REMOVAL ACTION PROJECT PLAN
FINAL DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for Submittal to

U.S. Environmental Protection Agency, Region 10

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CERTIFICATION STATEMENT

This Removal Action Project Plan has been prepared in accordance with the Administrative Order on Consent for Removal Action in the matter of the Portland Harbor Superfund Site, Gasco Facility, Portland, Oregon. U.S. Environmental Protection Agency, Region X, CERCLA Docket No. 10-2004-0068. NW Natural (a.k.a. Northwest Natural Gas Company) Respondent.

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1 INTRODUCTION 1

2 DESIGN CHARACTERIZATION 3
2.1 Physical Characterization 4
2.1.1 Identification of Sediment Zones 4
2.1.2 Surface Tar Body Extent 5
2.1.3 Physical Consistency 6
2.2 Chemical Characterization 8
2.2.1 Elutriate Testing 9
2.2.2 Disposal Suitability 10
2.2.3 General Chemical Characterization 10
2.3 Cultural Resources Characterization 12

3 REMOVAL ACTION PROJECT PLAN 13
3.1 Pre-Construction Activities 14
3.2 Removal 15
3.3 Removal Constructability Review 18
3.3.1 Physical Characteristics 18
3.3.2 In-Water Obstructions/Debris 19
3.3.3 River Elevation and Velocity 20
3.3.4 Additional Removal Issues 21
3.4 Transportation and Disposal 22
3.4.1 Sediment Drying Procedure 22
3.4.2 Offloading Facility 22
3.4.3 Subtitle C Disposal Facility 23
3.5 Pilot Capping/Cover 24
3.5.1 Pilot Cap 24
3.5.2 Fringe Cover 26
3.5.3 Cap/Cover Construction 26
3.6 Environmental Controls 27
3.6.1 Water Quality Analysis 27
3.6.2 Summary of Environmental Controls 29
3.7 Notifications and Reporting 40

4 ARAR COMPLIANCE SUMMARY 43

5 REFERENCES 44

List of Tables

Table 1 Lateral and Vertical Extents of the Tar Body Zone

Table 2 Lateral and Vertical Extents of the Visually Contaminated Zone

Table 3 Sample Analytical Summary Matrix

Table 4 Summary of Grain Size Results for Visually Contaminated and Visually Uncontaminated Zones
Table 5 Summary of Atterberg Limit Results for Visually Contaminated and Visually Uncontaminated Zones
Table 6 Elutriate Testing Analytical Summary
Table 7 Toxicity Characteristic Leaching Procedure Analytical Summary
Table 8 Chemical Analytical Results for Visually Contaminated and Visually Uncontaminated Zones
Table 9 Comparison of TPAH Concentrations in Tar and New Sediment Surface
Table 10 Dredge Water Quality Kuo-Hayes Model Simulation Results
Table 11 ARAR Compliance Summary

List of Figures

Figure 1 Vicinity Map
Figure 2 Summary of Sediment Sampling Locations in Vicinity of Tar Body
Figure 3 Lateral and Vertical Extents of Surface Tar Body
Figure 4 Dredge Plan and Cross Section Locations
Figure 5a Cross Sections at Stations 0+50 and 1+00
Figure 5b Cross Sections at Stations 1+50 and 2+100
Figure 6 Pre-Dredge and Post-Dredge Bathymetry
Figure 7 Post Cap and Cover Bathymetry
Figure 8a Inner Removal Area - Non-Rigid Containment Configuration
Figure 8b Outer Removal Area - Non-Rigid Containment Configuration
Figure 9a Inner Removal Area - Haul Barge Holding Area and Transfer Location
Figure 9b Outer Removal Area - Haul Barge Holding Area and Transfer Location

List of Appendices

Appendix A – Transportation and Disposal Plan
Appendix B – Construction Health and Safety Plan
Appendix C – Construction Quality Assurance Plan
Appendix D – Construction Water and Sediment Monitoring Plan
Appendix E – Removal Action Environmental Protection Plan
Appendix F – Monitoring and Reporting Plan annotated outline

Appendix G – Boring Logs and Station Coordinates

Appendix H – Slope Stability Analysis

Appendix I – Project Schedule

Appendix J – Drying Reagent Bench Scale Testing Results

AINW	Archeological Investigations Northwest
Anchor	Anchor Environmental, L.L.C.
AST	Aboveground Storage Tank
bgs	Below ground surface
BMP	Best Management Practice
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CHASP	Construction Health and Safety Plan
CQAO	Construction Quality Assurance Officer
CQAP	Construction Quality Assurance Plan
cy	cubic yards
DEQ	Oregon Department of Environmental Quality
DMEF	Dredge Material Evaluation Framework
DNAPL	Dense Non-Aqueous Phase Liquid
DRET	Dredging Elutriate Test
EE/CA	Engineering Evaluation/Cost Analysis
EPA	United States Environmental Protection Agency
GPS	Global positioning system
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
HSO	Health and Safety Officer
MARP	Monitoring and Report Plan
MGP	Manufactured Gas Plant
NTU	Nephelometric turbidity unit
Order	Administrative Order on Consent
OHW	Ordinary High Water
OLW	Ordinary Low Water
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
OVM	Organic Vapor Monitor
PAH	Polycyclic Aromatic Hydrocarbon
PEC	Project Emergency Coordinator
PFD	Personal Flotation Device

PID	Photo-ionization detector
PM	Project Manager
PPE	Personal Protective Equipment
ppmv	Parts Per Million by Volume
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RACR	Removal Action Completion Report
RAEPP	Removal Action Environmental Protection Plan
RAPP	Removal Action Project Plan
RAWP	Removal Action Work Plan
SAP	Sampling and Analysis Plan
SOW	Statement of Work
SSO	Site Safety Officer
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TDP	Transportation and Disposal Plan
TPAH	Total Polycyclic Aromatic Hydrocarbons
TPH	Total Petroleum Hydrocarbons
tsf	Tons per square foot
USACE	United States Army Corps of Engineers
VOC	Volatile Organic Compound
WSMP	Construction Water and Sediment Monitoring Plan

1 INTRODUCTION

NW Natural entered into an Administrative Order on Consent (Order) with the U.S. Environmental Protection Agency (EPA) on April 28, 2004 to perform a time-critical removal action at the "Gasco" site (Site) (EPA 2004a). The location of the Site is shown on Figure 1. The Order requires that NW Natural perform a number of actions associated with removing a tar body (as defined in the Order) at the surface of the nearshore sediment adjacent to the Site. NW Natural submitted the Removal Action Work Plan (RAWP, Anchor 2004a), pursuant to Section VIII.16.a of the Order. The final approved RAWP was sent to EPA on August 30, 2004. NW Natural subsequently submitted an interim deliverable on preliminary design (Anchor 2004b) in response to EPA comments (EPA 2004b) on the RAWP.

Consistent with Section 3.A of the Statement of Work (SOW, Appendix B of the Order) and Section 3 of the RAWP, planning and preliminary design of the removal action started in May 2004 and continued through November 2004, when NW Natural submitted the Draft Final Removal Action Project Plan (RAPP) to EPA (Anchor 2004c). In December 2004, it became apparent to EPA that the removal planning process would exceed 6 months. Where a 6 month planning period exists, preparation of an Engineering Evaluation/Cost Analysis (EE/CA) is required. Consequently, NW Natural was directed by EPA in February 2005 to prepare an EE/CA consistent with a Non-Time-Critical Removal Action and in accordance with EPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA 1993). Following several comment and response iterations, EPA solicited public comment on the draft EE/CA (Anchor 2005) in May and June of 2005. EPA's Action Memorandum selecting the removal action was signed on June 20, 2005. This Final RAPP provides plans and design documents for implementation of EPA's selected action.

The SOW requires that the project final design documents include:

- A presentation of all sampling results, quality assurance reviews, and other data evaluations
- Various plans to support the implementation of the removal action.

This Draft Final RAPP addresses these requirements and was developed by Anchor Environmental, L.L.C. and Sevenson Environmental Services, Inc., who is the proposed construction contractor for the project.

The results of the design characterization, including an evaluation of historical data where appropriate, are presented in Section 2. The overall requirements for the implementation of the removal action and the sequence of activities for the selected design are presented in Section 3. The other design documents required by the SOW are included as appendices to the RAPP and cited, where appropriate, in the RAPP description of the design. These documents are:

- Transportation and Disposal Plan (TDP, Appendix A)
- Construction Health and Safety Plan (CHASP, Appendix B)
- Construction Quality Assurance Plan (CQAP, Appendix C)
- Construction Water/Sediment Monitoring Plan (WSMP, Appendix D)
- Removal Action Environmental Protection Plan (RAEPP, Appendix E)
- Monitoring and Reporting Plan (MARP) outline (Appendix F)

Consistent with the schedule identified in Appendix E of the EE/CA for Alternative C (the selected alternative), the removal action implementation will commence in August of 2005, during the summer/fall construction window. This schedule is shown in Appendix I of this document. Construction is scheduled to be completed in October 2005 just prior to closure of the summer/fall construction window.

2 DESIGN CHARACTERIZATION

Sampling was performed in July 2004 in general accordance with the EPA-approved RAWP and the Sampling and Analysis Plan (SAP) appendix to that document (Anchor 2004a). As explained in the following paragraph, three additional sediment cores were collected beyond those proposed in the RAWP. The other deviation from the RAWP was that a piston-core sampler was used to collect shallow, less than 5-foot, cores at several locations because direct-push core sampler did not recover sample from the shallow sediment at several locations.

The river level was low during the characterization field work, exposing most of the tar body. The weather was dry and hot. The exposed surface of the tar body ranged from viscid to hard and included gravel-size lumps of brittle sandy tar in many locations. The tar body was considerably stiffer than, for example, typical maintenance dredge material. Workers were able to walk on the surface of the tar and drive the drilling rig onto the tar surface, with very little or no sinking into the material.

Sediment cores were collected from 20 sampling stations (Figure 2) within and surrounding the perimeter of the previously identified extent of the surface tar body. Three of the sampling stations (i.e., RAA-18, RAA-19, and RAA-20), located along the toe of the shoreline embankment within the area of coarse rip rap, were not proposed in the SAP but were added during the field sampling effort to obtain additional data for sediments/soils in the transition zone between the uplands and the nearshore zone. As the vertical extent of the surface tar body was unknown prior to the design characterization sampling, deep (i.e., 40 feet) reconnaissance cores were proposed to determine the depth of contamination and guide the sampling depths for the remaining coring stations. A single 40-foot core was advanced approximately in the middle of the surface tar body (RAA-09). Visible contamination at this location extended to a depth of approximately 16 feet below mudline, with tar extending approximately 13 feet below mudline at this location. Following discussions with EPA regarding these data, all additional cores were advanced to a depth of 20 feet below mudline. At each station, the full penetration depth was logged and the depths of the tar body zone, visibly contaminated zone, and visibly uncontaminated zone were identified. In addition, at each station subsamples were collected from each of these zones for potential physical and chemical analyses. The remainder of this section discusses in further detail the physical and chemical characterization results and the cultural resources characterization.

2.1 Physical Characterization

2.1.1 Identification of Sediment Zones

The primary objective of the design characterization sampling was to define the lateral and vertical extents of the tar body in the removal action area through visual observations. To achieve this objective, sediment cores were collected at 20 sampling stations (Figure 2) using a track-mounted Geoprobe rig (2-inch diameter core), either deployed from a barge or on land. At each station the full penetration depth of the cores was logged according to ASTM Method D 2487, with particular emphasis on identification of the tar body, visibly contaminated, and visibly uncontaminated zones as defined in the RAWP. The core logs are provided in Appendix G. In addition, core logs for previous subsurface investigations in the vicinity of the surface tar body are included in this appendix.

During evaluation of the cores, Anchor and EPA reached consensus on the depth(s) of the zones present at each station for the purposes of sampling. To maintain a consistent definition of each zone throughout the characterization, each zone was identified through the presence of particular physical characteristics. Observations of the tar body included:

- Thin tar laminations bounded by sediments
- Lenses of tar
- Somewhat soft, sticky masses of tar
- Dense brittle fragments of tar containing little or no sediments.

Observations of the visibly contaminated zone included sediments:

- Saturated (i.e., visibly detectable) dense sticky non-flowing oil (but composed primarily of sediments)
- Saturated with tar and tar-like substances (but composed primarily of sediments)
- With a heavy sheen
- With blebs of dense sticky non-flowing oil and/or tar
- With a slight sheen.

Sediments with no sheen, oil, tar, or petroleum odor noted were identified as the visibly uncontaminated zone.

2.1.2 Surface Tar Body Extent

Based on the physical definitions discussed above for defining the presence of tar body, the lateral and vertical extents of the tar body were delineated (Figure 3). The elevations and thicknesses of the surface tar body and visibly contaminated zones are provided in Tables 1 and 2. Based on these elevations and thicknesses, a dredge prism was identified as shown in Figures 4, 5a and 5b and discussed further in Section 3.2.

No tar body zone was identified in the cores (i.e., RAA-12, RAA-16, and RAA-17) located downstream from the existing dock and pipeway structures. At each of these stations the 20-foot cores showed a zone of visual contamination underlain by a visibly uncontaminated zone. Sediments at station RAA-12 were very soft near the mudline elevation leading to poor recovery at this station (i.e., no recovery from 0 to 10 feet below ground surface [bgs]). The vast majority of the surface tar body is upstream of these stations and the existing pipeway structures, with only a small portion underneath the pipeway (Figure 3). Sampling underneath the dock itself was not possible, and the presence or absence of tar in the area immediately under the dock cannot be confirmed through this sampling. However, the original diver visual survey of surface tar described in the RAWP did not find surface tar underneath the dock structure.

The presence of tar has been also noted in subsurface layers in two cores collected immediately upstream (AN 2-1 through AN 2-4) and two cores shoreward (RAA-19 and 20) of the surface tar body. The tar in these cores is covered by 1.5 to several feet of sediment or soil type material and the tar itself is approximately 1.5 to 5 feet thick (Table 1). It is notable that this tar was not present in RAA-18 and RAA-15 (Table 1), which are slightly upstream and downstream (Figure 2) of RAA-19 and RAA-20. Further, this tar is not present in RAA-08 (Table 1), which is just riverward of RAA-19 (Figure 2). It is possible that there is a connection between buried tar in RAA-19 and 20 close to the shoreline and the surface tar body residing above the river sediments. However, if there is a connection between these tars, it is confined to a narrow lateral region that runs in between these surrounding cores.

Even if there is a component of buried tar within the shoreline materials, it does not represent either a current or future potential direct exposure to aquatic organisms as may be presented by the surface tar body as described in the SOW. Upon removal of the surface tar body, it is likely that a layer of tar material approximately 1.6 to, at most, 5 feet thick may be bisected by the cut line. Because this approach will result in a net reduction in the exposure of surface tar, and the entire area will be covered with sand (as described below), removal of the surface tar shown in Figure 3 will meet the objectives of the SOW.

As noted in the core logs (Appendix G) and Table 1, there was lack of recovery in a number of cores. Where there were gaps in core recovery, the entire core was examined for the deepest location of observed tar. In these cases, it was assumed that tar was present in all unrecovered segments above this level. Where a gap existed below observed tar within a single four foot core tube, it was assumed that tar was present until the end of that tube. This method provides the maximum possible estimate of the vertical extent of continuous tar that may be present at these locations, where tar was observed at that station.

2.1.3 Physical Consistency

Field observations and laboratory results (discussed below) indicate that the physical characteristics of the tar and sediments within the removal action area are spatially heterogeneous. At most stations substantial hydraulic pressure was needed to advance cores into the material as indicated by the automatic triggering of the piston hammer on the coring device. This indicates in most locations the tar and related material were relatively stiff at least within some layers at that location. In contrast, the surficial material at five sampling stations (i.e., RAA-02, RAA-03, RAA-07, RAA-13, and RAA-14) was mostly soft material that was likely deposited alluvial sediment or other soft material. At these locations, the direct-push coring device penetrated as much as 10 feet under little pressure or its own weight. In some of these instances no sample was recovered in shallow depths, which suggests that soft sediment or material deformed around the device rather than entering the core barrel.

The physical characteristics of the tar material were spatially heterogeneous and varied in consistency from soft, sticky, plastic, stiff and firm, to brittle. The brittle material is generally gravel-size lumps of tarry sand that appears to have weathered. Much of the brittle tar is found on the sediment surface and was generally found at stations closer into the shoreline in areas that have been exposed to air during low flow conditions. Small pieces of this material were also found at depth in some cores. During fieldwork the low water levels exposed some areas of weathered tar above the water line. This material was stiff enough to walk on and support the weight of the track-mounted Geoprobe rig. Most of the tar present below this weathered layer was a softer consistency. Although it smears on surfaces it touches, it is too viscous to flow noticeably and the intermixed sands and non-plastic silt/sands prohibited it from acting viscid when sheared in place. None of the tar layers identified exhibited a noticeable sheen.

The visually contaminated zone varied in consistency from sediments with a slight hydrocarbon odor, slight sheen, slight oil staining, and minor blebs of dense sticky non-flowing oil and/or tar to sediments with more extreme hydrocarbon odor, heavy sheen, and sediments more heavily saturated in dense sticky non-flowing oil and/or tar blebs. No free hydrocarbon product beyond small scattered oily blebs was identified in any of the cores either in tar or in visually contaminated sediments. All oily sediments encountered were dense and sticky, felt viscous to the touch were intermixed in a mostly sand/silt matrix and did not flow noticeably during the core cutting and sampling procedure. It should be noted that, although sediments from this zone contained light to heavy sheen in several cores, only small amounts of sheen were occasionally observed on the water surface due to the physical disturbance caused by the core collection activities (including grounding and spudding barges on the tar body). Therefore, the potential for excessive sheening during the removal action is expected to be low.

Following completion of the sampling and evaluation of the core logs, several samples containing a substantial visual fraction of silts and clays were submitted for Atterberg limits tests, and percent fines analysis were performed on four samples to obtain additional information on the consistency of material in the visually contaminated and uncontaminated zones with a substantial fraction of silts and clays. A matrix

summarizing the samples submitted for physical and chemical analysis is provided in Table 3. The grain size characteristics and Atterberg limits results are provided in Tables 4 and 5, respectively. These results are consistent with visual observations discussed above. Most of the samples are predominately sand (for all samples the average sand or coarser material content is 51 percent) and are consistent with the substantial resistance found at many locations during coring. Similarly, most of the Atterberg tests results were "non-plastic" indicating that the fined grained material will not act as cohesive sediment. In three cases some plasticity, although limited, was observed (Table 5).

A representative tar body sample from station RAA-07SD was analyzed for total solids and specific gravity to quantify the buoyancy of tar body fragments potentially mobilized into the water column during dredging. The specific gravity of this sample was 1.23 g/ml. This is somewhat denser than water and would indicate that tar particles released into the water column would sink over time.

In addition, a bench scale test was conducted with representative samples of surface tar/sediments to estimate the amount of drying reagent that would need to be mixed into the material to pass paint filter test and a bearing capacity of 1 ton per square foot (tsf), which are two requirements for disposal at the disposal facility (see Section 3 for details on disposal facility and sediment drying process.) The results of this test are shown in Appendix J. In summary, approximately 5 percent (by weight) Portland cement will meet the 1 tsf requirement in one day of curing time. Greater than 5 percent cement may be needed to pass the paint filter test in the same one day curing time and/or a greater curing time may be needed. Paint filter tests will be conducted in the field during the operation to refine the cement additive and curing time requirements as the project progresses.

2.2 Chemical Characterization

At each sampling station, a subsample was collected from within each identified zone (i.e., tar body, visibly contaminated, and visibly uncontaminated) for potential chemical analysis. The objectives of this characterization were to evaluate potential water quality impacts at the point of dredging, the disposal suitability of any removed materials, and the chemical

concentrations within and below the visibly contaminated zone. Because the removal action objectives defined in the SOW require the removal of the visible extent of the tar body, the purpose of obtaining chemical concentrations from the sediment zones underneath the tar was to understand the chemical characteristics of the post-removal surface that could be created by removing the overlying tar. The purpose of analytical data was not to identify the vertical extent of the removal (which is based on the visual presence of tar), because chemical concentration-based criteria or goals are not an objective of this removal action.

In accordance with the SAP, all samples were shipped to the laboratory and archived until evaluation of the boring logs was completed to determine which samples provided the most spatially and physically representative samples. A matrix summarizing the samples submitted for chemical analysis is provided in Table 3. All samples were collected and analyzed in accordance with the EPA-approved Quality Assurance Project Plan (QAPP), which is an appendix to the RAWP (Anchor 2004a).

