	Field Final Press. (Hg)	Field Final Time	TO-15 Full Scan	TO-15 BTEXN	TO-15 cVOCs	APH	Notes
MW-39A	01	150		10/26	30	2015	10	2020	X			X	(PID = 30ppm)
MW-93	02	102		10/26	29	1914	8	1921	X			X	PID = 22.8 ppm
MW-36A	03	108		10/26	30	1743	10	1750	X			X	PID = 12.8
MW-42	04	18		10/25	29	1940	10	1944	X			X	TPH odor (no pid reading)
MW-59	05	104		10/25	29	2110	10	2115	X			X	start time = 2110 TPH odor
													Samples received at 20 °C

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

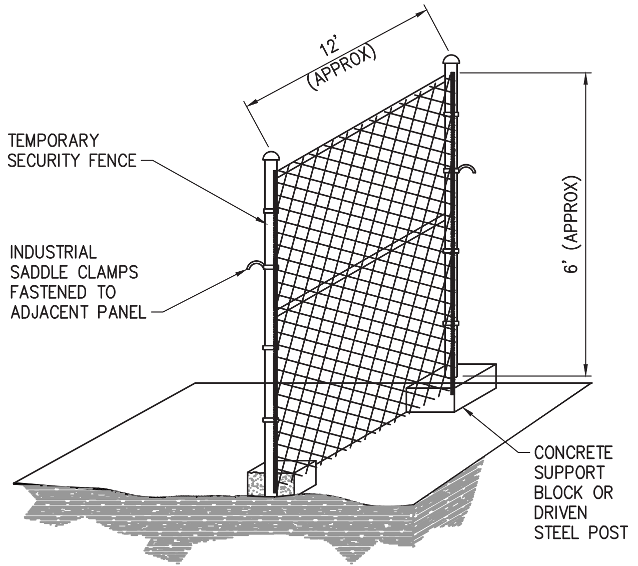
SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Jamie Ste	Jamie Steven	CRETE	10/27	9:30
Received by:	Mike Withee	Fed Ex	10-27	9:30
Relinquished by:				
Received by:	Nhan Phan	FeBI	10/27/17	10:15



PLAN

EQUIPMENT ENCLOSURE AREA LAYOUT
SCALE: 1"=20'