2.2.1 Elutriate Testing

To provide information for a detailed removal water quality analysis (described in Section 3.6.1) two samples were collected from both the surface tar body (stations RAA-11 and RAA-13) and visibly contaminated zones (stations RAA-03 and RAA-11) (Figure 2) and analyzed using the U.S. Army Corps of Engineers (USACE) Dredging Elutriate Test (DRET) method (DiGiano et. al 1995). The elutriate water samples obtained from the DRET procedures were analyzed for Semi-Volatile Organic Compounds (SVOCs) by EPA Method 8270, Volatile Organic Compounds (VOCs) by EPA Method 8260, total petroleum hydrocarbons (TPH), total and amenable cyanide by EPA Method 9010, and total and dissolved arsenic, chromium, copper, nickel, lead and zinc by EPA Method 6010. The DRET method is intended as bench scale simulation of conditions that might be present in the water column very close to the dredge (within a few feet). This information can be used in quantitative evaluations of potential water quality impacts associated with dredging. This analysis is presented in detail in Section 3.6.1.

The results of the DRET are summarized in (Table 6) and compared against appropriate water quality guidelines that are discussed further in Section 3.6.1. Several PAH and BTEX compounds were detected in both the tar body and visually contaminated

sediment elutriate waters. It was also noted during elutriate testing of tar samples that a light sheen was visible at the surface of the test vessel after the elutriate procedure was conducted. This sheen was light and did not have a measurable thickness of non-aqueous phase liquid. No such sheen was observed in DRET analyses for visually contaminated sediments. The presence of detected chemicals in the elutriate test water is consistent with the presence of a visible sheen in the tar DRET tests. These laboratory observations are also consistent with field observations of some small scale sheening that occurred during design characterization sampling.

2.2.2 Disposal Suitability

As directed by EPA, samples of the tar body were analyzed following the Toxicity Characteristic Leaching Procedure (TCLP) to profile the material for disposal. The results are presented in Table 7.

Results in Table 7 are compared to hazardous waste criteria promulgated with the TCLP test method. The two tar body samples had benzene results greater than the relevant criterion. As noted in the RAWP, Manufactured Gas Plant (MGP) waste is not a hazardous waste under federal or state law. EPA's January 14, 2005 site-specific disposal performance criteria require the disposal facility receiving dredged material from this project to be constructed with multiple liners, a leachate collection system, and a leak detection system. Only Subtitle C hazardous waste landfills, such as the Chemical Waste Management of the Northwest (CWMNW) landfill in Arlington, Oregon, would typically meet the leak detection performance standard, which is a minimum technological requirement for Subtitle C landfills. 40 C.F.R. §264.301(c). For this reason, Alternative C was recommended in the EE/CA (Anchor 2005) over Alternative D, which proposed disposal at a Subtitle D solid waste landfill.

2.2.3 General Chemical Characterization

Select samples of the visually contaminated and visually uncontaminated sediments underneath the tar body were analyzed for bulk sediment chemistry (Table 3). The purpose of collecting these data was to understand the concentrations of chemicals in sediments that might be incidentally removed with the tar due to design or construction

logistical considerations, as well as sediments that might remain after the tar is removed. The chemistry results are presented in Table 8.

The visually contaminated sediments have relatively high organic carbon content (likely associated with the presence of oil and tar blebs) and TPH and PAH concentrations, whereas the visually uncontaminated sediments contain relatively normal levels of organic carbon for river sediments and substantially less TPH and PAH. Neither sediment zone has elevated levels of metals. Cyanide was detected in visually contaminated sediments. Cyanide was not detected in seven out of 11 visually uncontaminated sediment samples and was detected at low levels below the detection limit only in the remaining four of these samples. Most volatile chemicals were not detected in both sediment layers, except BTEX compounds, which were often detected in the visually contaminated sediments. It is notable that BTEX compounds were not detected in the deeper visually uncontaminated sediment layers, with only a few low level exceptions.

One of the removal action objectives identified in the SOW is to remove the surface tar body to a depth that leaves a surface of lesser total polycyclic aromatic hydrocarbons (TPAH) concentrations. The delineation of the tar body is based on visible criteria, and the removal of the tar body will achieve this objective. The primary factors in identifying the dredge prism to achieve this objective are the vertical extent of the tar body, based on descriptions of the sediment cores, and slope stability for dredging. The dredge prism based on these considerations is shown in Figure 4 and is described in more detail in Section 3.

A comparison of the tar TPAH concentrations to the concentrations in sediments that would comprise the new sediment surface after removal based on the dredge prism is shown in Table 9. Historical sample SD-7 is shown in Table 9 as representative of tar material. The exact location of SD-7 is unclear from historical documentation on this sample, and therefore cannot be accurately mapped relative to this design characterization. However, logs associated with SD-7 describe tar in the sample, and this sample provides an approximate level of TPAH in tar material. The new surface would include both visually contaminated and visually uncontaminated materials based

on the dredge prism shown in Figure 4. The results for samples representative of this new surface as shown in Table 9 range from less than 0.01 percent to 2.04 percent TPAH with an average of 0.67 percent TPAH, while the SD-7 tar sample contained 2.64 percent TPAH.

2.3 Cultural Resources Characterization

Archeological Investigations Northwest, Inc. (AINW) determined that sediment cores advanced 50 feet shoreward or riverward of the ordinary low water line (7.91 feet NAVD 88) (Figure 2) should be inspected by AINW for evidence of cultural resources at the Site. Ten stations fell within the 50 foot distance, and AINW was on-site to evaluate each of those cores. No evidence was found to indicate that there are cultural resources at the Site. AINW has written a cultural resources characterization report per the RAWP (AINW 2004) and this report has been submitted to EPA (November 2004). AINW will be present to inspect the nearshore portion (50 feet shoreward or riverward of the ordinary low water line) of the excavation during the removal activities.

3 REMOVAL ACTION PROJECT PLAN

The following general sequence of activities will occur to perform the removal action:

- Pre-construction mobilization and meeting
- Set up of location controls (e.g., station lines and staff gauge)
- Set up of environmental controls at the Site and upland transfer facility (e.g., silt curtains, skirts, oil booms, and spill aprons at the dredging location and spill plates, pad tarps, curbing, a loading hopper, and a wheel washing area at the transfer facility)
- Piling removal, dredging, dewatering (i.e., sediment drying), barge transport, upland transport and disposal
- Equipment decontamination
- Capping/cover placement
- Removal of environmental controls.

Consistent with the schedule in the EE/CA and shown in Appendix I, the removal action will start in August of 2005 within the summer construction window. Construction is scheduled to be completed in October 2005 just prior to closure of the summer/fall construction window. If, due to unexpected project delays, it appears there is a potential for not meeting this schedule the following measures could be taken:

- Increase the number of days per week worked
- Extend the work day within daylight hours
- Extend the work into night time for some activities, but only where such work can be conducted safely and will not violate local noise and light ordinances
- Seek an exemption from the Services for some or certain types of work outside the summer/fall work window immediately after October 31 (NOAA Fisheries has indicated that such an exemption is unlikely)
- Modify some objectives, design parameters, or requirements of the project so that work is completed in this summer/fall work window.
- Complete the work in the next summer/fall work window

Any measures being considered will be determined in coordination with EPA before any action is taken.

Environmental controls will be employed at each step of the project described in the following sections. The environmental controls for each step are summarized together in Section 3.6 and detailed in RAEPP (Appendix E). Water quality monitoring applicable to each step of the process is described in the WSMP (Appendix D).

The CHASP (Appendix B) contains health and safety information regarding the potential for volatile air emissions due to the likelihood of encountering elevated concentrations of benzene during the removal activities. Air will be monitored and compared to OSHA required levels during dredging in the removal action area and during material handling at the upland transfer facility. One to two action levels will be used for each measurement (Appendix B). If volatile air emissions exceed lower action levels, the following types of contingency measures will be taken either singly or in combination:

- Slowing pace of work
- Covering dredged and/or dried sediments
- Slowing the addition of drying reagents
- Using of air-purifying respirators for workers close to the source of vapors
- Implementing dust suppression measures for dust related issues.

If higher action levels are exceeded, then activities will cease and workers will proceed to a designated rally point outside the decontamination zone (as defined in Appendix B) and contact the health and safety manager. The health and safety manager will coordinate with NW Natural and EPA to determine whether construction must proceed under additional or alternate health and safety procedures.

3.1 Pre-Construction Activities

Section 5 of the SOW requires notification to EPA 30 days prior to construction start. Due to the tight timeline in the current schedule (Appendix I), NW Natural proposes to notify EPA 17 days prior to construction start.

Prior to August 25, 2005, the construction contractor will commence construction preparations including mobilizing equipment, setting up location controls, preparation of the transfer facility site and setting up support equipment at the Site prior to holding the preconstruction meeting. The preconstruction meeting will be held on or prior to August

25, 2005 and before placing any in-water containment (e.g., silt curtains) and subsequent removal activities. EPA and all partner agencies will be pre-notified of the time and place of the preconstruction meeting, which will include conference call access. At the preconstruction meeting, Anchor and the construction contractor will:

- Review methods and individual responsibilities for documenting and reporting data and compliance with the RAPP including methods for processing design changes and securing EPA review and approval of such changes as necessary.
- Review methods for distributing and storing documents and reports.
- Review CHASP work areas as well as security and safety protocols. The CHASP (Appendix B) will be reviewed in detail; all personnel will have an opportunity to raise questions about the removal plan and the health and safety protocol, and all personnel who will be working in the exclusion and decontamination zones will sign the acknowledgement of familiarity with the requirements of the CHASP.
- Demonstrate that construction management is in place, and discuss any appropriate modifications of the CQAP (Appendix C) to monitor that project specific considerations are addressed.
- Discuss methods for direct measurement, including confirmation sampling of construction work to be used to monitor that performance standards are met. The responsibilities of the construction contractor to perform construction quality control, and the responsibilities of Anchor to perform construction quality assurance will be reviewed.
- If requested by EPA, conduct a Removal Action Area tour with EPA in the project area to verify that the RAPP contents are understood and to review material and equipment storage and operation locations, as appropriate.

3.2 Removal

The removal plan, based on field observations from the design characterization and previous investigations, is shown on Figures 4 and 5a and 5b. The estimate of the volume of material to be removed is 14,000 to 15,000 cubic yards (cy) including an allowable overdredge of 6 inches. Environmental controls described in Section 3.6 will be used throughout the removal process. Water quality monitoring described in the WSMP (Appendix D) will be conducted throughout the removal process.

The proposed pre- and post-removal bathymetry is shown in Figure 6. The removal plan includes 2.5 horizontal to 1 vertical (2.5H:1V) slopes based on a slope stability analysis (detailed in Appendix H). Static slope stability conditions were modeled using the computer software Slide (version 5.0). The program calculates the factor of safety against slope instability for a two-dimensional cross section. Based on this analysis, the proposed 2.5H:1V dredge cut is considered to be stable under static conditions. Removal work will be accomplished using a dredge bucket. Removed material will be placed directly on sealed floating haul barges.

To effectively remove the deeper outer limits of the surface tar body and maintain stable 2.5H:1V dredge slopes, significant dredging below the extent of surface tar body is required (see Figures 4, 5a, and 5b). This design results in a bathymetric low spot (even after cap and cover placement as described in Section 3.5) that can be monitored long term for any seepage that may occur. The long term Monitoring and Reporting Plan (MARP; outline in Appendix F) will include regular sampling (via methods to be determined in the MARP) and visual observations through the cap and cover in the removal area to assess whether seepage may be occurring. The monitoring methods used will be able to measure seepage regardless of whether seeping material is denser or lighter than water, because either type of material would first seep through the cap material and will be observable in sediment samples. In addition, visual monitoring including diver surveys would detect any seepage that is floating free to the surface or "rolling" along the new sediment surface. These or similar methods will be detailed in the MARP. In addition, the MARP will describe that if seepage is observed, contingency actions may be taken at that time including, but not limited to:

- Additional monitoring/observations for confirmation of results
- Placement of additional cap material
- Placement of other types of cap material such as organoclay layers
- Additional removal of cap and/or seepage source.

The MARP will be submitted to EPA within 60 days of EPA approval of the Final RAPP (per the RAWP). As shown in Appendix I, the anticipated date for MARP submittal to EPA is October 3, 2005.

It is assumed for the purposes of this RAPP that dredging will start at the top of the slope and work outward toward the river. However, there may be instances where the contractor will have to first dredge short cuts further offshore to accommodate equipment drafts for access. Water levels during the construction period will likely control the contractor's removal approach.

Either during or following completion of filling of the transfer barge, the material will be re-handled via a second derrick into a haul barge (following environmental controls specified in Section 3.6). Once a haul barge is filled it will be pushed from the Site to the upland transfer site. Sediment drying and transfer operations are discussed in Section 3.4.

The construction contractor will be responsible for providing the equipment and labor to remove the specified material on schedule, while following specified environmental controls and contingency measures. The construction contractor will demonstrate, through bathymetric survey or soundings that the specified material has been removed to the specified vertical extents. At the end of the removal, the construction contractor will perform a bathymetric survey to document conditions at the Site prior to placing the cover or pilot cap. A final removal bathymetry survey will also be conducted by an independent third-party surveyor. Based on this information, EPA will make the final verification regarding the completion of the dredge prism described in this RAPP.

Anchor will review the construction contractor's operations and data to monitor compliance with the design (described in the CQAP in Appendix C), and review bathymetry results prior to the contractor starting capping to verify that the appropriate dredge prism was removed. The responsibilities of the construction contractor and Anchor and the methods of monitoring compliance with the removal elevations are described in greater detail in the CQAP (Appendix C). The CQAP also requires the contractor to prepare a separate quality control plan, which will propose specific measurements and methods to confirm that removal objectives are being achieved during the course of the removal action. The contractor CQAP will be provided by the contractor to the design engineer at least 15 days prior to the start of work.

3.3 Removal Constructability Review

3.3.1 Physical Characteristics

As discussed in Section 2.1.3, the physical consistency of the material to be removed is spatially heterogeneous within the defined dredged prism (Figure 4). In a few locations the material to be removed is relatively soft. In most locations the material is relatively firm and often contains substantial fine to medium coarse sands that are non-plastic. In some locations the tar fraction in the surficial sediments was weathered and very stiff and/or firm whereas at other locations the tar was more viscid. These data indicate that a conventional clamshell bucket would be the most efficient technology for removal. This type of bucket has the capability to remove a range of sediments from soft silt-like materials to stiff and/or firm materials more similar to sands.

During preliminary design, one potential technology that was evaluated was the use of a Cable Arm bucket. These closed dredge buckets remove soft sediments very well, and some evidence suggests that under these conditions these devices can reduce the amount of resuspension during removal. However, because these buckets weigh about half as much as traditional clamshell buckets, they do not work well in stiffer materials or sandy sediments. Under these conditions the bucket digs poorly and often does not close properly. Two recent examples where these problems occurred were identified in (1) the East Waterway in Elliot Bay, Washington, where a closed bucket was attempted, but was found to dig poorly and did not substantially improve water quality compliance downstream; and (2) Ketchikan Pulp in Alaska, where a closed bucket worked well in extremely soft sediments, but a standard bucket was needed to dredge more compacted firmer sediments. Closed buckets also do not close when debris is encountered and becomes lodged in the jaws of the bucket. Given the limited ability of this type of bucket to remove stiff sediments, it would likely not have the ability to penetrate the predominantly sandy sediment layers or the firmer weathered and stiff tar layers identified in portions of the removal area. However, use of closed cable arm bucket will at least be attempted during the removal. The contractor will consult with EPA on the need to switch to a standard clamshell bucket (at either all or part of the area dredging) if the closed bucket causes any of the following types of issues that cannot be resolved by use of best management practices:

- The closed bucket cannot meet the minimum production rates assumed in the project schedule (as described in Appendix A) due to inefficient digging.
- The closed bucket cannot effectively penetrate any harder areas of tar or sandy sediments.
- The closed bucket causes unacceptable resuspension due to inefficient digging, loss of material through improperly closed jaws, or similar types of problems.

Although sediments saturated with dense viscous non-flowing oil were identified at some locations, there were no layers encountered that contained continuous free phase hydrocarbons in the absence of a sediment matrix. As noted in Section 2, samples with saturated oil did not flow during the course of the core cutting and sample processing. In addition, during design characterization sampling, the barge was beached on the tar body, the track mounted corer was driven across the tar body in numerous areas, and the barge was anchored via spuds extending through the tar body in numerous areas. Despite these activities, only minimal sheen was observed. These data suggest that the removal will not release large quantities of free product into the water column and that temporary containment barriers such as silt curtains, floating skirts, and oil absorbent booms will be sufficient to contain the sheens that will likely be produced during the removal action (see Section 3.6). This determination is further supported by analyses described in the EE/CA (Anchor 2005). However, as discussed in Section 3.6 and the RAEPP (Appendix E), contingency measures (termed "additional controls") have been planned for and will be deployed in the event that sheens or substantial free product is encountered.

3.3.2 In-Water Obstructions/Debris

Based on field observations during the design characterization sampling and historical photos of the removal action area, it is not anticipated that substantial surface or subsurface debris will be encountered during the removal action. During coring, there were no instances where abrupt refusal was encountered or penetration of the core barrel progressed abnormally slow indicating the presence of debris. Similarly, no layers of decayed wood or other debris materials were encountered in any cores.

The only identified in-water obstructions include five clusters of piling (Figure 4). There are three piles at four of the locations and two piles at the fifth location totaling 14 piles. Each of the 14 piles will be pulled prior to dredging in these locations. If a pile breaks at or below the mudline, the remainder of the pile will be removed during the dredging operation. This removal will be accomplished using one of the available mechanical buckets.

3.3.3 River Elevation and Velocity

Much of the surface tar body was exposed during the design characterization (July 2004) due to low water level elevations. Similar water elevations levels will likely be encountered during the summer work window (late August and September, particularly). The water stage elevation is influenced by upstream reservoir regulation on the Columbia and Willamette Rivers, natural stream flow from these rivers and tributaries, and tidal effects. The Army Corps of Engineers (2004) analyzed and summarized the river stage elevations at the Morrison Street Bridge USGS gage (station 14211720) over a 30-year period (from 1973 to 2003). The elevations are identified during August, September, and October when in-water construction activities are proposed. The data is presented in minimum and maximum daily stages, minimum and maximum monthly stages, mean monthly stages, and minimum and maximum extreme stages for these months over the 30-year period. In addition, hourly water surface elevations for 2002 and 2004 (only years with hourly elevation records) at the Morrison Street Bridge gage during August, September and October were reviewed (NOAA 2005) to determine both the elevations during these months and typical daily tidal variations. Based on this information, the water surface is likely to range from between 5 to 13 feet NAVD 88 throughout the in-water construction activities. This variation would lead to surface elevations of the tar body submerged beneath approximately 0 to 48 feet of water. Daily tides at the Site are anticipated to range between approximately 3 to 4 feet.

Removal from areas above the water line will be accomplished using the same basic water-based equipment and approach described throughout this document for underwater removal. Specifically, the dredge bucket will be deployed over the exposed (above the waterline) sediments, dropped down onto those sediments, and then retrieved. The water quality issues for removal above the water line are fewer, and the

bucket may be allowed to impact exposed sediments at a higher speed to improve dredging efficiency. Otherwise all operational best management practices described later in this document will be employed for removal of exposed sediments. The derrick crane will have a limited reach. Consequently, in some cases the derrick may need to "dredge into" higher exposed areas and or wait for higher river or daily tide conditions to access the highest elevation sediments.

Based on historical river discharge data obtained from the Morrison Street Bridge USGS gage (station 14211720) and the channel morphology in the vicinity of the Site, the anticipated range of water velocities in the removal action area is about 0.1 to 0.3 fps during the period from August to October (see Appendix H for details). Based on experience with silt curtains in similar river environments and consultation with silt curtain suppliers, river velocities in excess of 1 fps require very aggressive anchoring systems that decrease the ability to move and position the silt curtains to different areas. The silt curtains as detailed below are designed to withstand up to 1 fps as a safety factor above the expected maximum of 0.3 fps. The monitoring and response scenarios for elevated river velocities are discussed in Section 3.6 and the RAEPP (Appendix E).

3.3.4 Additional Removal Issues

As discussed in Section 2.1.2, no tar body zone was identified in the cores (i.e., RAA-12, RAA-16, and RAA-17) located downstream from the existing dock and pipeway structures. The vast majority of the tar body is upstream of the dock and pipeway. The vertical clearance beneath the pipeway is limited, so that a derrick with a dredge bucket would not be able to easily navigate under the pipeway. Therefore, to minimize the impacts of this structure on the removal, the dredge prism cut was set directly underneath the pipeway structure (Figure 4). Dredging will proceed to the appropriate depths at this edge of the dredge prism and the resulting slope will be allowed to come to equilibrium at the natural angle of repose. For depiction purposes only, Figure 4 shows a 1V:1H slope assuming that the angle of repose will likely approach this angle.

In addition, the as built drawings of the dock and pipeway supports were evaluated for potential impact of the removal on these structures. These supports penetrate sufficiently deep that dredging nearby at the current mudline to the depths shown in

Figure 4 (including resulting movement to the angle of repose) will not adversely impact these structures. As shown in Figure 4, a 15 foot buffer will be observed around these structures to ensure they are not physically contacted by the dredge bucket or crane. Because material will move to the angle of repose, this buffer should allow for the efficient removal of tar and sediments immediately adjacent to these structures. Regardless of these buffers, care will be taken when dredging in and around the supports at all times so that they are not physically contacted by the dredge bucket or crane.

3.4 Transportation and Disposal

Transportation and disposal of dredged materials is described in the TDP (Appendix A). The environmental controls applicable to the sediment drying procedure and offloading facility are described in the RAEPP (Appendix E). This section provides an overview of the transportation and disposal activities.

3.4.1 Sediment Drying Procedure

As the material is dredged, it will be loaded into sealed haul barges. Drying will be conducted by adding a drying reagent (e.g., Portland cement) to the material in the barge using a crane-operated bucket. The reagent and dredged material will be thoroughly mixed using the bucket in the barge. Based on the sediment drying bench scale test (see Section 2.1.3), a minimum of 5 percent (by weight) of drying reagent will be added to meet the 1 tsf requirement. Compliance with the paint filter test will be determined in the field. Procedures for paint filter testing are described in the TDP (Appendix A). Because curing time is a factor in the ability to pass the paint filter test, tar/sediment not passing the paint filter test may be allowed to leave the Site in anticipation of additional curing in the barge while in transit to the transfer facility. In this case, additional paint filter testing would be conducted once the barge arrives at the transfer facility (prior to offloading) and additional drying reagent may be added to the barge at the transfer facility, where necessary to pass the paint filter test.

3.4.2 Offloading Facility

The dried material will be transported to the Tidewater Marine facility at the Port of Morrow, Oregon, to be offloaded from the haul barge onto trucks for transportation to

the disposal facility. Even after drying reagent addition and mixing, free water can occur due to compaction/vibration of material in transit and or due to rain falling on the material. If free water is identified in the haul barge upon arrival at the offloading facility (or material left the Site not passing the paint filter test), additional drying reagent will be added to the barge from temporary upland holding containers using a bin suspended from the transfer crane.

The volume or weight of the dredged material will be recorded onto a weigh ticket when the material is loaded onto trucks. The material will be trucked directly to the disposal facility. The disposal facility will verify receipt of the shipment and record the time that the shipment is received. The disposal facility will also record the weight of the shipment. The weekly progress reports will contain a summary of the material removed from the Site and received at the disposal facility. The location of the offloading facility and a schematic showing the offloading is provided in the TDP (Appendix A).

3.4.3 Subtitle C Disposal Facility

The dredged material will be transported from the Site to the CWMNW landfill in Arlington, Oregon, by barge and then by truck. The transportation will occur in the following stages:

- Transport by barge to the Port of Morrow (operated by Tidewater Marine) near Boardman, Oregon, where the material will be unloaded from barges and loaded into trucks for transportation to the landfill
- Transport by truck from the Port of Morrow dock to the CWMNW Subtitle C landfill near Arlington, Oregon, for disposal.

CWMNW has two requirements for accepting the material for disposal:

- The waste must pass the Paint Filter Test to demonstrate that there is no free liquid
- The waste must have a minimum loading bearing capacity of 1 tsf.

As noted above, a minimum of 5 percent Portland cement will be added to the dredged material in order to meet the loading bearing capacity of 1 tsf. The ability to pass paint

filter test will be monitored in the field, so that the amount of cement and curing time can be adjusted as necessary.

The CWMNW landfill satisfies all of the performance standards required by EPA's letter of January 14, 2005 that are applicable to Subtitle C disposal sites and/or as required in regulations governing the operation of Subtitle C disposal facilities (as detailed in the TDP, Appendix A). CWMNW is also operating in compliance with its hazardous waste operations permit as required for CERCLA waste by the Off-Site Rule.

3.5 Pilot Capping/Cover

Following completion of the removal and disposal activities described in Sections 3.2 and 3.4, cover/capping material will be placed over the removal area as shown in Figure 7. The pilot cap will be placed in the center of the removal area and cover material will be placed on the fringe slopes around the capping area (Figure 7). The pilot cap and then the fringe cover are discussed in the next two subsections. Environmental controls will be employed during cap/cover placement and are described in Section 3.6 and the RAEPP (Appendix E). Water quality monitoring as described in the WSMP (Appendix D) will be conducted throughout cap/cover placement.

All materials used in cap/cover placement will meet the requirements established in the December 2003 Technical Plans and Specifications (Ecology and the Environment 2003) for the McCormick & Baxter sediment cap located within the Willamette River. Specifically, the "cap material to be used for construction of the sediment cap will be imported, clean, granular material free of roots, organic material, contaminants, and all other deleterious and objectionable material."

3.5.1 Pilot Cap

The purpose of the pilot cap is to place a barrier over the removal area of the Site that can be monitored, while possible remediation alternatives of other surrounding sediments are determined. The monitoring information collected will be used to help understand the potential effectiveness of capping as long-term remedial action for portions of the Gasco sediments. The cap is designed (as discussed below) to withstand

erosive forces that might reasonably be expected over the next few years. It is not intended as a long-term remedy for this area.

The pilot cap would be comprised of a 12-inch "cap" layer overlain with a 6-inch "armor" layer (Figure 7). The area of the pilot cap is 16,800 sf. The 6-inch armor layer will be consistent with:

- Grain size gradation
  - 100 percent passing 1.5 inches (with flexibility on this percentage)
  - Maximum 50 percent passing 0.5 inch (no flexibility)
  - Less than 20 percent passing #10 sieve (with flexibility)
  - Less than 5 percent passing #200 sieve
- Ideally crushed (angular) material, but other materials may be accepted at the discretion of the design engineer.

This material was selected to be protective for the 25-year flow event (82 percent chance of non-exceedance in a 5-year period) in the river. The estimation grain size stability and river velocities under various return events is discussed in detail in Appendix H, Attachments H-1 and H-2. The volume of armor layer material to be placed is approximately 300 cy.

The pilot cap 12-inch layer will consist of:

- 90 to 100 percent passing 4 inches
- 50 to 90 percent passing ¾ inches
- 35 to 65 percent passing #4 sieve
- 15 to 45 percent passing #10 sieve
- 2 to 10 percent passing #40 sieve
- 0 to 2 percent passing #200 sieve

The volume of cap layer material to be placed is approximately 700 cy. Note, the above specified gradations include a small probability that the delivered cap material will contain a higher percentage of coarse materials (as defined by the D50 grain size) than the armor layer.

3.5.2 Fringe Cover

The purpose of the fringe cover material is to place a sand layer over the outer lateral edge of the dredged surface and side slopes to provide a new clean surface over top of any dredge residuals. The sand used in the fringe cover may get mixed in and incorporated with new surface sediments in these areas over time. Even with some amount of mixing, this new clean surface will reduce the level of chemical exposures in the biologically active zone. The sand to be placed (see below) is similar in grain size to much of the sediments present in the area, and is expected to be as stable as these existing sediment deposits. The area to be covered is approximately 46,000 sf (Figure 7).

The 6-inch thick fringe cover layer will consist of:

- 100 percent passing #10 sieve
- Less than 5 percent passing #200 sieve.

The volume of fringe cover layer material to be placed ranges from approximately 850 cy.

3.5.3 Cap/Cover Construction

The supplier of the cap/cover materials will provide test data demonstrating that the materials meet the specifications. The materials will be barged to the Site. As material is received at the Site, the construction contractor will provide documentation of the number of shipments received and the weight or volume of material in each shipment.

The construction contractor will place the pilot capping armor material in one 6-inch lift, cap material in either two 6-inch lifts or one 12-inch lift, and fringe cover material in one 6-inch lift. The materials will be placed mechanically from a barge using a clamshell bucket. The bucket will be lowered through the water column prior to releasing cap materials. The material will be placed with sufficient control to meet the design thickness for that layer. Lead line measurements as well as set volume or tonnage over the surface area will be used to verify adequate coverage during the placement of each layer.

Following the placement of the cover/pilot cap, a bathymetric survey will be performed to document that the cover meets the specification and provide a record of the as-built contour of the completed removal action. Anchor will monitor the placement of the cover/pilot cap. The CQAP (Appendix C) provides specific details about the responsibilities for quality control and quality assurance during the placement of the cover/pilot cap.

3.6 Environmental Controls

The potential effects to water quality of the removal action were assessed using the results of DRET tests presented in Section 2.2.1 and a quantitative analysis of those results. This water quality analysis is summarized in Section 3.6.1 and detailed in the RAEPP (Appendix E, Attachment A). Based on these results, a summary of the proposed environmental controls are presented in Section 3.6.2 and detailed in the RAEPP. As detailed in Appendix E, the water quality analysis for the project (conducted per Section 404 of the Clean Water Act) concludes that given all the circumstances at this site, this limited removal action will not result in any net loss of habitat or aquatic function, as long as environmental control measures included summarized below and detailed in Appendix E (BMPs, operational controls, field and water quality monitoring) will be conducted throughout the removal action.

3.6.1 Water Quality Analysis

A quantitative water quality analysis was conducted (Appendix E, Attachment A) and is summarized in this section. As a first step, the water quality analysis included direct comparison of DRET test results (which are intended to mimic conditions within a few feet of the dredge operation, as opposed to a distance downstream where water quality monitoring will occur; see Appendix D) to appropriate acute freshwater quality criteria. Aquatic chronic water quality guidelines are intended for comparison to continuous long-term potential impacts to water bodies. Given dredging operations for this project are expected to be discontinuous (e.g., stopping at night, during equipment movement, during barge transfer, etc.) and of a relatively short duration of approximately two weeks, it is most appropriate to compare any expected chemical concentrations near dredging operations to acute values. Similarly, human health water quality guidelines are intended for long term (over many years) exposures of people to water and fish from

surface waters. Also, human health water quality guidelines may not be practicable to achieve considering the exigencies of the project.

Since there are no currently accepted acute water quality criteria for the Portland Harbor Superfund site, or the Gasco site, the appropriate water quality guidelines were chosen based on the lowest freshwater acute concentrations provided from the following sources of water quality criteria and screening level concentrations:

- EPA National Recommended Water Quality Criteria: 2002 (EPA 2002)
- Oak Ridge National Laboratory (ORNL) Tier II toxicity values contained in "*Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota*" (ORNL 1996)
- State of Oregon Regulations OAR 340-41 – Water Quality Criteria (Tables 20, 33A, 33B, and 33C – Acute Freshwater) (ODEQ 2004)

Values from other than Oregon regulations were used because Oregon regulations do not have water quality criteria for many of the chemicals under consideration. Direct comparison of DRET test results to water quality guidelines can provide a conservative method to screen out any chemicals that would not be expected to cause water quality impacts, even very close to a dredging operation. This conservative screening is shown in Table 6. Only copper, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluorene, naphthalene, ethylbenzene, and toluene exceed one of the acute water quality guidelines. Consequently, these chemicals were examined in the second step of the quantitative analysis. In addition, EPA requested examination of cyanide, fluoranthene, and benzene in the second step of the analysis.

The second step in the quantitative water quality analysis was to better understand the distribution of chemicals in the water column around dredging operations during this project. A simple analytical model developed by Kuo and Hayes (1991) was employed for this purpose. This model assumes no silt curtains or similar controls are present. Consequently, it provides a very conservative estimate of water column concentrations around this particular dredging operation, which will employ several types of environmental controls as detailed in RAEPP (Appendix E) and Section 3.6.2.

Modeling results are shown in Table 10 as the ratio of the predicted water column concentration over the applicable acute water quality guideline. Ratios greater than 1 indicate a predicted exceedance of the water quality guideline. Results are presented for each of the chemicals examined at distance of 50, 100, 200, 300, and 400 feet downstream of the dredging operation. For each distance, a 50th, 90th, and 95th percentile results are also presented. The percentile result can be viewed as a probability of exceedance. For example, given the range of input parameters, there is a 95 percent chance that the predicted results are at or below the value shown in the 95th percentile column.

As shown in Table 10, the 50th percentile results at all distances from the dredge for all chemicals are below their respective criteria (i.e., the ratios are less than 1 in Table 10). These results are based on conservative calculations assuming no containment. Benzo(a)anthracene is predicted to exceed the guideline using the 90th and 95th percentile estimate at 50 feet from the dredge and the 95th percentile estimate at 100 feet from dredge. Benzo(a)pyrene is predicted to exceed the guideline using the 90th and 95th percentile estimate at 50, 100, and 200 feet from the dredge and the 95th percentile estimate at 300 feet from the dredge. Overall, these results indicate that exceedances of appropriate water quality guidelines at distances greater than 300 feet from the dredge are unlikely for this removal action even without environmental controls in place. Despite this result, numerous environmental controls have been proposed for this project and are described in the next section.

3.6.2 Summary of Environmental Controls

The details of environmental controls proposed for the project are presented in the RAEPP (Appendix E). This section summarizes those environmental controls of each step of the project described above.

Water quality testing using the DRET test and subsequent quantitative water quality analysis helped to estimate the concentration of dissolved chemical constituents and suspended solids in the water column downstream of the project. However, these estimates did not include all of the water quality criteria (e.g., chronic criteria) that EPA indicated may be relevant and that may be better controlled with the addition of a robust system of non-rigid containment barriers encompassing the removal action area

is a conservative design approach that will diminish the potential for water quality exceedances outside of the containment area. Further, because it is possible that unexpected conditions could be encountered during removal, it is prudent to have several types of environmental controls in place and/or available for quick deployment while the operation takes place. In addition, without proper environmental controls, there exists a potential for loss of materials at several other steps in the removal process after the actual dredging operation. Therefore, environmental controls that will be implemented are summarized below for:

- In water removal of the tar and sediments
- Holding and movement of material in barges on the water
- Addition and mixing of drying reagent
- Transfer of material to upland transport and the disposal site
- The placement of the cover/pilot cap over the removal area

The construction contractor will be responsible for implementing the environmental controls detailed in the RAEPP (Appendix E). Anchor will monitor the construction contractor's performance for adherence to the design, including the environmental controls specified in the RAEPP. Anchor will also be responsible for monitoring water quality in accordance with the detailed WSMP (Appendix D).

In the event that water quality exceedances are observed despite the use of the primary standard and project specific environmental controls described below, the RAEPP includes a step wise process for implementing additional environmental controls and/or stopping work as necessary to minimize the duration and magnitude of any potential water quality impacts. In addition, current velocity limitations exist for silt curtains. These limitations have been identified in the RAEPP and monitoring for environmental controls includes specific criteria for when operations should be limited or stopped to minimize the chances for control failures.

Finally, all environmental controls are identified as either "standard," "project specific," or "additional." "Standard" controls are the types of controls that are typical for contaminated sediment dredging projects. "Project specific" controls are more robust environmental controls that have been added through discussions with EPA regarding

potential water quality impacts that may be specific to this Site. These controls are proposed for deployment at the start of and throughout this particular project in order to meet the public and EPA and partner agency comments. Based on these comments, standard and project specific controls will be deployed regardless of the results of any water quality monitoring or observations.

"Additional" controls are a set of contingency measures that can be considered should water quality exceedances or other problems be encountered. The concept behind this approach is to allow flexibility in the field so that the best contingency actions can be chosen to fit the specific problems potentially encountered. This is preferable to setting a rigid set of contingency measures that should be applied, because in most cases, such approaches fail to predict the actual causes of any problems eventually encountered in the field.

In-Water Removal of Tar Body Materials

Environmental controls during removal of tar and sediments will include the use of multiple containment barriers that are designed to limit the movement of the various types of materials that are or may be present in the removal area. The removal area has been subdivided into two areas herein referred to as the "inner removal area" and the "outer removal area." The inner removal area is closest to the shoreline with water depths less than approximately 33 feet and the outer removal area is channelward with water depths in excess of approximately 33 feet. The dredge area was split into two areas based on the variation in water depths and the resulting feasibility of installing and maintaining the containment barriers in the variable water depths. The need to maintain access to the dock for commercial shipping is also an advantage of completing the removal in two separate areas. The primary standard and project specific in-water controls and their method of construction deployment are shown in Figures 8a and Figure 8b for the inner and outer removal areas, respectively.

The primary standard and project specific controls for the inner removal area (see Figure 8a) (presented in order from shoreline outward) include:

- Inner mobile floating oil absorbent boom to capture buoyant substances (project specific).

- Middle silt curtain extending down to the mudline to capture suspended sediments and related materials and prevent bedload movement (project specific). A construction access door will be located along the portion of the silt curtain parallel to shore (an example location is shown in Figure 8a). Barges will be loaded across the middle silt curtain barrier with spill plates in place as detailed below under "holding and movement of barges."
- Outer bedload baffle extending from the mudline upward 12 feet into the water column around the foot print of the dredge prism in the channel to help further contain any particulates within the dredge area (project specific).
- An outer bubble curtain extending outward around all transfer and haul barges, which is expected to deter movement of fish into the area as well as help reduce turbidity (if present) moving out of the area (project specific).
- An outer oil containment boom with a skirt extending 2 feet below the water surface to capture any floatables (project specific).

The primary standard and project specific controls for the outer removal area (see Figure 8b) (presented in order from shoreline outward) include:

- Inner mobile floating oil absorbent boom (project specific)
- Inner bedload baffle extending from the mudline upward 12 feet into the water column (project specific)
- Middle silt curtain anchored flush to the mudline along portions of the upstream and downstream areas with the remaining upstream, downstream and channel ward portions of the curtain extending to within approximately 2 feet from the mudline (project specific). Construction access doors will be located on the upstream and downstream legs of the silt curtain (as shown in Figure 8b). Barges will be loaded inside all containment devices as detailed below under "holding and movement of barges."
- An outer bubble curtain which is expected to deter movement of fish into the area as well as help reduce turbidity (if present) moving out of the area (project specific)
- An outer oil containment boom with a skirt extending 2 feet below the water surface to capture any floatables (project specific).

Further details regarding the fabrication of the silt curtains and the various containment barriers are provided in the RAEPP (Appendix E).

As discussed in Appendix H the expected range for current velocities at the Site is 0.1 to 0.3 fps range in August through October. The inner and outer removal area silt curtain configurations were designed to operate at a maximum river velocity of 1 fps. The river currents will be monitored during the removal and capping activities and if currents exceed 1.0 fps operations will be stopped until currents decrease below this velocity threshold. At all times the curtains will be observed for proper deployment, effectiveness, and signs of unacceptable sailing or dragging. If topside monitoring of the silt curtain containment identifies a significant maintenance issue or if water quality monitoring identifies an unexplained plume, the same diving crew used to install the curtains will be mobilized to inspect the curtain and make any necessary repairs. Wave action that visibly compromises floating skirts and/or booms will also trigger limiting or stopping operations until either wave conditions calm or controls can be deployed in an effective manner under those conditions.

When the silt curtain is closed, entrapment of fish could occur within the curtain, but is not expected to be likely. Seining methods will be used to remove fish from within the containment barrier and prevent potential contact with the dredge bucket. Several beach seine nets will be deployed to remove fish from the containment area. Additional nets may be deployed if fish are identified within the removal area containment during the removal. A bubble curtain will also be deployed surrounding the haul barges during both inner and outer removal area loading These controls in addition to the silt curtains will greatly deter fish from entering the project area during the removal activities. Captured fish will be contained in an aerated tank and released outside of the project area.

Other standard and project specific in-water environmental controls discussed in the RAEPP (Appendix E) include:

- No multiple bites with dredge bucket (limits resuspension of sediments; standard)
- No bottom stock piling (limits resuspension of sediments; standard)

- No over water swing to haul barge outside silt curtain (project specific)
- No dragging of the dredge bucket across the bottom (project specific)
- No lateral movement of the dredge bucket under water (i.e., the bucket will be lifted straight up and down through the water column)(project specific).