1"=20'-0" 20 0 20 40 Scale Feet

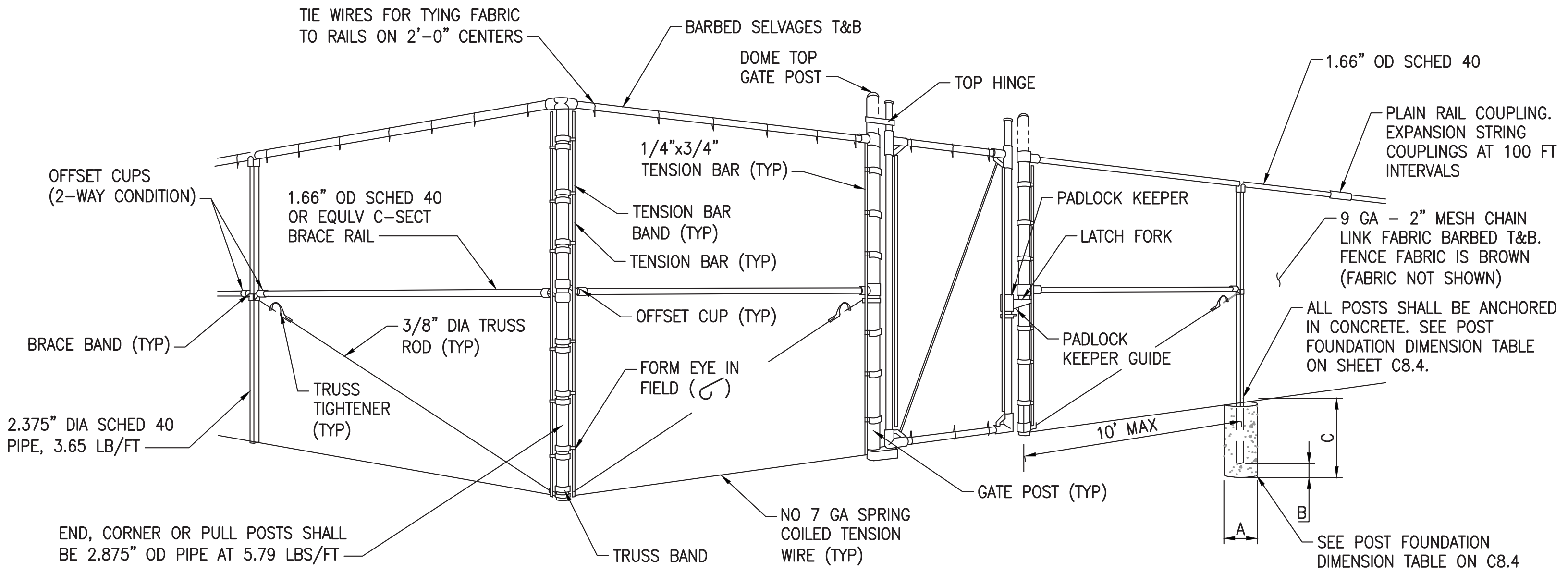


DETAIL

TEMPORARY SECURITY FENCE
SCALE: NTS
17/C2.1 17/C2.2

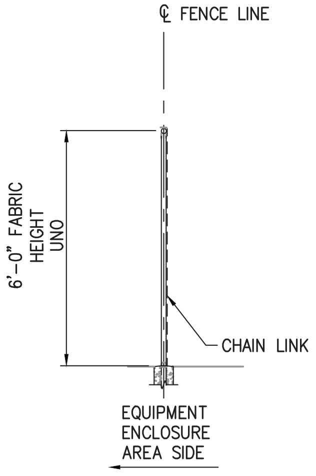
NOTES

1. ALL FENCE AND GATE FABRIC, FRAMEWORK, FITTINGS, AND TIES SHALL BE GALVANIZED AND PVC COATED, COLOR BLACK, SEE SPECIFICATIONS.
2. BOTTOM OF FABRIC SHALL BE NO MORE THAN 2" ABOVE FINISH GRADE.
3. SEE SITE PLAN FOR FENCING LOCATION.



DETAIL

TYPICAL FENCE & GATE CONFIGURATION
SCALE: NTS
18/C8.3



DETAIL

TYPICAL FENCE
SCALE: NTS
19/C8.3

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

CRETE CONSULTING, INC.
moffatt & nichol

PROJECT ENGR./ARCH:	CRETE/MOFFATT & NICHOL
DESIGNER:	JCS
DRAWN BY:	CJG
SCALE:	NONE
DATE:	5/12/18
CHECKED BY:	JCS
CHECKED/APPROVED BY:	MGB

MICHAEL G. BYERS 30698

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	8-24-17	JCS	60% DESIGN	MGB	.	.	.	.	.
2	12-6-17	JCS	90% DESIGN	MGB	.	.	.	.	.
3	5-12-18	JCS	100% DESIGN (NOT FOR CONSTRUCTION)	MGB	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

POS PROJECT MANAGER:	CATHERINE CHU
POS PROJECT ENGINEER:	
POS DESIGN ENGINEER:	
POS DRAFTER:	
POS SCALE:	
POS DATE:	
POS CHECKED/APPROVED BY:	

Port of Seattle SEAPORT FACILITIES

PROJECT NAME: TERMINAL 30 CLEANUP

SHEET TITLE: **AS/SVE SYSTEM & RECOVERY WELL DETAILS - 3 OF 4**

POS WORK PROJECT NUMBER	WP-U00212
CONSULTANT'S PROJECT NUMBER	9834
POS PROJECT TRACKING NUMBER	30-1801 C8.3

File: Q:\SEA\9834\CADD_Active_SheetSet\301801C008_3; Plotted: 5/24/2018 2:26 PM by SZARVADI, ANDRA; Saved: 5/24/2018 11:44 AM by CGREENE