Additional in-water controls in the event of unexpected issues or water quality exceedances discussed in the RAEPP include:

- Response skimmer boat and spill response team in the event of oily releases outside floating and absorbent booms.
- Extra pads and booms present on-site at all times for additional deployment
- Increase dredging cycle time (reduces resuspension of sediments)
- Reducing the rate of dredge water released from the transfer barge back into the primary containment (note that no water will be allowed to be released outside the primary containment at any time)
- Changing the methods of releasing water from the transfer barge back into the primary containment
- Filtering water through filter fabric, hay bales, and/or similar devices before releasing water back into the primary containment.

Inspection of construction activities and deployment of additional booms and absorbent materials will be triggered if sheen is observed outside the outer standard perimeter controls. (Visual measurement and assessment of sheens is discussed in the WSMP, Appendix D). If substantial sheen is observed from project activities, work will cease, construction activities reviewed, and additional booms and absorbent deployed. If large continuous, heavy, or persistent oily releases or free product are observed, work will cease and the spill response boat and team will be deployed.

In the event that distressed or dying fish or birds are observed, all work will stop and the fish or birds will be collected and examined. If such species are endangered or threatened initial notification will be made to the NOAA Fisheries Law Enforcement Office or U.S. Fish and Wildlife Service. In this case, work will not recommence until informal discussions with the Services can be held to determine appropriate actions. If non-listed species are found, then sonar and/or diver surveys (or visual surveys for

birds) will be conducted of the area to determine whether fish or birds are still present, and if so where. Measures as described above and in the RAEPP will be taken to exclude fish or birds from the immediate area before work is initiated or reinitiated.

Holding and Movement of Barges

The general configuration of dredge derrick and supporting equipment and haul barges are shown in Figures 9a (inner removal area) and 9b (outer removal area). A derrick crane ("Sea Vulture") and dredge bucket will excavate the material and load the material onto a sealed flat deck transfer barge. The sealed flat deck surface is surrounded by a perimeter that extends above the deck to contain material and water during loading and prevent splashing outside of the haul barge. From the transfer barge, the material will be rehandled by another derrick and crane ("Seahawk") to the sealed haul barge ("CHETCO" is shown in the figure, but three different haul barges will be available for use). During the inner area removal, the sealed transfer barge will be outside the silt curtain (because of the limited space inside the silt curtain) and during outer area removal the transfer barge will be inside the silt curtain. Otherwise, the configuration of barges and derricks relative the containment features are very similar in the two removal areas. In addition, in both configurations, the drying reagent barge will be in between the transfer barge and haul barge (Figures 9a and 9b).

To prevent spillage between the dredge bucket and the transfer barge as well as between transfer and haul barges three cantilevered spill aprons will be attached to these barges to direct spilled material into the barges. As shown in Figures 9a and 9b, no part of any bucket swing path will be allowed to occur over open water outside the primary silt curtain barriers in each configuration. This system will also prevent any spillage of drying reagent into the water.

The primary standard and project specific controls for holding and moving of barges within both the inner and outer removal areas will be:

- Placement of barges such that no spillage is allowed outside the primary silt curtain containment (project specific)
- No discharge of water or solids of any kind outside the silt curtain (project specific)

- Containment of all water on the barge during transport (project specific)
- Filling barges to less than 85 to 90 percent capacity to prevent any possible spillage (project specific) and prevent loss due to stormwater overflow (which would fill less than 2 percent of the barge even under extreme rain conditions).

Once the barge is loaded it will be inspected to detect any sediment on the side of the barge that could enter the river during transport. Contractor personnel will conduct a complete walk around the barge deck area to find and remove sediment (to inside the barge) prior to moving the barge out of the outer containment barriers. If material is identified along the deck with the potential to enter the river during transport, the material will be removed and placed into the barge. The material will be removed by sweeping as necessary either with or without additional water (e.g., river water from buckets or hoses) so that all material is forced into the haul barge. No wash water or swept material will be allowed to escape to the river.

It may be periodically necessary to move the dredge derrick or transfer barge (in outer removal operations only) out of the contained area via the contractor access doors (Figures 8a and 8b) to move or service equipment. In these situations, all dredge work within the primary silt curtain containment will be stopped before the access door is opened and will not recommence until the door is closed. In addition, the access door will not be opened if substantial turbidity or sheen (assessed visually) is present within the primary silt curtain containment, and in this case, the operation will pause with the door closed for a sufficient period to allow larger solids materials to settle before the door is opened. If sheen is identified that has the potential to be released when the door is opened, the sheen will be removed with absorbent materials prior to opening the door. In addition, prior to opening the door a visual inspection will be made to confirm that the bubble curtain is on and functioning properly to exclude fish from entering the containment area.

The sealed haul barges will pushed by a tugboat to the offloading facility. During all operations the haul barges will be sealed and no water will be allowed to enter the river either at the Site or in transit to the offloading facility. In the event of accidental spills (e.g., a barge collides with something), Appendix A details spill response and

notification procedures for spills at the site during loading, during transport to the upland transfer facility, or while docked at the upland transfer facility.

Addition of Drying Reagent Procedure

As described in Section 3.4.1, the use of drying reagent is an environmental control that prevents the need for handling, discharge, or treatment of dewater from the dredge operation. The drying reagent will be added from a covered drying reagent storage barge and mixed with the dredged material in the haul barge (Figures 9a and 9b). Drying reagent addition and mixing operations will be visually observed at all times. The drying agent will be lifted with the transfer derrick bucket across a spill plate to the haul barge. The spill plate will prevent any material from entering the water rather than one of the two barges. In addition, the drying reagent storage barge will be covered except when being actively used for retrieval of drying reagent to prevent wind loss of reagent. Once the drying reagent addition and mixing is complete, the contractor will conduct a walk around to confirm that no drying reagent has settled on the barge deck with a potential to enter the river while in transit to the transfer facility. If any such material is found, it will be swept into the haul barge.

Transfer of Material to Upland Transport

As noted above, barges will be hauled to the offloading facility where the dry material will be transferred to trucks for transport to the landfill. The primary goals of the environmental controls at the transfer location will be to:

- Prevent any material from entering the water at the transfer site
- Prevent any material from being tracked or lost beyond the immediate defined loading area.

Operations will be visually observed at all times. If there is a threat of the above goals not being met, work will be stopped and controls will be modified as needed until these goals are met. If, despite these controls, temporary accidental releases of material occur, conditions leading to the accident will be corrected, and the releases will be documented and reported to EPA at that time. As detailed in the RAEPP (Appendix E), the following standard environmental controls will be deployed to meet the above goals during material transfer:

- Overwater spill apron at transfer site (standard control)
- Loading of sediment into a hopper to guide sediment into trucks and control potential spillage outside of trucks during truck loading (project specific control)
- Trucks will be water-tight to eliminate leakage (standard control)
- Under loading of trucks to prevent "sloshing" loss (standard control)
- Clean tarping of truck loading area to prevent tire contact with materials (project specific control)
- Spill/material return control curbing on dock (standard control)
- Visual inspection of the truck loading area and the truck prior to releasing the truck and visual inspection of the access route for tracking prior to releasing the truck from the offload facility to public roads (standard control)
- Cleaning of tires (if necessary) before leaving site including dry brushing and/or tire/wheel washing (standard control)
- Cleaning and decontamination of transfer area and all equipment used in transfer (standard control)
- Adding additional sediment drying reagent to the barge to treat any free liquid that may be present following transport from the sediment drying facility and prevent the need for any control or handling of water.

An additional control will be to limit or discontinue operations in the event of high river flows, storm, and/or wave conditions occur at the transfer facility. There is no set condition (e.g., specific river velocity) that will trigger this contingency, because it impossible to predict the exact conditions that would impair operations. However, if conditions appear to pose a threat to meeting either of the above goals, operations will be suspended until conditions improve.

In addition, water quality monitoring will be conducted around the transfer site to confirm that no materials are being released (WSMP, Appendix D). Sampling of roadway shoulders leaving the transfer facility will be conducted before and after transfer to confirm that no tar materials were tracked or lost in transfer (see TDP, Appendix A for details).

Decontamination of Equipment

Decontamination of the holding barges will be done at the completion of the removal activities. The transfer barge, used at the dredge site, will be swept and pressure washed (including all portions of the barge where sediment or tar material is visually present) such that no material is released to the river and the remaining material and water inside the barge will be loaded/pumped into the last haul barge going to the disposal transfer facility. On the last trip that each haul barge makes to the disposal transfer facility, the dredged material will be unloaded and the haul barge will be swept of all loose material, which will be placed in trucks and hauled to the disposal site. The barges will then be pressure washed and the collected water pumped to a baker holding tank (or similar type storage vessel) onshore for eventual trucking and disposal at either the local sanitary district (if permits can be obtained), a liquid contaminated waste disposal facility, or the 500 gallon above ground storage tank for DNAPL extraction system at the Gasco site. The contractor will perform a visual inspection of each barge before it leaves the transfer site to determine if all visible material has been removed. Given that the swing path of the transfer bucket is across the sediment drying storage barge, there exists some potential for spillage to occur in the storage barge. Any drying agent that is contaminated with dredge spillage will be removed to the final haul barge, prior to that haul barge leaving the site for the transfer facility. Following completion of the dredging and sediment drying addition, if substantial drying reagent remains in the barge, the sediment drying barge will be hauled to Hickey Marine, and the reagent will be recycled for future use. If minor amounts of drying reagent remain, they will be placed in the last haul barge going to the transfer facility.

Decontamination of the dredging, mixing, and upland transfer buckets will be done at the completion of the removal activities. In between barge loads, the buckets will not be decontaminated given their use will be dedicated to transfer of the Site material. At the completion of the removal, the dredging and mixing buckets will be pressure washed over the last haul barge prior to going to the offloading facility. The contractor will perform a visual inspection. If any residual material remains on the buckets, the buckets will be pressure washed repeatedly until the visible material has been removed. A similar procedure will be used on the upland transfer bucket at the time of pressure washing of the last haul barge at the transfer facility, as described above. Wastewater

from this process will be handled as described above for the pressure washing of the haul barges at the transfer facility.

Pilot Cap/Cover Placement

Once the removal is complete, clean cap and cover material described above will be hauled to the Site via clean barges. Standard and project specific environmental controls that will be deployed during cap/cover placement are detailed in the RAEPP (Appendix E) and include:

- Cap/cover material will be tested to be clean meeting the requirements established for the McCormick and Baxter Superfund project (Ecology and Environment 2003) prior to placement.
- Operational controls for placement to limit resuspension of bottom sediments (see RAEPP, Appendix E for details).
- Silt curtains and oil absorbent booms (as described for removal).

Water quality monitoring will be conducted during cap/cover placement as detailed in the WSMP (Appendix D).

3.7 Notifications and Reporting

The Order imposes several requirements for notification for the removal action.

- NW Natural will notify EPA, in accordance with Section VII (Paragraph 11) of the Order, of the names and qualifications subcontractors that will be used to perform the removal action. We have notified EPA that Sevenson Environmental Services is the prime contractor for the project. Notification of the selection of subcontractors is required at least 20 days before the subcontractors begin work.
- We have contacted the Off Site Rule coordinator for Region 10, who replied on June 21, 2005 that CWMNW is in compliance with the Off-Site Rule.
- No shipping of any material out of state for disposal is proposed. Therefore, notification for off-site out of State coordination is not needed for the project.
- NW Natural will notify EPA 17 days before beginning the removal action field work. Section II.5 of the SOW requires notification 30 days prior to beginning removal action field work. However, given the current project schedule this would result in notification prior to EPA's final approval of the final design.

- NW Natural will notify EPA, in accordance with Section II.5 of the SOW, within 7 days of making a preliminary determination that construction is complete. EPA and NW Natural will agree to a time for a final inspection and/or meeting, which will also be coordinated with partner agencies. Within 14 days of the final inspection/meeting, NW Natural will send a letter to EPA confirming that the removal action is complete and responding to any issues raised by EPA in the final inspection/meeting.
- NW Natural will notify EPA prior to the initiation of any field work at least a week in advance where possible. Further, special field activities, such as those requiring use of divers may also require submittal and EPA review of deliverables, such as Health and Safety Plans prior to the work. Notifications shall be made at a minimum via email to: Sheldrake.sean@epa.gov and rwadsworth@parametrix.com. For unforeseen events, such as a field sampling plan change, notice shall also be made verbally to: (206) 553-1220 and (503) 963-7000

During removal action field work, NW Natural will submit weekly progress reports to EPA electronically, in accordance with Section II.5 of the SOW. The reports will contain:

- A summary of the work performed during the week
- Identification of any problems encountered
- Identification of proposed solutions to any problems
- Results of water quality monitoring
- A summary of work to be performed during the following week.

Within 60 days of completing the removal action field work, NW Natural will submit the Removal Action Completion Report (RACR) to EPA, in accordance with Section II.6 of the SOW, to document the successful completion of the removal action. The RACR will contain:

- A statement that the Removal Action was constructed in accordance with the design and specifications. If applicable, design modifications will be identified in the RACR.
- As-built drawings, signed and stamped by a professional engineer, that document the area and depth of the removal of tar and the dimensions of the cap.
- A summary of the volume and types of materials removed from the Site and final disposition of those materials.

- A presentation of the analytical results of all sampling and analyses performed (including a map showing the locations of any confirmatory samples), and accompanying appendices containing all relevant documentation generated during the Removal Action (e.g., manifests and permits). All analytical data collected during project implementation will be provided electronically to EPA.
- The final Performance Monitoring and Water Quality Monitoring report.
- A description of any institutional controls that are in place, or engineering controls that are necessary to sustain the integrity of the removal action, along with copies of any agreements or other documents used to establish and implement such controls.

It should be noted that EPA will review and approve the final bathymetric survey prior to cap placement and the final cap bathymetry prior to the contractor leaving the site.

The draft MARP, as required by Section II.7 of the SOW, will be provided to EPA within 60 days of receiving approval of the final design. An outline of the MARP is provided as Appendix F. The outline of the MARP will be modified, as necessary, to reflect modifications of the design. The final MARP will be submitted to EPA within 60 days of completing the removal action or receiving comments on the draft MARP, whichever is later.

4 ARAR COMPLIANCE SUMMARY

Table 11 contains a summary of locations where ARARs are addressed by the RAPP and supporting documentation.

5 REFERENCES

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TABLES

Table 1
Lateral and Vertical Extents of the Tar Body Zone

Station ID	Mudline Elevation of Core in feet NAVD 88	Tar Body					
		Tar Observed at Surface (upper foot)?	Depth to Tar Body Bottom in feet	Depth to Bottom with Recovery Correction	Assumed Thickness in feet	Bottom Elevation in feet (1)	Core Log Notes
Removal Action Design Characterization Sampling							
RAA-01	5.9	No	0.0	0.0	0.0	NA	Sand saturated with sticky oil at surface, but no tar body (1.5 of 5 ft recovered). Next core showed no tar, so assumed no tar present.
RAA-02	3.4	Yes	0.5	4.0	4.0	-0.6	Sandy tar in 0.5 of 4 ft recovered. No recovery until 10 ft. Assumed entire 4 foot of first core contains tar.
RAA-03	-18.3	Yes	1.5	8.0	7.8	-26.3	Black firm tar layers in top 0.2 to 1.5 (of 1.5 ft recovered). No recovery to 8 ft, where no tar present, so assumed 7.8 ft of tar.
RAA-04	7.9	Yes	1.0	2.0	2.0	5.9	Sandy tar in top 1 ft (2.5 of 5 ft recovered). No tar observed below 1 ft, so 2 ft of tar assumed with recovery correction.
RAA-05	5.7	Yes	1.3	2.8	2.8	2.8	Tar in top 1.3 ft (2.3 of 5 ft recovered). No tar observed below 1.5 ft, so 2.8 ft of tar observed with recovery correction.
RAA-06	2.5	Yes	1.3	3.0	2.5	-0.5	Tar with silty sand from 0.5 to 1.3 ft (2.2 of 5 ft recovered). No tar below 1.3 ft, so assumed 2.5 ft of tar with correction factor.
RAA-07	-7.1	No Recovery	13.0	13.0	13.0	-20.1	No recovery in first 5 ft. Layer tar found in 6 to 12 ft with 70% recovery throughout. No tar observed below 13 ft, so assumed 13 ft of tar.
RAA-08	8.9	No	0.0	0.0	0.0	NA	Sand with oil/tar saturation found at 1-2 ft and 6-7.5 ft.
RAA-09	6.7	Yes	1.5	4.0	4.0	2.7	1.5 feet of tar observed in 0 to 4 foot core with 1.5 feet recovery, SAND observed in drive shoe; in a second boring at same location, 1.8 feet of tar observed in 0 to 5 foot core with 2 feet recovery. Tar body assumed less than 4 feet.
RAA-10	3.6	No	0.0	0.0	0.0	3.6	No tar found, but because this station is in center of tar body, may want to assume some depth of removal.
RAA-11	5.5	Yes	1.1	1.7	1.7	3.8	Tar found in top 1.1 feet (3.3 of 5 ft recovered) with no tar below, so assumed 1.7 ft of tar with recovery correction.
RAA-12	4.1	No	0.0	0.0	0.0	NA	No tar found in 1.5 of 5 ft recovered. Very fine (0.1 ft) tar layer found at 12 ft, otherwise silt with oil or sheen.
RAA-13	-12.1	No Recovery	10.0	10.0	10.0	-22.1	No recovery to 7 ft but noted oil/tar on core tube. Tar observed at 8-10 ft, with silt and sand below, so assumed 10 ft of tar.
RAA-14	-23.5	Yes	1.1	?	10.0	-33.5	Tar observed in top 1.1 ft (6, 0.1 ft lenses). No recovery to 10 ft. Last tar observed at 13.5 ft, so assumed 10 ft thick tar.
RAA-15	10.9	No	0.0	0.0	0.0	NA	No tar observed.
RAA-16	4.5	No	0.0	0.0	0.0	NA	No tar observed.
RAA-17	4.2	No	0.0	0.0	0.0	NA	No tar observed.
RAA-18	10.6	No	0.0	0.0	0.0	NA	No tar observed.
RAA-19	11.2	No	7.3	10.0	5.0	1.2	No tar observed in top 2.5 of 5ft recovered. 2 ft thick layer of tar is at least 5 feet beneath mudline.
RAA-20	11.6	No	2.3	4.6	1.6	7.0	No tar observed in top 1.5 ft (2.5 of 5 ft recovered). 0.8 ft thick layer of tar observed is at least 1.5 ft beneath mudline.
Historical Sediment Characterization Results in Tar Body Vicinity							
AN2-1	2.0	No	5.9	5.9	1.7	-3.9	1.7 ft of tar observed 4.2 ft below mudline (not continuous)
AN2-2	-5.0	No	5.6	5.6	3.8	-10.5	3.8 ft of tar observed at 1.8 ft below mudline (not continuous)
AN2-3	-10.0	No	5.1	5.1	2.2	-15.1	2.2 ft of tar observed at 2.9 ft below mudline (1.1 ft gap of sediments between two tar layers)
AN2-4	-26.0	No	6.6	6.6	3.9	-32.6	2 segments - 2.3 ft of tar observed 2.7 ft below mudline, and 0.6 ft of tar observed at 6 ft below mudline

Table 2
Lateral and Vertical Extents of Visually Contaminated Zone

Core ID	Mudline Elevation of Core in feet NAVD 88	Visually Contaminated Sediments				
		Depth to Bottom VC in feet	Depth to Bottom VC with Recovery Correction	Assumed VC Thickness in feet)	Bottom Elevation VC in feet NAVD 88	Core Log Notes
Removal Action Design Characterization Sampling						
RAA-01	5.9	5.3	5.4	5.4	0.4	
RAA-02	3.4	17.5	18.6	14.6	-15.2	
RAA-03	-18.3	13.0	13.0	5.0	-31.3	
RAA-04	7.9	6.0	6.0	4.0	1.9	
RAA-05	5.7	10.0	10.0	7.2	-4.4	
RAA-06	2.5	18.0	18.0	15.0	-15.6	
RAA-07	-7.1	15.5	16.0	3.0	-23.1	
RAA-08	8.9	6.5	8.8	8.8	0.1	
RAA-09	6.7	16.0	16.0	12.0	-9.4	
RAA-10	3.6	12.0	12.5	12.5	-9.0	
RAA-11	5.5	12.0	12.5	10.8	-7.1	
RAA-12	4.1	18.0	18.0	18.0	-14.0	
RAA-13	-12.1	18.5	18.5	8.5	-30.6	
RAA-14	-23.5	13.5	13.5	3.5	-37.0	
RAA-15	10.9	6.0	6.3	6.3	4.9	Some sheen in possible sluff at 6 ft (only 1ft thick)
RAA-16	4.5	10.0	10.0	10.0	-5.6	
RAA-17	4.2	13.0	13.0	13.0	-8.9	
RAA-18	10.6	0.0	0.0	0.0	10.6	
RAA-19	11.2	5.0	5.0	5.0	6.2	VC above tar layer
RAA-20	11.6	5.6	5.6	1.0	6.0	
Historical Sediment Characterization Results in Tar Body Vicinity						
AN2-1	2.0	8.0	8.0	2.1	-2.2	VC above tar layer
AN2-2	-5.0	1.8	1.8	1.8	-6.8	VC above tar layer
AN2-3	-10.0	NA	NA	NA	NA	No visual contamination outside tar layers
AN2-4	-26.0	10.0	10.0	3.0	-28.6	VC above

VC= visually contaminated

Table 3
Sample Analytical Summary Matrix

Sample ID	Sediment Zone	Sediments								
		TCLP, DRET	Metals, Grainsize	Specific Gravity, TS	Atterberg Limits, #200 Wash	SVOCs, TPH, TOC, TS, Cn (EPA List)	SVOCs, TPH, TOC, TS, Cn (PAHs)	VOCs (EPA List)	VOCs (BTEX)	Archived Volume
RAA-01SD-0005	VC									1x16-oz
RAA-01SD-0520	VU				X					1x2-oz, 1x8-oz, 1x16-oz
RAA-02SD-0004	TB									1x16-oz
RAA-02SD-1019	VC		X		X	X		X		
RAA-03SD-0002	TB									1x16-oz
RAA-03SD-0513	VC	X								1x2-oz, 2x8-oz
RAA-03SD-1323	VU									1x2-oz, 2x8-oz, 1x16-oz
RAA-04SD-0002	TB									1x16-oz
RAA-04SD-0506	VC						X		X	
RAA-04SD-0620	VU				X				X	1x8-oz, 1x16-oz
RAA-05SD-0203	TB									1x16-oz
RAA-05SD-0410	VC									1x2-oz, 1x8-oz
RAA-05SD-1020	VU		X				X			1x8-oz
RAA-06SD-0304	TB									1x16-oz
RAA-06SD-0407	VC								X	
RAA-06SD-0415	VC		X				X			1x16-oz
RAA-06SD-1520	VU		X			X		X		1x8-oz
RAA-07SD-0511	TB			X						1x16-oz
RAA-07SD-1117	VC									1x2-oz, 2x8-oz
RAA-07SD-1720	VU									1x2-oz, 1x8-oz, 1x16-oz
RAA-08SD-0407	VC									1x16-oz
RAA-08SD-0720	VU		X				X		X	1x8-oz
RAA-09SD-0005	TB									1x16-oz
RAA-09SD-0516	VC		X			X		X		1x8-oz, 1x16-oz
RAA-09SD-1635	VU									1x2-oz, 2x8-oz, 1x16-oz
RAA-10SD-0010	VC									1x2-oz, 2x8-oz, 2x16-oz
RAA-10SD-1020	VU		X		X	X		X		
RAA-11SD-0204	TB	X								

Table 3
Sample Analytical Summary Matrix

Sample ID	Sediment Zone	Sediments								
		TCLP, DRET	Metals, Grainsize	Specific Gravity, TS	Atterberg Limits, #200 Wash	SVOCs, TPH, TOC, TS, Cn (EPA List)	SVOCs, TPH, TOC, TS, Cn (PAHs)	VOCs (EPA List)	VOCs (BTEX)	Archived Volume
RAA-11SD-0413	VC	X								1x2-oz, 2x8-oz, 1x16-oz
RAA-11SD-1320	VU		X				X		X	1x8-oz
RAA-61SD-1320	VU		X				X		X	
RAA-12SD-1015	VC									1x2-oz
RAA-12SD-1018	VC									2x8-oz, 2x16-oz
RAA-12SD-1820	VU		X			X		X		
RAA-13SD-0911	TB	X								
RAA-13SD-1115	VC		X			X		X		
RAA-13SD-1522	VU									1x2-oz, 2x8-oz, 1x16-oz
RAA-14SD-1014	VC		X		X		X		X	
RAA-14SD-1420	VU		X			X		X		1x8-oz
RAA-15SD-0506	VC									1x2-oz
RAA-15SD-0615	VU									1x2-oz, 2x8-oz, 1x16-oz
RAA-16SD-0005	VC									1x2-oz
RAA-16SD-0010	VC									2x8-oz, 2x16-oz
RAA-16SD-1020	VU									2x8-oz, 1x16-oz
RAA-17SD-0010	VC		X		X	X		X		1x16-oz
RAA-17SD-1420	VU		X			X		X		1x8-oz
RAA-18SD-0020	VU				X					1x2-oz, 1x8-oz, 1x16-oz
RAA-19SD-0609	TB									1x16-oz
RAA-19SD-0920	VU		X		X		X		X	
RAA-20SD-0405	TB									1x16-oz
RAA-20SD-0506	VC								X	
RAA-20SD-0620	VU				X					1x8-oz, 1x16-oz
RAA-RB-040722	Rinsate Blank		X			X		X		

Table 4
Summary of Grain Size Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-02	RAA-04	RAA-06	RAA-06	RAA-09	RAA-13	RAA-17	RAA-20	RAA-04	RAA-05
Sample ID		RAA-02SD-1019	RAA-04SD-0506	RAA-06SD-0415	RAA-06SD-0407	RAA-09SD-0516	RAA-13SD-1115	RAA-17SD-0010	RAA-20SD-0506	RAA-04SD-0620	RAA-05SD-1020
Sample Date		7/20/2004	7/21/2004	7/20/2004	7/20/2004	7/19/2004	7/20/2004	7/22/2004	7/22/2004	7/21/2004	7/22/2004
Depth Interval		10-19 ft	5-6 ft	4-15 ft	4-7 ft	5-16 ft	11-15 ft	0-10 ft	5-6 ft	6-20 ft	10-20 ft
Sediment Zone	Unit	VC	VC	VC	VC	VC	VC	VC	VC	VU	VU
Conventionals											
Total Organic Carbon	%	10.2	8.96 X	3.68	--	6.46	13.2	5.87	--	--	1.63
Total Solids	%	61.6	74.8	68.7	70.8	73.7	69.1	62	66.9	63.9	66.2
Percent fines	%	69.7	--	26.67	--	9.89	17.88	48.64	--	--	57.7
Gravel	%	0.28	--	2.06	--	2.34	1.4	1.72	--	--	0
Sand, Very Coarse	%	0.45	--	0.96	--	2.92	2.46	1.35	--	--	0.14
Sand, Coarse	%	0.63	--	2.41	--	5.28	4.95	3.51	--	--	0.29
Sand, Medium	%	1.62	--	15.9	--	35.2	43.5	12.7	--	--	2.62
Sand, Fine	%	8.74	--	31.9	--	37.1	26.6	18.1	--	--	19.9
Sand, Very Fine	%	16.7	--	18.9	--	7.7	3.94	16.7	--	--	19.5
Silt	%	54.1	--	20.6	--	7.44	13.1	41	--	--	45.4
Clay	%	15.6	--	6.07	--	2.45	4.78	7.64	--	--	12.3

Table 4
Summary of Grain Size Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID	RAA-06	RAA-08	RAA-10	RAA-11	RAA-11	RAA-12	RAA-14	RAA-17	RAA-19
Sample ID	RAA-06SD-1520	RAA-08SD-0720	RAA-10SD-1020	RAA-11SD-1320	RAA-61SD-1320	RAA-12SD-1820	RAA-14SD-1420	RAA-17SD-1420	RAA-19SD-0920
Sample Date	7/20/2004	7/21/2004	7/19/2004	7/22/2004	7/22/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004
Depth Interval	15-20 ft	7-20 ft	10-20 ft	13-20 ft	13-20 ft	18-20 ft	14-20 ft	14-20 ft	9-20 ft
Sediment Zone	VU	VU	VU	VU	VU	VU	VU	VU	VU
Conventionals									
Total Organic Carbon	1.39	0.84 X	4.87	1.35	1.52	2.76	0.36	1.65	0.83
Total Solids	66.6	67.8	65.5	66.4	65.3	62.6	72	62.3	69.3
Percent fines	46.3	52.5	71.4	53.7	54.6	79.9	27.14	64.04	49.5
Gravel	0	0	0.05	0.22	0.49	0	0	0.05	0.02
Sand, Very Coarse	0.06	0.04	0.1	0.31	0.29	0	0.02	0.3	0.22
Sand, Coarse	0.24	0.17	0.34	1.3	0.96	0.12	0.2	0.52	0.17
Sand, Medium	9.15	0.88	2.73	7.37	7.59	0.85	25.9	4.8	0.67
Sand, Fine	34.8	16.6	10.6	22.3	21.4	3.31	37.1	16.9	19.7
Sand, Very Fine	8.94	29.9	12.2	15.2	14.6	15	9.36	13.7	28.7
Silt	36.1	42.2	58.1	41.6	42	64.8	21.3	59.7	39.2
Clay	10.2	10.3	13.3	12.1	12.6	15.1	5.84	4.34	10.3

Table 5
Summary of Atterberg Limit Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-02	RAA-14	RAA-17	RAA-01	RAA-04	RAA-10	RAA-18SD-0020	RAA-19	RAA-20
Sample ID		RAA-02SD-1019	RAA-14SD-1014	RAA-17SD-0010	RAA-01SD-0520	RAA-04SD-0620	RAA-10SD-1020	RAA-18SD-0020	RAA-19SD-0920	RAA-20SD-0620
Sample Date		7/20/2004	7/20/2004	7/22/2004	7/21/2004	7/22/2004	7/19/2004	7/21/2004	7/22/2004	7/22/2004
Depth Interval		10-19 ft	10-14 ft	0-10 ft	5-20 ft	6-20 ft	10-20 ft	0-20 ft	9-20 ft	6-20 ft
Sediment Zone	Unit	VC	VC	VC	VU	VU	VU	VU	VU	VU
Atterberg Limits										
Liquid Limit	%	31	29.9	NP	NP	NP	29.2	NP	NP	NP
Plastic Limit	%	28	29.2	NP	NP	NP	24.5	NP	NP	NP
Plasticity Index	%	3	0.7	NP	NP	NP	4.7	NP	NP	NP

Notes:

NP - Non-plastic

Table 7
Toxic Characteristic Leaching Procedure Analytical Summary

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	TCLP Criteria	RAA-03 RAA-03SD-0513 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD-0204 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD-0413 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD-0911 7/20/2004 9-11 ft Tar Body
Metals						
Arsenic	mg/l	5	**0.03 J**	0.1 U	0.1 U	0.1 U
Barium	mg/l	100	**1.5**	**0.6 J**	**0.6 J**	**0.5 J**
Cadmium	mg/l	1	0.01 U	0.01 U	0.01 U	0.01 U
Chromium	mg/l	5	0.01 U	**0.004 J**	**0.003 J**	**0.003 J**
Lead	mg/l	5	0.05 U	0.05 U	0.05 U	0.05 U
Selenium	mg/l	1	0.1 U	0.1 U	0.1 U	0.1 U
Silver	mg/l	5	0.02 U	0.02 U	0.02 U	0.02 U
Mercury	mg/l	0.2	0.001 U	0.001 U	0.001 U	0.001 U
Pesticides						
Chlordane	mg/l	0.03	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Endrin	mg/l	0.02	0.00050 U	0.00050 U	0.00050 U	0.00050 U
gamma-BHC (Lindane)	mg/l	0.4	0.00050 U	0.00050 U	0.00050 U	0.00050 U
Heptachlor	mg/l	0.008	0.00050 U	0.00050 U	0.00050 U	0.00050 U
Heptachlor Epoxide	mg/l	--	0.00050 U	0.00050 U	0.00050 U	0.00050 U
Methoxychlor	mg/l	10	0.0010 U	0.0010 U	0.0010 U	0.0010 U
Toxaphene	mg/l	0.5	0.010 U	0.010 U	0.010 U	0.010 U
2,4-D	mg/l	10	0.10 U	0.10 U	0.10 U	0.10 U
Silvex	mg/l	1	0.02 U	0.02 U	0.02 U	0.02 U
Semi-Volatile Organic Compounds (SVOC)						
2,4,5-Trichlorophenol	mg/l	400	0.10 U	0.10 U	0.10 U	0.10 U
2,4,6-Trichlorophenol	mg/l	2	0.10 U	0.10 U	0.10 U	0.10 U
2,4-Dinitrotoluene	mg/l	0.13	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
2-Methylphenol	mg/l	200	0.10 U	**0.022 J**	0.10 U	0.10 U
4-Methylphenol	mg/l	200	0.10 U	**0.083 J**	0.10 U	0.10 U
Hexachlorobenzene	mg/l	0.13	0.10 U	0.10 U	0.10 U	0.10 U
Hexachlorobutadiene	mg/l	0.5	0.10 U	0.10 U	0.10 U	0.10 U
Hexachloroethane	mg/l	3	0.10 U	0.10 U	0.10 U	0.10 U
Nitrobenzene	mg/l	2	0.10 U	0.10 U	0.10 U	0.10 U
Pentachlorophenol	mg/l	100	0.25 U	0.25 U	0.25 U	0.25 U
Pyridine	mg/l	2	0.50 U	0.50 U	0.50 U	0.50 U
Volatile Organic Compounds (VOC)						
1,1-Dichloroethene	mg/l	0.7	0.20 U	0.20 U	0.20 U	0.20 U
1,2-Dichloroethane	mg/l	0.5	0.20 U	0.20 U	0.20 U	0.20 U
1,4-Dichlorobenzene	mg/l	7.5	0.20 U	0.20 U	0.20 U	0.20 U
2-Butanone (MEK)	mg/l	200	8.0 U	8.0 U	8.0 U	8.0 U
Benzene	mg/l	0.5	0.20 U	**30 ***	**0.45**	**3.3 ***
Carbon tetrachloride	mg/l	0.5	0.20 U	0.20 U	0.20 U	0.20 U
Chlorobenzene	mg/l	100	0.20 U	0.20 U	0.20 U	0.20 U
Chloroform	mg/l	6	0.20 U	0.20 U	0.20 U	0.20 U
Tetrachloroethene	mg/l	0.7	0.20 U	0.20 U	0.20 U	0.20 U
Trichloroethene	mg/l	0.5	0.20 U	0.20 U	0.20 U	0.20 U
Vinyl chloride	mg/l	0.2	0.080 U	0.080 U	0.080 U	0.080 U

Notes:

J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

U The compound was analyzed for, but was not detected at or above the MRL/MDL.

* The result is greater than the criteria value.

Table 8
Chemical Analytical Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-02	RAA-04	RAA-06	RAA-06	RAA-09	RAA-13	RAA-14	RAA-17	RAA-20	RAA-04	RAA-05	RAA-06
Sample ID		RAA-02SD-1019	RAA-04SD-0506	RAA-06SD-0415	RAA-06SD-0407	RAA-09SD-0516	RAA-13SD-1115	RAA-14SD-1014	RAA-17SD-0010	RAA-20SD-0506	RAA-04SD-0620	RAA-05SD-1020	RAA-06SD-1520
Sample Date		7/20/2004	7/21/2004	7/20/2004	7/20/2004	7/19/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004	7/21/2004	7/22/2004	7/20/2004
Depth Interval		10-19 ft	5-6 ft	4-15 ft	4-7 ft	5-16 ft	11-15 ft	10-14 ft	0-10 ft	5-6 ft	6-20 ft	10-20 ft	15-20 ft
Sediment Zone	Unit	VC	VC	VC	VC	VC	VC	VC	VC	VC	VU	VU	VU
Conventionals													
Total Organic Carbon	%	**10.2**	**8.96 J**	**3.68**	--	**6.46**	**13.2**	**14.2**	**5.87**	--	--	**1.63**	**1.39**
Total Solids	%	**61.6**	**74.8**	**68.7**	**70.8**	**73.7**	**69.1**	**61.5**	**62**	**66.9**	**63.9**	**66.2**	**66.6**
Cyanide	mg/kg	**0.08 J**	**1.7**	**0.17 J**	--	**0.8**	**0.7**	**0.8**	**0.14 J**	--	--	0.2 UJ	0.2 U
Percent fines	%	**69.7**	--	**26.67**	--	**9.89**	**17.88**	**52.9**	**48.64**	--	--	**57.7**	**46.3**
Metals													
Arsenic	mg/kg	**3**	--	**2.3**	--	**1.9**	**1.7**	**2.8**	**3**	--	--	**2.5**	**2.7**
Chromium	mg/kg	**19.8**	--	**18.3**	--	**14.9**	**11.6**	**18**	**18.6**	--	--	**19.2**	**17.7**
Copper	mg/kg	**27.1**	--	**19.4**	--	**15.8**	**14.1**	**26.9**	**26.3**	--	--	**23.7**	**22.6**
Lead	mg/kg	**26.1**	--	**20**	--	**10.2**	**9.83**	**18.5**	**19.8**	--	--	**10.7**	**14**
Nickel	mg/kg	**19.6**	--	**19.6**	--	**19.5**	**15.8**	**20.8**	**20.4**	--	--	**19**	**18.2**
Zinc	mg/kg	**64.1**	--	**50.2**	--	**41.5**	**43.8**	**79.9**	**64.5**	--	--	**51.3**	**53.8**
Total Petroleum Hydrocarbons (TPH)													
TPH -Diesel Range	mg/kg	**8800 Z**	**26000Z**	**2800 Z**	--	**15000 Z**	**17000 Z**	**51000Z**	**3400 Z**	--	--	**190 Y**	**130 Y**
TPH - Residual Range	mg/kg	**8100 Z**	**14000Z**	**2800 Z**	--	**9100 Z**	**11000 Z**	**24000Z**	**3600 Z**	--	--	**420 O**	**300 O**
Semivolatile Organic Compounds (SVOC)													
2,4,5-Trichlorophenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2,4,6-Trichlorophenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2,4-Dichlorophenol	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
2,4-Dimethylphenol	ug/kg	25000 U	--	--	--	10000 U	50000 U	--	4000 U	--	--	--	50 U
2,4-Dinitrophenol	ug/kg	100000 U	--	--	--	40000 U	20000 U	--	16000 U	--	--	--	200 U
2,4-Dinitrotoluene	ug/kg	5000 U	--	--	--	2000 U	1300 U	--	800 U	--	--	--	10 U
2,6-Dinitrotoluene	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Chloronaphthalene	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Chlorophenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Methylnaphthalene	ug/kg	**65000**	**510000**	**7500**	--	**210000**	**440000**	**1600000**	**11000**	--	--	**260**	**7.2 J**
2-Methylphenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Nitroaniline	ug/kg	10000 U	--	--	--	4000 U	2000 U	--	1600 U	--	--	--	20 U
2-Nitrophenol	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
3,3'-Dichlorobenzidine	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
3-Nitroaniline	ug/kg	10000 U	--	--	--	4000 U	2000 U	--	1600 U	--	--	--	20 U
4,6-Dinitro-2-methylphenol	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
4-Bromophenylphenylether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
4-Chloro-3-methylphenol	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
4-Chloroaniline	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
4-Chlorophenyl-phenylether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
4-Methylphenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	**63**
4-Nitroaniline	ug/kg	10000 U	--	--	--	4000 U	2000 U	--	1600 U	--	--	--	20 U
4-Nitrophenol	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
Acenaphthene	ug/kg	**200000**	**710000**	**47000**	--	**230000**	**830000**	**1400000**	**61000**	--	--	**1000**	**100**
Acenaphthylene	ug/kg	**9900**	**99000**	**3000**	--	**170000**	**140000**	**190000**	**3400**	--	--	**120**	**36**
Anthracene	ug/kg	**95000**	**400000**	**28000**	--	**160000**	**420000**	**550000**	**32000**	--	--	**780**	**110**
Benzo(a)anthracene	ug/kg	**89000**	**290000**	**24000**	--	**130000**	**340000**	**410000**	**29000**	--	--	**940**	**280**
Benzo(a)pyrene	ug/kg	**130000**	**340000**	**35000**	--	**170000**	**450000**	**500000**	**43000**	--	--	**1800**	**610**
Benzo(b)fluoranthene	ug/kg	**110000**	**200000**	**20000**	--	**150000**	**390000**	**290000**	**37000**	--	--	**1100**	**540**
Benzo(g,h,i)perylene	ug/kg	**120000**	**260000**	**33000**	--	**140000**	**370000**	**390000**	**38000**	--	--	**2000**	**680**
Benzo(k)fluoranthene	ug/kg	**36000**	**210000**	**21000**	--	**48000**	**130000**	**330000**	**10000**	--	--	**980**	**140**
Benzoic acid	ug/kg	100000 U	--	--	--	40000 U	200000 U	--	16000 UJ	--	--	--	200 U
Benzyl alcohol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
bis(2-Chloroethoxy)methane	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U

Table 8
Chemical Analytical Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-08	RAA-10	RAA-11	RAA-11	RAA-12	RAA-14	RAA-17	RAA-19
Sample ID		RAA-08SD-0720	RAA-10SD-1020	RAA-11SD-1320	RAA-61SD-1320	RAA-12SD-1820	RAA-14SD-1420	RAA-17SD-1420	RAA-19SD-0920
Sample Date		7/21/2004	7/19/2004	7/22/2004	7/22/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004
Depth Interval		7-20 ft	10-20 ft	13-20 ft	13-20 ft	18-20 ft	14-20 ft	14-20 ft	9-20 ft
Sediment Zone	Unit	VU	VU	VU	VU	VU	VU	VU	VU
Conventionals									
Total Organic Carbon	%	**0.84 J**	**4.87**	**1.35**	**1.52**	**2.76**	**0.36**	**1.65**	**0.83**
Total Solids	%	**67.8**	**65.5**	**66.4**	**65.3**	**62.6**	**72**	**62.3**	**69.3**
Cyanide	mg/kg	**0.04 J**	**0.1 J**	0.2 UJ	0.2 UJ	**0.09 J**	**0.06 J**	**0.3 J**	0.2 UJ
Percent fines	%	**52.5**	**71.4**	**53.7**	**54.6**	**79.9**	**27.14**	**64.04**	**49.5**
Metals									
Arsenic	mg/kg	**1.9**	**2.5**	**2.9**	**2.9**	**2.9**	**2.3**	**3.2**	**1.8**
Chromium	mg/kg	**17.7**	**18.3**	**18**	**18.5**	**20.3**	**17.3**	**21.5**	**18.3**
Copper	mg/kg	**21.4**	**25.9**	**23.3**	**23.4**	**28.6**	**18.6**	**26.8**	**21.8**
Lead	mg/kg	**4.59**	**16**	**12.8**	**12.8**	**19**	**3.47**	**15**	**4.68**
Nickel	mg/kg	**18.8**	**18.4**	**18**	**18.7**	**18.9**	**20.5**	**20.6**	**19.8**
Zinc	mg/kg	**43.3**	**56.5**	**51.2**	**52.1**	**65.1**	**42.4**	**57.6**	**44.6**
Total Petroleum Hydrocarbons (TPH)									
TPH -Diesel Range	mg/kg	**17 J**	**2800 Z**	**190 Y**	**160 Y**	**510 Z**	24 U	**180 Y**	23 U
TPH - Residual Range	mg/kg	**39 J**	**2700 Z**	**340 O**	**300 O**	**760 Z**	**49 J**	**370 O**	**31 J**
Semivolatile Organic Compounds (SVOC)									
2,4,5-Trichlorophenol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,4,6-Trichlorophenol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,4-Dichlorophenol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,4-Dimethylphenol	ug/kg	--	5100 U	--	--	5000 U	50 U	40 U	--
2,4-Dinitrophenol	ug/kg	--	21000 U	--	--	20000 U	200 U	160 U	--
2,4-Dinitrotoluene	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,6-Dinitrotoluene	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Chloronaphthalene	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Chlorophenol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Methylnaphthalene	ug/kg	**140**	**31000**	**440**	**850**	**2300**	**39**	**160**	**15**
2-Methylphenol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Nitroaniline	ug/kg	--	2100 U	--	--	2000 U	20 U	16 U	--
2-Nitrophenol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
3,3'-Dichlorobenzidine	ug/kg	--	11000 U	--	--	10000 U	100 U	80 U	--
3-Nitroaniline	ug/kg	--	2100 U	--	--	2000 U	20 U	16 U	--
4,6-Dinitro-2-methylphenol	ug/kg	--	11000 U	--	--	10000 U	100 U	80 U	--
4-Bromophenylphenylether	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Chloro-3-methylphenol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Chloroaniline	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Chlorophenyl-phenylether	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Methylphenol	ug/kg	--	1100 U	--	--	1000 U	10 U	51	--
4-Nitroaniline	ug/kg	--	2100 U	--	--	2000 U	20 U	16 U	--
4-Nitrophenol	ug/kg	--	11000 U	--	--	10000 U	100 U	80 U	--
Acenaphthene	ug/kg	**200**	**120000**	**1600**	**1900**	**14000**	**150**	**120000**	**370**
Acenaphthylene	ug/kg	**90**	**4900**	**200**	**290**	**640 J**	**12**	**57**	**8**
Anthracene	ug/kg	**140**	**63000**	**960**	**1000**	**9600**	**56**	**56000**	**9.4**
Benzo(a)anthracene	ug/kg	**140**	**50000**	**910**	**1100**	**7900**	**42**	**78000**	**16**
Benzo(a)pyrene	ug/kg	**200**	**67000**	**1800**	**2100**	**11000**	**60**	**130000**	**22**
Benzo(b)fluoranthene	ug/kg	**120**	**58000**	**1100**	**1200**	**9900**	**53**	**110000**	**16**
Benzo(g,h,i)perylene	ug/kg	**160**	**63000**	**2200**	**2600**	**11000**	**56**	**130000**	**21**
Benzo(k)fluoranthene	ug/kg	**110**	**17000**	**900**	**1100**	**2900**	**16**	**260**	**13**
Benzoic acid	ug/kg	--	21000 U	--	--	20000 U	200 U	160 UJ	--
Benzyl alcohol	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
bis(2-Chloroethoxy)methane	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--

Table 8
Chemical Analytical Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-02	RAA-04	RAA-06	RAA-06	RAA-09	RAA-13	RAA-14	RAA-17	RAA-20	RAA-04	RAA-05	RAA-06
Sample ID		RAA-02SD-1019	RAA-04SD-0506	RAA-06SD-0415	RAA-06SD-0407	RAA-09SD-0516	RAA-13SD-1115	RAA-14SD-1014	RAA-17SD-0010	RAA-20SD-0506	RAA-04SD-0620	RAA-05SD-1020	RAA-06SD-1520
Sample Date		7/20/2004	7/21/2004	7/20/2004	7/20/2004	7/19/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004	7/21/2004	7/22/2004	7/20/2004
Depth Interval		10-19 ft	5-6 ft	4-15 ft	4-7 ft	5-16 ft	11-15 ft	10-14 ft	0-10 ft	5-6 ft	6-20 ft	10-20 ft	15-20 ft
Sediment Zone	Unit	VC	VC	VC	VC	VC	VC	VC	VC	VC	VU	VU	VU
bis(2-Chloroethyl)ether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
bis(2-chloroisopropyl)ether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
bis(2-Ethylhexyl)phthalate	ug/kg	100000 U	--	--	--	**810 J**	20000 U	--	16000 U	--	--	--	**8.7 J**
Butylbenzylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Chrysene	ug/kg	**110000**	**380000**	**30000**	--	**170000**	**420000**	**500000**	**35000**	--	--	**1300**	**380**
Dibenzo(a,h)anthracene	ug/kg	**12000**	**22000**	**2000**	--	**17000**	**48000**	**33000**	**4100**	--	--	**110**	**39 J**
Dibenzofuran	ug/kg	**5600**	**56000**	**1700**	--	**17000**	**40000**	**81000**	**1800**	--	--	**36**	**3.4 J**
Diethylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Dimethylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Di-n-butylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Di-n-octylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Fluoranthene	ug/kg	**330000**	**1100000**	**97000**	--	**520000**	**1300000**	**1600000**	**120000**	--	--	**4500**	**1300**
Fluorene	ug/kg	**60000**	**360000**	**15000**	--	**140000**	**340000**	**590000**	**20000**	--	--	**360**	**34**
Hexachlorobenzene	ug/kg	--	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Hexachlorobutadiene	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
Hexachlorocyclopentadiene	ug/kg	25000 UJ	--	--	--	10000 U	5000 U	--	4000 U	--	--	--	50 U
Hexachloroethane	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Indeno(1,2,3-cd)pyrene	ug/kg	**100000**	**220000**	**28000**	--	**130000**	**330000**	**330000**	**31000**	--	--	**1700**	**530**
Isophorone	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
Naphthalene	ug/kg	**640000**	**1600000**	**26000**	--	**1400000**	**3200000**	**6300000**	**96000**	--	--	**1100**	**56**
Nitrobenzene	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
N-Nitroso-di-n-propylamine	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
n-Nitrosodiphenylamine	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Pentachlorophenol	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
Phenanthrene	ug/kg	**440000**	**2200000**	**150000**	--	**910000**	**2200000**	**3200000**	**150000**	--	--	**4000**	**660**
Phenol	ug/kg	15000 U	--	--	--	6000 U	3000 U	--	2400 U	--	--	--	**8.4 J**
Pyrene	ug/kg	**400000**	**1500000**	**150000**	--	**590000**	**1400000**	**2200000**	**140000**	--	--	**5700**	1600
Volatile Organic Compounds (VOC)													
1,1,1-Trichloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1,2,2-Tetrachloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1,2-Trichloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1,2-Trichlorotrifluoroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1-Dichloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1-Dichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,2,3-Trichlorobenzene	ug/kg	--	--	--	--	--	--	--	3200 U	--	--	--	--
1,2,4-Trichlorobenzene	ug/kg	33 U	--	--	--	120 U	150 U	--	800 U	--	--	--	10 U
1,2-Dibromo-3-chloropropane	ug/kg	33 U	--	--	--	120 U	150 U	--	3200 U	--	--	--	30 U
1,2-Dichlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,2-Dichloroethane	ug/kg	**6.1 J**	--	--	--	**140**	36 U	--	800 U	--	--	--	7.5 U
1,2-Dichloropropane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,3-Dichlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,4-Dichlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
2-Butanone (MEK)	ug/kg	33 U	--	--	--	120 U	150 U	--	32000 U	--	--	--	30 U
2-Hexanone	ug/kg	33 U	--	--	--	120 U	150 U	--	32000 U	--	--	--	30 U
4-Methyl-2-pentanone (MIBK)	ug/kg	33 U	--	--	--	120 U	150 U	--	32000 U	--	--	--	30 U
Acetone	ug/kg	33 UJ	--	--	--	**58 J**	150 UJ	--	32000 U	--	--	--	**61 J**
Benzene	ug/kg	**290**	**17000**	**190**	**1200**	**6700**	**620**	**18000**	800 U	**400**	**2.2 J**	--	7.5 U
Bromochloromethane	ug/kg	--	--	--	--	--	--	--	800 U	--	--	--	--
Bromodichloromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Bromoform	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Bromomethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 UJ	--	--	--	7.5 U
Carbonisulfide	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U

Table 8
Chemical Analytical Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-08	RAA-10	RAA-11	RAA-11	RAA-12	RAA-14	RAA-17	RAA-19
Sample ID		RAA-08SD-0720	RAA-10SD-1020	RAA-11SD-1320	RAA-61SD-1320	RAA-12SD-1820	RAA-14SD-1420	RAA-17SD-1420	RAA-19SD-0920
Sample Date		7/21/2004	7/19/2004	7/22/2004	7/22/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004
Depth Interval		7-20 ft	10-20 ft	13-20 ft	13-20 ft	18-20 ft	14-20 ft	14-20 ft	9-20 ft
Sediment Zone	Unit	VU	VU	VU	VU	VU	VU	VU	VU
bis(2-Chloroethyl)ether	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
bis(2-chloroisopropyl)ether	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
bis(2-Ethylhexyl)phthalate	ug/kg	--	21000 U	--	--	20000 U	**37 J**	**8.3 J**	--
Butylbenzylphthalate	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Chrysene	ug/kg	**160**	**63000**	**1300**	**1500**	**10000**	**80**	**93000**	**23**
Dibenzo(a,h)anthracene	ug/kg	**17**	**7100**	**97**	**110**	**860 J**	**5.4 J**	**100**	**1.6 J**
Dibenzofuran	ug/kg	**18**	**3700**	**64**	**97**	**370 J**	**5.4 J**	**25**	**1.3 J**
Diethylphthalate	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Dimethylphthalate	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Di-n-butylphthalate	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Di-n-octylphthalate	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Fluoranthene	ug/kg	**410**	**200000**	**5000**	**5600**	**33000**	**150**	**310000**	**47**
Fluorene	ug/kg	**120**	**44000**	**510**	**750**	**5600**	**45**	**300**	**12**
Hexachlorobenzene	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Hexachlorobutadiene	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Hexachlorocyclopentadiene	ug/kg	--	5100 U	--	--	5000 U	50 U	40 U	--
Hexachloroethane	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Indeno(1,2,3-cd)pyrene	ug/kg	**160**	**52000**	**1800**	**2100**	**8900**	**47**	**110000**	**16**
Isophorone	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Naphthalene	ug/kg	**650**	**140000**	**1500**	**2800**	**2000**	**220**	**93000**	**36 J**
Nitrobenzene	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
N-Nitroso-di-n-propylamine	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
n-Nitrosodiphenylamine	ug/kg	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Pentachlorophenol	ug/kg	--	11000 U	--	--	10000 U	100 U	80 U	--
Phenanthrene	ug/kg	**640**	**280000**	**4200**	**5200**	**44000**	**260**	**320000**	**47**
Phenol	ug/kg	--	3100 U	--	--	3000 U	**5.4 J**	**11 J**	--
Pyrene	ug/kg	**480**	**230000**	**6100**	**7500**	**39000**	**170**	**380000**	**64**
Volatile Organic Compounds (VOC)									
1,1,1-Trichloroethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1,2,2-Tetrachloroethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1,2-Trichloroethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1,2-Trichlorotrifluoroethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1-Dichloroethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1-Dichloroethene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,2,3-Trichlorobenzene	ug/kg	--	--	--	--	--	--	32 U	--
1,2,4-Trichlorobenzene	ug/kg	--	31 U	--	--	32 U	10 U	8.0 U	--
1,2-Dibromo-3-chloropropane	ug/kg	--	31 U	--	--	32 U	28 U	32 U	--
1,2-Dichlorobenzene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,2-Dichloroethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,2-Dichloropropane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,3-Dichlorobenzene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,4-Dichlorobenzene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
2-Butanone (MEK)	ug/kg	--	31 U	--	--	**14 J**	28 U	32 U	--
2-Hexanone	ug/kg	--	31 U	--	--	32 U	28 U	32 U	--
4-Methyl-2-pentanone (MIBK)	ug/kg	--	31 U	--	--	32 U	28 U	32 U	--
Acetone	ug/kg	--	**24 J**	--	--	**69 J**	**24 J**	**47**	--
Benzene	ug/kg	**2.9 J**	**23**	7.5 U	**1.3 J**	8.0 U	**3.6 J**	7.9 U	**9.2**
Bromochloromethane	ug/kg	--	--	--	--	--	--	7.9 U	--
Bromodichloromethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Bromoform	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Bromomethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Carbonisulfide	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--

Table 8
Chemical Analytical Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-02	RAA-04	RAA-06	RAA-06	RAA-09	RAA-13	RAA-14	RAA-17	RAA-20	RAA-04	RAA-05	RAA-06
Sample ID		RAA-02SD-1019	RAA-04SD-0506	RAA-06SD-0415	RAA-06SD-0407	RAA-09SD-0516	RAA-13SD-1115	RAA-14SD-1014	RAA-17SD-0010	RAA-20SD-0506	RAA-04SD-0620	RAA-05SD-1020	RAA-06SD-1520
Sample Date		7/20/2004	7/21/2004	7/20/2004	7/20/2004	7/19/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004	7/21/2004	7/22/2004	7/20/2004
Depth Interval		10-19 ft	5-6 ft	4-15 ft	4-7 ft	5-16 ft	11-15 ft	10-14 ft	0-10 ft	5-6 ft	6-20 ft	10-20 ft	15-20 ft
Sediment Zone	Unit	VC	VC	VC	VC	VC	VC	VC	VC	VC	VU	VU	VU
Carbon tetrachloride	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chloroform	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chloromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
cis-1,2-Dichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
cis-1,3-Dichloropropene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Cyclohexane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	1600 U	--	--	--	7.5 U
Dibromochloromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Dichlorodifluoromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Dichloromethane	ug/kg	17 U	--	--	--	**7.0 J**	**12 J**	--	3200 U	--	--	--	**1.7 J**
Ethylbenzene	ug/kg	**53**	**7100**	**120**	**370**	**780**	**130**	**31000**	**1600**	**1300**	**7.8 U**	--	7.5 U
Isopropylbenzene	ug/kg	**3.5 J**	--	--	--	**72 J**	**19 J**	--	**190 J**	--	--	--	30 U
m,p-Xylenes	ug/kg	**25**	**6900**	**32**	**120**	**580**	**200**	21000 U	800 U	**570**	7.8 U	--	7.5 U
Methyl acetate	ug/kg	8.1 UJ	--	--	--	28 UJ	36 UJ	--	1600 U	--	--	--	7.5 UJ
Methyl cyclohexene	ug/kg	8.1 U	--	--	--	**6.7 J**	36 U	--	1600 U	--	--	--	7.5 U
Methyltert-butylether	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
o-Xylene	ug/kg	**13**	**4800**	**49**	**170**	**350**	**100**	**11000**	**330 J**	**700**	7.8 U	--	7.5 U
Styrene	ug/kg	8.1 U	--	--	--	**60**	36 U	--	800 UJ	--	--	--	7.5 U
Tetrachloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Toluene	ug/kg	**3.2 J**	**1300**	**11**	**54**	**1500**	**56**	**3800**	800 U	**100 J**	7.8 U	--	7.5 U
trans-1,2-Dichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
trans-1,3-Dichloropropene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Trichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Trichlorofluoromethane	ug/kg	8.1 UJ	--	--	--	28 UJ	36 UJ	--	800 U	--	--	--	7.5 UJ
Vinyl Acetate	ug/kg	33 U	--	--	--	120 U	150 U	--	--	--	--	--	30 U
Vinyl chloride	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U

Table 8
Chemical Analytical Results for Visually Contaminated and Visually Uncontaminated Zones

Location ID		RAA-08	RAA-10	RAA-11	RAA-11	RAA-12	RAA-14	RAA-17	RAA-19
Sample ID		RAA-08SD-0720	RAA-10SD-1020	RAA-11SD-1320	RAA-61SD-1320	RAA-12SD-1820	RAA-14SD-1420	RAA-17SD-1420	RAA-19SD-0920
Sample Date		7/21/2004	7/19/2004	7/22/2004	7/22/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004
Depth Interval		7-20 ft	10-20 ft	13-20 ft	13-20 ft	18-20 ft	14-20 ft	14-20 ft	9-20 ft
Sediment Zone	Unit	VU	VU	VU	VU	VU	VU	VU	VU
Carbon tetrachloride	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chlorobenzene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chloroethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chloroform	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chloromethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
cis-1,2-Dichloroethene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
cis-1,3-Dichloropropene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Cyclohexane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Dibromochloromethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Dichlorodifluoromethane	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Dichloromethane	ug/kg	--	**1.8 J**	--	--	**3.1 J**	**1.7 J**	**2.9 J**	--
Ethylbenzene	ug/kg	7.4 U	**25**	7.5 U	7.6 U	8.0 U	**1.5 J**	7.9 U	7.2 U
Isopropylbenzene	ug/kg	--	**4.1 J**	--	--	**1.8 J**	**3.4 J**	32 U	--
m,p-Xylenes	ug/kg	7.4 U	**10**	7.5 U	7.6 U	**2.9 J**	7.0 U	7.9 U	7.2 U
Methyl acetate	ug/kg	--	7.6 UJ	--	--	8.0 UJ	7.0 UJ	7.9 U	--
Methyl cyclohexene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Methyltert-butylether	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
o-Xylene	ug/kg	7.4 U	**11**	7.5 U	7.6 U	**1.5 J**	7.0 U	7.9 U	**1.0 J**
Styrene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Tetrachloroethene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Toluene	ug/kg	**1.9 J**	**2.5 J**	7.5 U	7.6 U	8.0 U	7.0 U	7.9 U	7.2 U
trans-1,2-Dichloroethene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
trans-1,3-Dichloropropene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Trichloroethene	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Trichlorofluoromethane	ug/kg	--	7.6 UJ	--	--	8.0 UJ	7.0 UJ	7.9 U	--
Vinyl Acetate	ug/kg	--	31 U	--	--	32 U	28 U	--	--
Vinyl chloride	ug/kg	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--

Notes:

J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

U The compound was analyzed for, but was not detected at or above the MRL/MDL.

Z The chromatographic fingerprint does not resemble a petroleum product.

VC Visually Contaminated

VU Visually Uncontaminated

Table 9
Comparison of TPAH Concentrations in Tar and New Sediment Surface

	Tar	Post-Dredge Surface Concentrations							
Location ID	**SD-7**	**RAA-02**	**RAA-04**	**RAA-06**	**RAA-09**	**RAA-10**	**RAA-11**	**RAA-13**	**RAA-14**
Sample ID	**SD-7-1**	**RAA-02-1019**	**RAA-04-0506**	**RAA-06-1520**	**RAA-09-0516**	**RAA-10-1020**	**RAA-11-1320**	**RAA-13-1115**	**RAA-14-1014**
Sample Reference	**Hahn 1996**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**
Depth Interval	**0-15 cm**	**10 - 19 ft**	**5 - 6 ft**	**15 - 20 ft**	**5 - 16 ft**	**10 - 20 ft**	**13 - 20 ft**	**11 - 15 ft**	**10 - 14 ft**
Sediment Zone	**Tar Sample**	**Visual. Cont.**	**Visual. Cont.**	**Visual. Uncont.**	**Visual. Cont.**	**Visual. Uncont.**	**Visual. Uncont.**	**Visual. Cont.**	**Visual. Cont.**
Total PAH[a] (mg/kg)	26,408	2,947	10,401	7.10	5,285	1,490	38	12,748	20,413
Total PAH[a] (%)	2.64%	0.29%	1.04%	0.00%	0.53%	0.15%	0.00%	1.27%	2.04%

Notes:

[a] - Total PAH concentrations calculated as sum of 17 PAHs (undetected assumed to be zero)

J- Analyte value is an estimate

Table 10
Dredge Water Quality Kuo-Hayes Model Simulation Results - 30 sec Cycle Time

Distance from Dredge	50 ft			100 ft			200 ft			300 ft			400 ft			Acute
Percentile Result	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**(ug/L)**
Total Suspended Sediment Concentration (mg/L)	263	757	961	177	491	621	114	283	375	83	209	280	65	163	223	N/AV
DRET-Based Water Concentration Ratio (unitless) - As Compared to Acute Water Quality Criteria																
Copper	3.42E-02	1.07E-01	1.43E-01	2.29E-02	6.93E-02	9.26E-02	1.45E-02	4.25E-02	5.62E-02	1.06E-02	3.11E-02	4.11E-02	8.34E-03	2.40E-02	3.24E-02	13
Cyanide	6.03E-03	6.03E-03	6.03E-03	4.11E-03	4.11E-03	4.11E-03	2.69E-03	2.69E-03	2.69E-03	2.03E-03	2.03E-03	2.03E-03	1.63E-03	1.63E-03	1.63E-03	22
Anthracene	2.64E-02	8.81E-02	1.30E-01	1.78E-02	5.94E-02	8.60E-02	1.14E-02	3.63E-02	5.31E-02	8.11E-03	2.66E-02	3.92E-02	6.26E-03	2.16E-02	3.01E-02	13
Benzo(a)anthracene	3.41E-01	1.24E+00	1.65E+00	2.31E-01	7.82E-01	1.08E+00	1.45E-01	4.79E-01	6.48E-01	1.08E-01	3.51E-01	4.69E-01	8.46E-02	2.81E-01	3.71E-01	0.49
Benzo(a)pyrene	7.12E-01	2.45E+00	3.52E+00	4.86E-01	1.63E+00	2.28E+00	3.14E-01	1.03E+00	1.42E+00	2.32E-01	7.65E-01	1.03E+00	1.81E-01	6.02E-01	8.06E-01	0.24
Benzene	5.60E-04	5.60E-04	5.60E-04	3.81E-04	3.81E-04	3.81E-04	2.49E-04	2.49E-04	2.49E-04	1.89E-04	1.89E-04	1.89E-04	1.51E-04	1.51E-04	1.51E-04	2300
Fluoranthene	8.98E-04	3.32E-03	4.31E-03	5.92E-04	2.08E-03	2.83E-03	3.79E-04	1.29E-03	1.75E-03	2.81E-04	9.29E-04	1.31E-03	2.19E-04	7.43E-04	1.05E-03	3980
Fluorene	1.24E-02	4.34E-02	6.44E-02	8.39E-03	2.78E-02	3.97E-02	5.38E-03	1.70E-02	2.38E-02	3.96E-03	1.25E-02	1.70E-02	3.08E-03	9.76E-03	1.33E-02	70
Naphthalene	3.36E-02	1.21E-01	1.71E-01	2.28E-02	7.92E-02	1.14E-01	1.45E-02	4.79E-02	7.12E-02	1.03E-02	3.36E-02	5.49E-02	7.91E-03	2.60E-02	4.37E-02	2300
Ethylbenzene	1.57E-02	5.65E-02	7.70E-02	1.05E-02	3.69E-02	4.83E-02	6.60E-03	2.21E-02	3.04E-02	4.89E-03	1.58E-02	2.30E-02	3.82E-03	1.24E-02	1.80E-02	130
Toluene	1.77E-02	5.59E-02	7.52E-02	1.18E-02	3.66E-02	4.94E-02	7.57E-03	2.19E-02	3.04E-02	5.58E-03	1.62E-02	2.18E-02	4.27E-03	1.23E-02	1.78E-02	120
Sum of Ratios	1.20E+00	4.17E+00	5.84E+00	8.16E-01	2.73E+00	3.80E+00	5.22E-01	1.70E+00	2.33E+00	3.86E-01	1.25E+00	1.69E+00	3.01E-01	9.92E-01	1.33E+00	

DRET - Dredging Elutriate Test

Table 11
ARAR Compliance Summary

The NCP provides that "removal action pursuant to CERCLA 106 shall, to the extent practicable considering the exigencies of the situation, attain applicable or relevant and appropriate requirements under the federal environmental or state environmental or facility siting laws. Waivers described in § 300.430(f)(1)(ii)(C) may be used for removal actions. In determining whether compliance with ARARs is practicable, the lead agency may consider appropriate factors, including: (1) The urgency of the situation; and (2) The scope of the removal action to be conducted." 40 CFR § 300.415(i). This table contains a summary of ARARs for this project as presented in the Draft Final Removal Action Project Plan (RAPP) and references the draft final RAPP sections that addressed each ARAR. This table is subject to revision based on the contents of the Final RAPP, which has not yet been completed.

ARARs	Citation	Summary	Reference
FEDERAL ARARS			
Clean Water Act	33 U.S.C. §§ 1251 et. seq.		
Federal Water Quality Criteria	CWA §§ 303 and 304 (33 U.S.C. §§ 1313 and 1314)	Pursuant to CERCLA §121(d)(B)(i), otherwise non-enforceable water quality criteria, developed by EPA for surface water, are ARARs. Two kinds of water quality criteria have been developed: one for protection of human health, and another for protection of aquatic life.	RAPP Section 2.2: Chemical Characterization RAPP Section 2.2.1: Elutriate Testing RAPP Section 3.2: Removal RAPP Section 3.6.1: Water Quality Analysis RAPP Section 3.6.2: Summary of Environmental Controls Appendix A Section 4.1: Spill Prevention Appendix A Section 4.2: Contingencies for Spills Appendix D Section 2.0: Water Quality Monitoring Appendix E Section 2.1: Action Triggers
Discharge of dredge and fill material	CWA §404 (33 U.S.C. 1344), 40 CFR § 230	Regulates discharge of dredged and fill material into waters of the United States.	RAPP Section 3.5 and 3.6.2

Table 11
ARAR Compliance Summary

ARARs	Citation	Summary	Reference
Floodplain Management and Wetlands Protection	40 CFR Part 6 App. A and Executive Order 11988 and 11990	Requires federal agencies to conduct their activities to avoid, if possible, adverse impacts associated with the destruction or modification of wetlands and occupation or modification of floodplains. Executive Order 11988 requires federal projects to avoid adverse effects associated with construction in floodplains.	Appendix E Section 4.1: Protection of Land Resources
Discharge of pollutants to waters	CWA § 401 (33 U.S.C. § 1341).	Applies to any activity which may result in any discharge into navigable waters and would require that such discharge comply with state water quality standards.	RAPP Section 2.2.3: General Chemical Characterization
Rivers and Harbors Act of 1899	33 U.S.C. §§ 401 et. seq.		Federal navigation will not be obstructed by the removal activities unless EPA insists on requiring a containment system that requires obstruction of Federal navigation.
Obstruction of navigable waters generally; wharves; piers, etc.; excavation and filling-in	33 U.S.C. § 403	Controls the alteration of navigable waters (i.e. waters subject to ebb and flow of the tide shoreward to the mean high water mark). Activities controlled include construction of structures such as piers, berms, and installation of pilings. Section 10 may be applicable for any action that may obstruct or alter a navigable waterway.	RAPP Section 3.2: Removal RAPP Section 3.2.2: In-water Obstructions/Debris?? RAPP Section 3.5: Pilot Capping/Cover
Resource Conservation and Recovery Act	42 U.S.C. §6901 et seq,		
Hazardous Waste identification and management	40 C.F.R. Parts 261 and 262 (adopted by reference in OAR §340-100-0002(1)).	Identifies and lists hazardous wastes and establishes standards applicable to generators of hazardous waste	Appendix A Section 5.2: Waste Profiling

Table 11
ARAR Compliance Summary

ARARs	Citation	Summary	Reference
Endangered Species Act	16 U.S.C. §§ 1531 et. seq.	Federal agencies must ensure that actions they authorize, fund, or carry out are not likely to adversely modify or destroy critical habitat of endangered or threatened species. Actions authorized, funded, or carried out by federal agencies may not jeopardize the continued existence of endangered or threatened species, as well as adversely modify or destroy their critical habitats.	RAPP Section 3.6.2: Summary of Environmental Controls Biological Assessment Section 4: Species Information, Analysis of Effects and Effects Determination Appendix E Section 4.3: Protection of Fish and Wildlife
Magnuson-Stevens Fishery Conservation and Management Act	50 CFR Part 600	An evaluation of impacts to Essential Fish Habitat (EFH) is necessary for activities that may adversely affect EFH	Biological Assessment Section 5: Essential Fish Habitat Assessment
Marine Mammal Protection Act	16 U.S.C. §§ 1361 et. seq.	EPA must ensure that its actions do not involve the unauthorized taking of marine mammals.	
Hazardous Materials Transportation Act	49 U.S.C. §§ 5101 et, seq.		
U.S. Department of Transportation – Subchapter C – Hazardous Materials Regulations	49 CFR §§ 171-177	Regulations provide for packaging, documentation, and transport of hazardous waste (also see RCRA requirements for labels and manifests for hazardous waste).	RAPP Section 3.4: Transportation and Disposal RAPP Section 3.6.2: Summary of Environmental Controls RAPP Section 3.7: Notification and Reporting Appendix A Section 4.3: Transfer Facility Appendix A Section 4.4: Transfer Facility Soil Sampling Appendix A Section 5.1: Identification of Preferred Disposal Facilities Appendix A Section 5.2: Waste Profiling Appendix A Section 5.3: Compliance Status Appendix A Section 5.4: Documentation and Tracking Appendix E Section 3.3: Barge Loading Appendix E Section 3.4: Transferring

Table 11
ARAR Compliance Summary

ARARs	Citation	Summary	Reference
National Historic Preservation Act	16 U.S.C. §§ 470 et. seq.	This statute requires EPA to consider effects of remedial actions on historic properties.	RAPP Section 2.3: Cultural Resource Characterization submitted under separate cover.
Archeological and Historical Preservation Act	16 U.S.C. § 4699a-1	In the event that significant scientific, prehistoric, or archeological data are present on a site, EPA must approve the remedial activities so that such data is preserved.	RAPP Section 2.3: Cultural Resource Characterization submitted under separate cover.
Native American Graves Protection and Repatriation Act	25 U.S.C. §3001 et seq.	Requires Federal agencies and museums with possession or control over Native American human remains and associated funerary objects to compile an inventory of such items. Requires Federal agencies and museums with possession or control over Native American non-associated funerary objects, sacred objects, or objects of cultural patrimony to provide a written summary of such objects. Prescribes when a Federal agency or museum must return Native American cultural items.	RAPP Section 2.3: Cultural Resource Characterization submitted under separate cover.
STATE ARARS			
Environmental Cleanup Act	ORS 465.200 – 465.482.		
	ORS 465.315(1)(b)(A) and (1)(e)	Standards for degree of cleanup.	RAPP Section 3.5: Pilot capping/cover RAPP Section 3.6.2: Summary of Environmental Controls
Standards	OAR 340-122-0040(2)(a), (4) and (6)	Hazardous substance remedial action levels and requirements.	Appendix B Section 3.2 RAPP Section 3.4: Transportation and Disposal RAPP Section 3.5: Pilot capping/cover
Air Quality	ORS Chapter 468A		

Table 11
ARAR Compliance Summary

ARARs	Citation	Summary	Reference
Policy and Application	OAR 340-226-0100	Provides general emission standards for fugitive emissions of air contaminants and requires the highest and best practicable treatment of control of such emissions.	RAPP Section 3: Removal Action Project Plan Appendix B Section 3.1 Appendix B Section 3.2 Appendix B Section 7.2
Visible Air Contaminant Limitations	OAR 340-208-0110	Prohibits the emission of any air contaminant from a new source for a period or periods aggregating more than 3 minutes in any 1 hour that is equal to or greater than 20% opacity. These are special rules for "special control areas," including Multnomah County.	Appendix E Section 4.4
Fugitive Emission Requirements	OAR 340-208-0200, 0210	Prohibits any handling, transporting, or storage of materials, or use of a road, or any equipment to be operated, without taking reasonable precautions to prevent particulate matter from becoming airborne. These are special rules for "special control areas," including Multnomah County.	Appendix B Section 3.3.4 Appendix B Section 7.2
Groundwater	OAR 340-040-020 and 340-040-030(3)(b)	The rules follow an "antidegradation policy to emphasize the prevention of groundwater pollution and to control waste discharges to groundwater so that the highest possible water quality is maintained."	RAPP Section 3.
Water Quality			

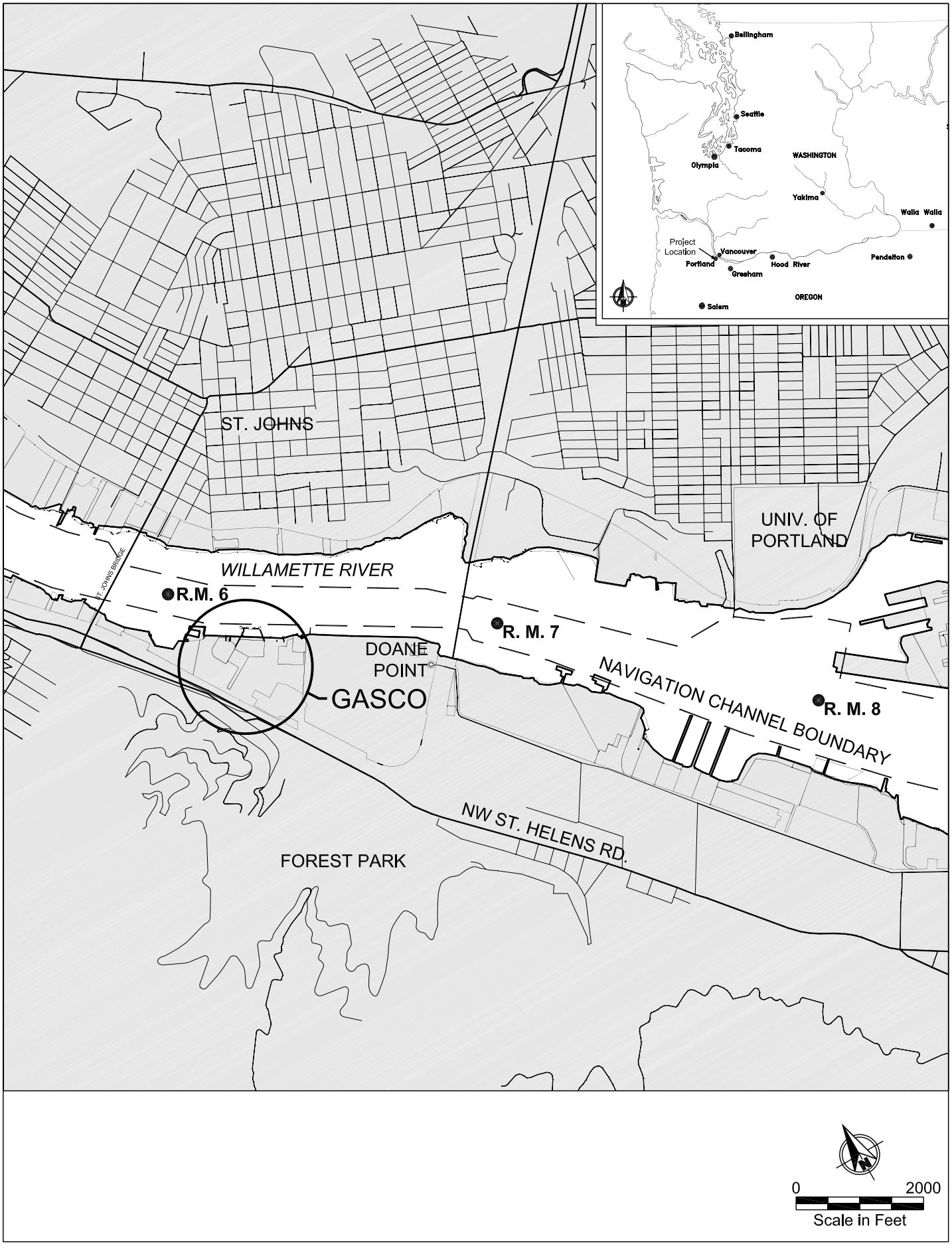
Table 11
ARAR Compliance Summary

ARARs	Citation	Summary	Reference
Statewide Water Quality Plan	OAR 340 Div. 41	Designates beneficial uses for water bodies and water quality standards and criteria necessary to protect those uses. In particular, OAR 340-041-0340 provides the beneficial uses that shall be protected in the Willamette Basin. The Tables referenced therein provide for particular water quality criteria and standards.	RAPP Section 3.5 RAPP Section 3.6.1 RAPP Section 3.6.2 Appendix B Section 3.3.3 Appendix C Section 4.1.3 Appendix D Section 1.0 Appendix D Section 2.0 Appendix D Section 6.2 Appendix E Section 2.1 Appendix E Section 3.2.2 Appendix E Section 3.3 Appendix E Section 3.4 Appendix E Section 5.0
Indian Graves and Protected Objects	ORS 97.740 et seq.	Protects human remains, funerary objects, sacred objects and objects of cultural patrimony	RAPP Section 2.3 and Cultural Resource Characterization submitted under separate cover.
Archaeological Objects and Site	ORS 358.905 et seq.	Protects archaeological objects and sites; requires notice upon discovery of artifacts	RAPP Section 2.3 and cultural resource characterization submitted under separate cover.

Table 11
ARAR Compliance Summary

ARARs	Citation	Summary	Reference
Solid Waste Management	OAR 340-093-0005 through 0060, 340-093-0170, and 340-093-0220	Provides definitions of solid waste and requires disposal of solid waste in a permitted facility. OAR 340-093-0060 provides for "letter authorization" for short-term operation of a disposal site, which includes the proposed transloading facility.	RAPP Section 3.4 and Appendix A
	OAR 340-094-0040	Provides operating criteria for municipal solid waste landfills (which may apply if the material is sent to a "Subtitle D" municipal landfill)	Appendix A Section 5
OTHER CRITERIA, ADVISORIES, GUIDANCE, AND TO BE CONSIDERED INITIATIVES (NONE)			

FIGURES



Aug 20, 2004 2:10pm sdekleva K:\Jobs\000029-GASCO\00002902\00002902-01.dwg FIG 1

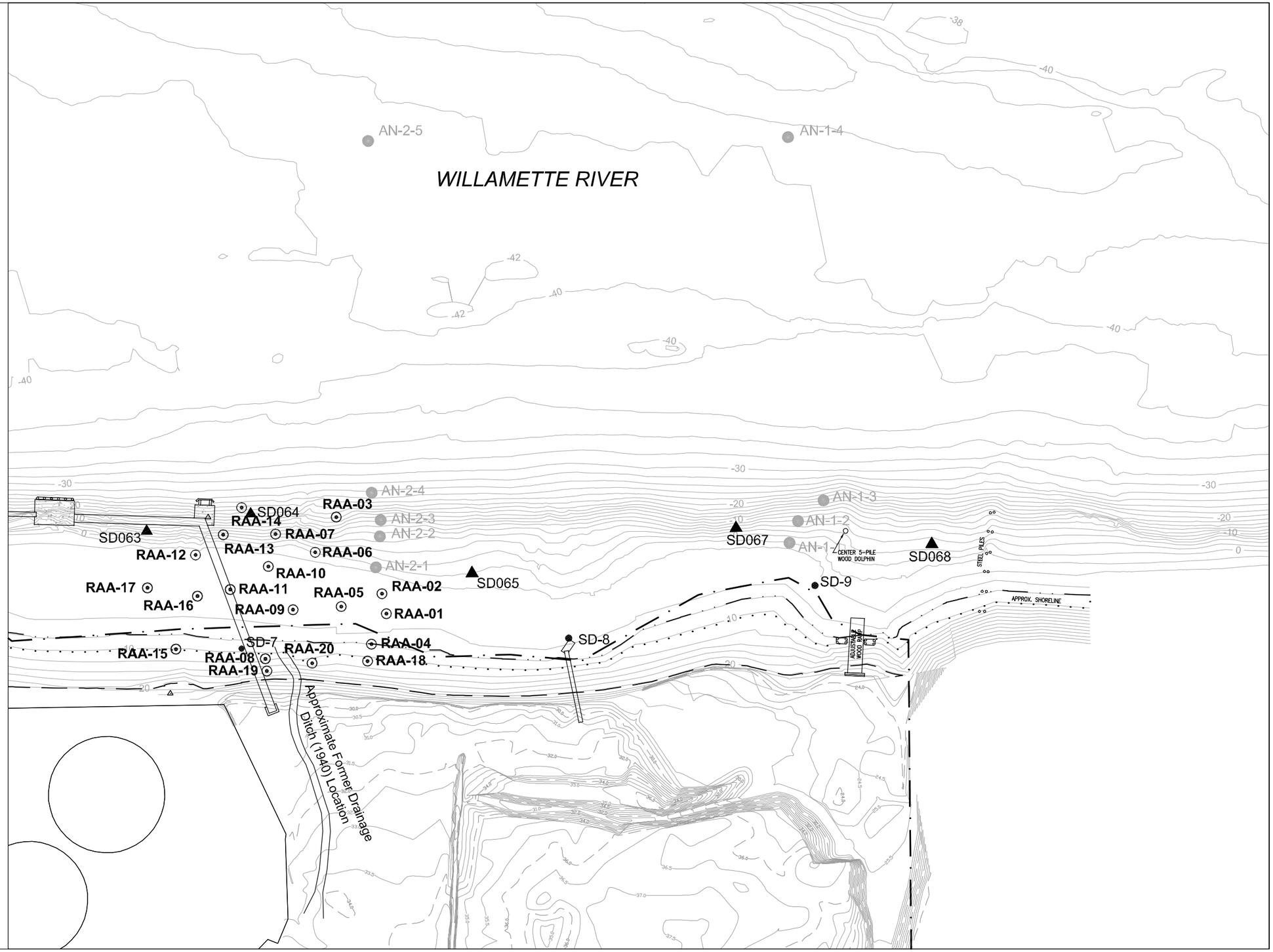
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Vicinity Map
Northwest Natural "Gasco" Site

Legend:

- ⊙ **RAA-01** Design Characterization Sediment Core Location (Anchor 2004)
- AN-2-1 ● Previous Sediment Core Location (Anchor 2002)
- SD063 ▲ Previous Sediment Core Location (Weston 1998)
- SD-7 ● Previous Sediment Core Location (HAI 1996)
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88

0 100
Scale in Feet



Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002).
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD 88 (ft).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report (HAI 1998).

Jul 26, 2005 1:27pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-51.dwg FIG 2

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Summary of Sampling Locations in Vicinity of Tar Body
NW Natural "Gasco" Site

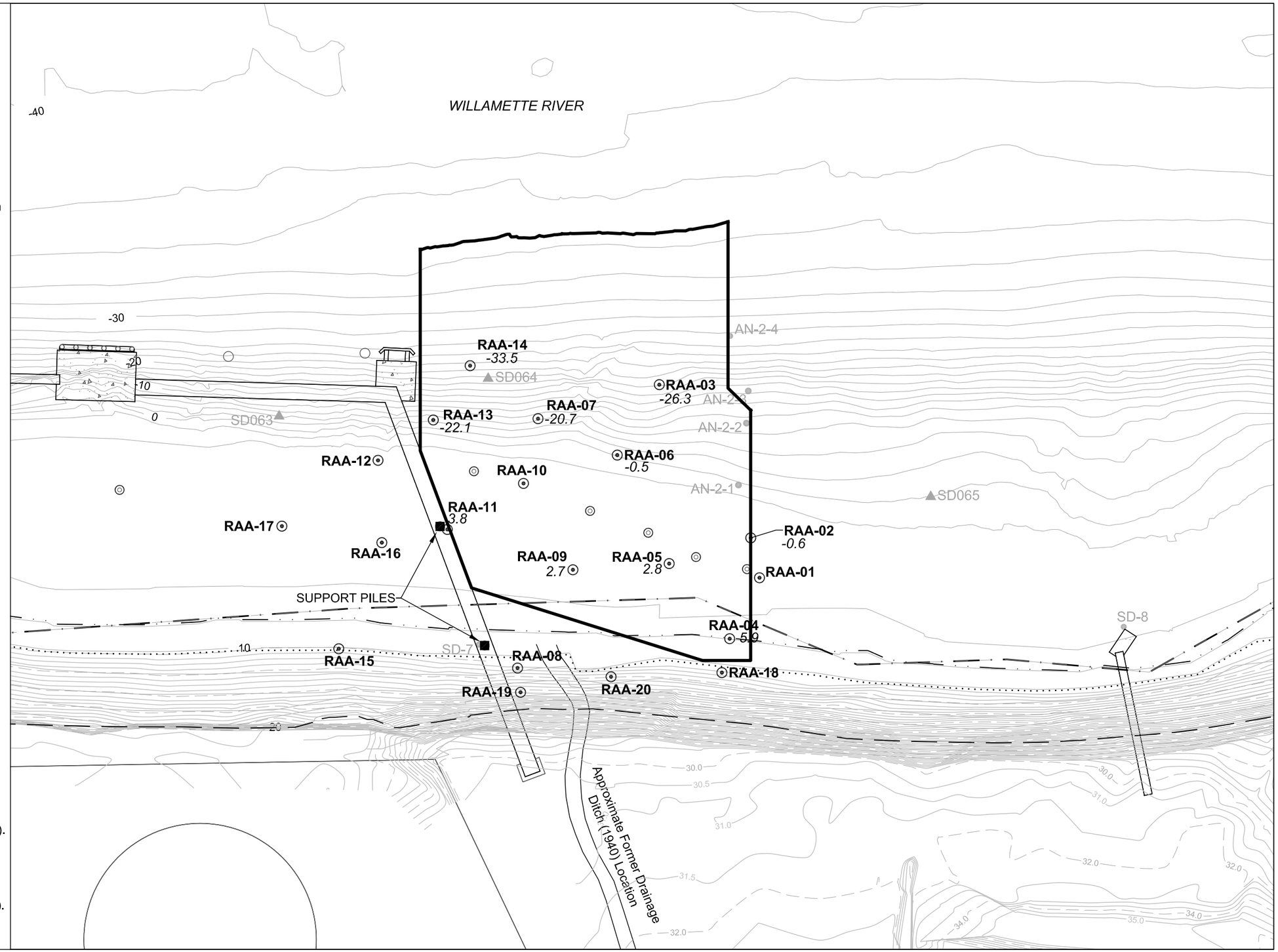
Legend:

- Lateral Extents of Suface Tar Body in Removal Action Area
- RAA-01 Design Characterization Sediment Core Location (Anchor 2004)
- -33.5 Bottom Elevation of Surface Tar Body in Removal Action Area (ft NAVD 88)
- Pile Location (surveyed August 2004)
- AN-2-1 Previous Sediment Core Location (Anchor 2002)
- SD063 Previous Sediment Core Location (Weston 1998)
- SD-7 Previous Sediment Core Location (HAI 1996)
- Support Pile Locations (to be protected during dredging)
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002).
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD 88 (ft).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report (HAI 1998).



K:\Jobs\000029-GASCO\00002902\00002902-62.dwg FIG 3

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ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3
Lateral and Vertical Extents of Surface Tar Body
NW Natural "Gasco" Site

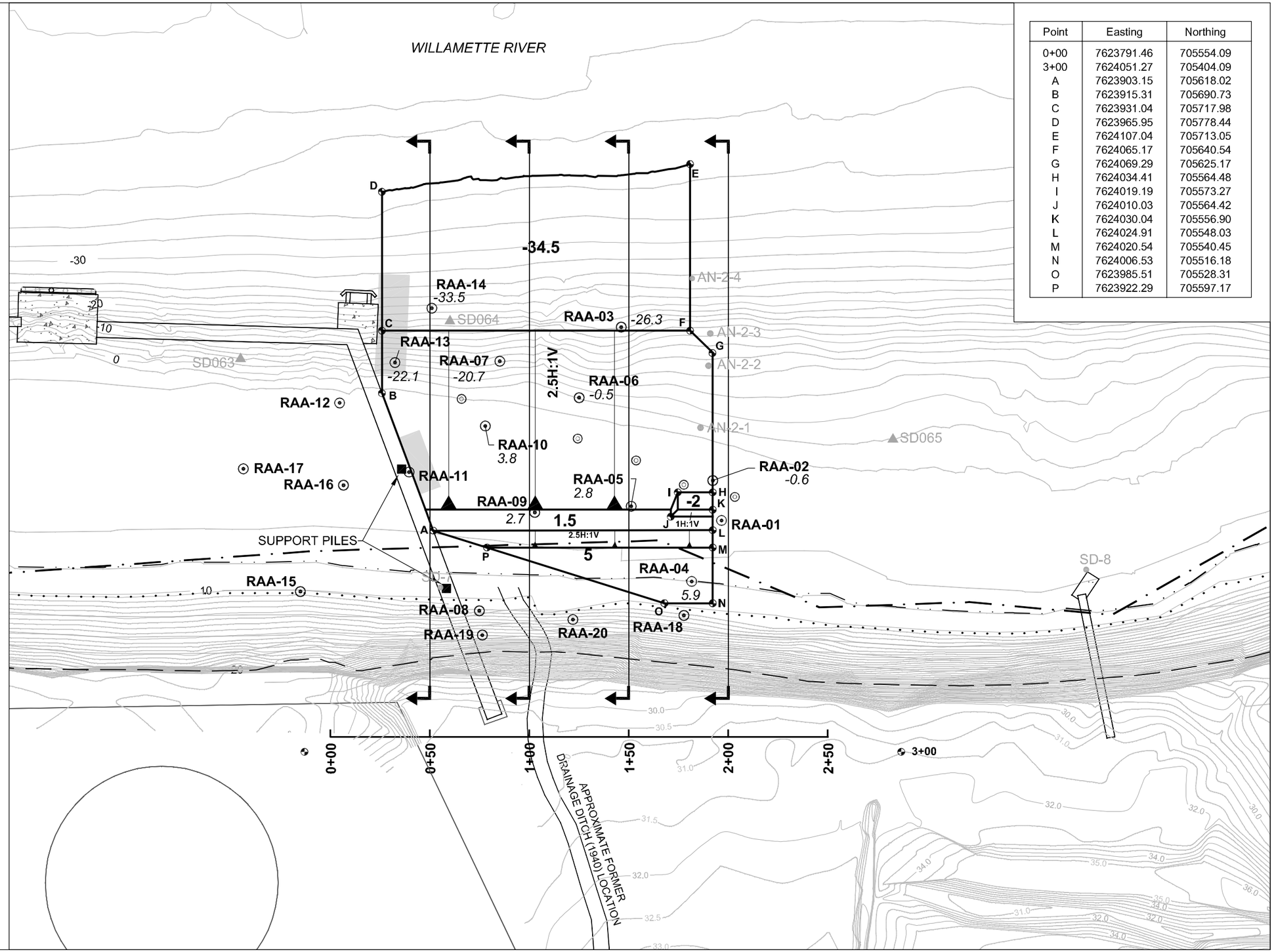
Legend:

- **1.5** Dredge Prism and Dredge Elevation
- **RAA-01** Sample Location and Number (July 2004, Anchor)
- *-33.5* Bottom Elevation of Surface Tar Body in Removal Action Area (ft NAVD 88)
- AN-2-1 Previous Sediment Core Location (Anchor 2001)
- SD063 Previous Sediment Core Location (Weston 1998)
- SD-7 Previous Sediment Core Location (HAI 1996)
- Pile Location (To be removed during dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- A Control Point

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002).
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD 88 (ft).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report (HAI 1998).

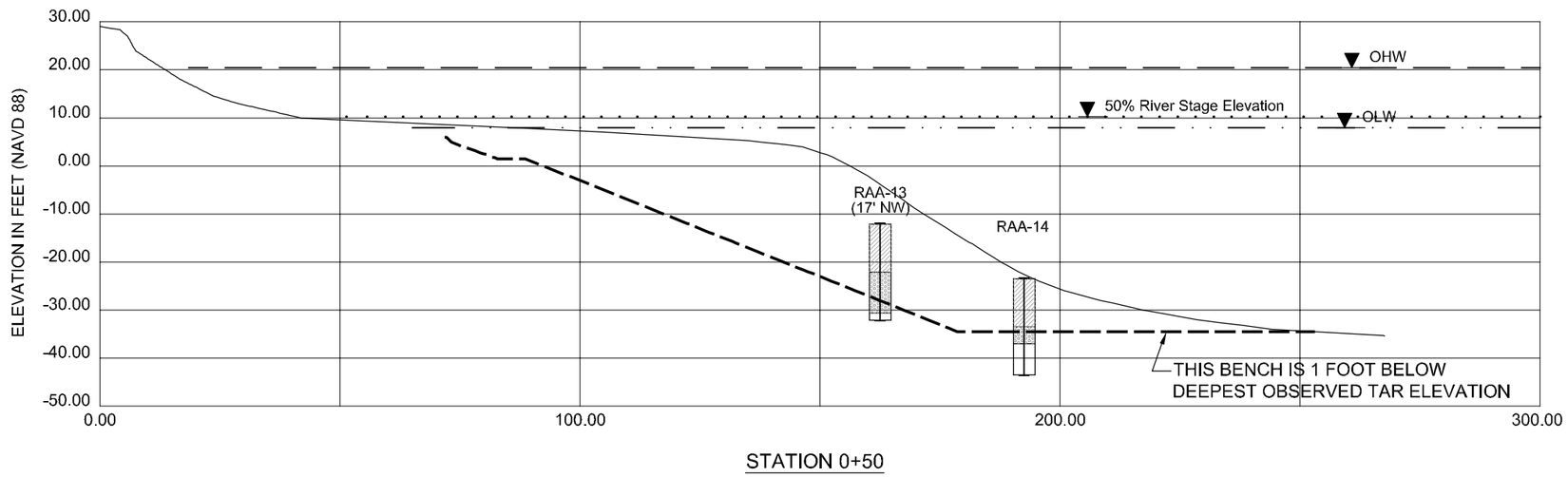


Point	Easting	Northing
0+00	7623791.46	705554.09
3+00	7624051.27	705404.09
A	7623903.15	705618.02
B	7623915.31	705690.73
C	7623931.04	705717.98
D	7623965.95	705778.44
E	7624107.04	705713.05
F	7624065.17	705640.54
G	7624069.29	705625.17
H	7624034.41	705564.48
I	7624019.19	705573.27
J	7624010.03	705564.42
K	7624030.04	705556.90
L	7624024.91	705548.03
M	7624020.54	705540.45
N	7624006.53	705516.18
O	7623985.51	705528.31
P	7623922.29	705597.17

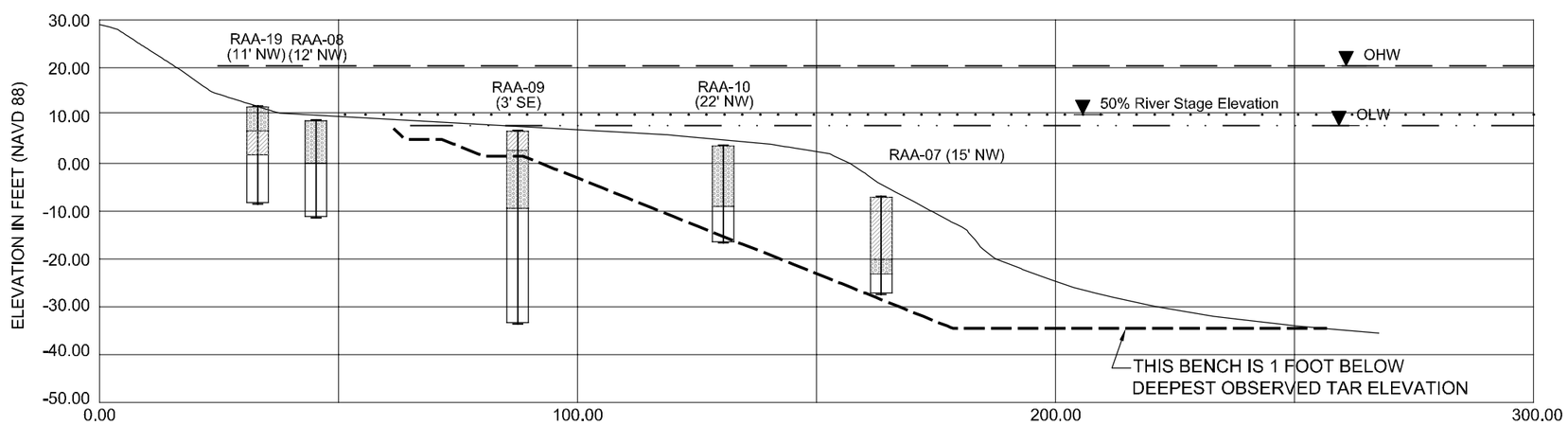
Jul 26, 2005 1:31pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-75.dwg Fig4

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4
Dredge Plan and Cross Section Locations
NW Natural "Gasco" Site



STATION 0+50



STATION 1+00

Legend:

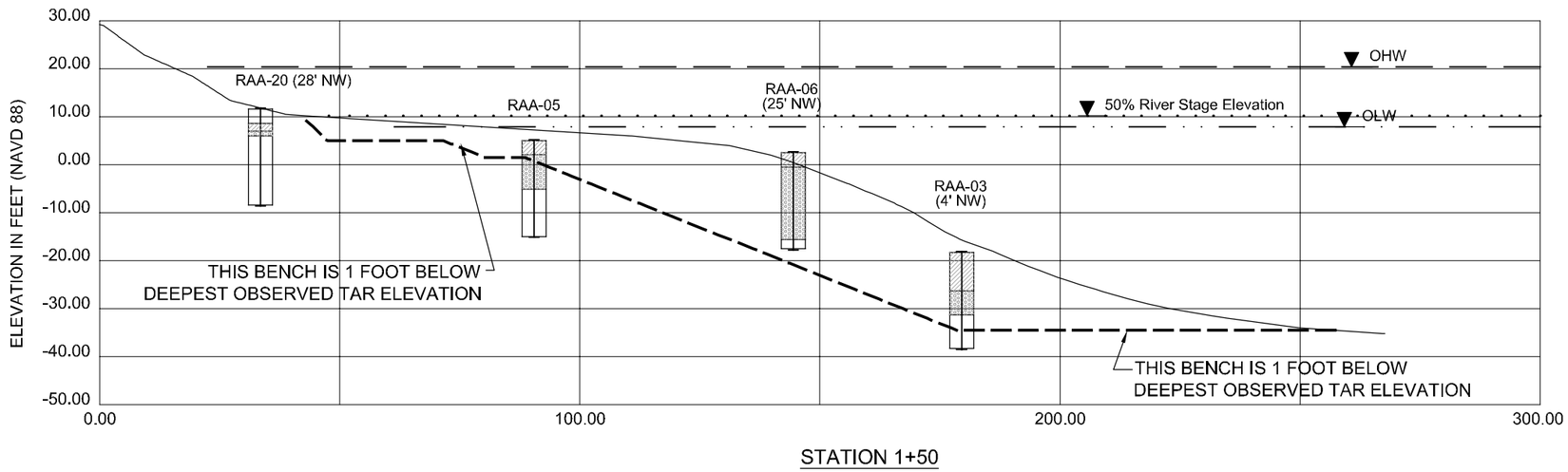
- Existing Surface
- Proposed Dredge Surface (2.5H:1V)
- Tar Present
- Visual Contamination (Oil, Sheen, Pitch, Odor)
- Visually Uncontaminated

0 30
Scale in Feet

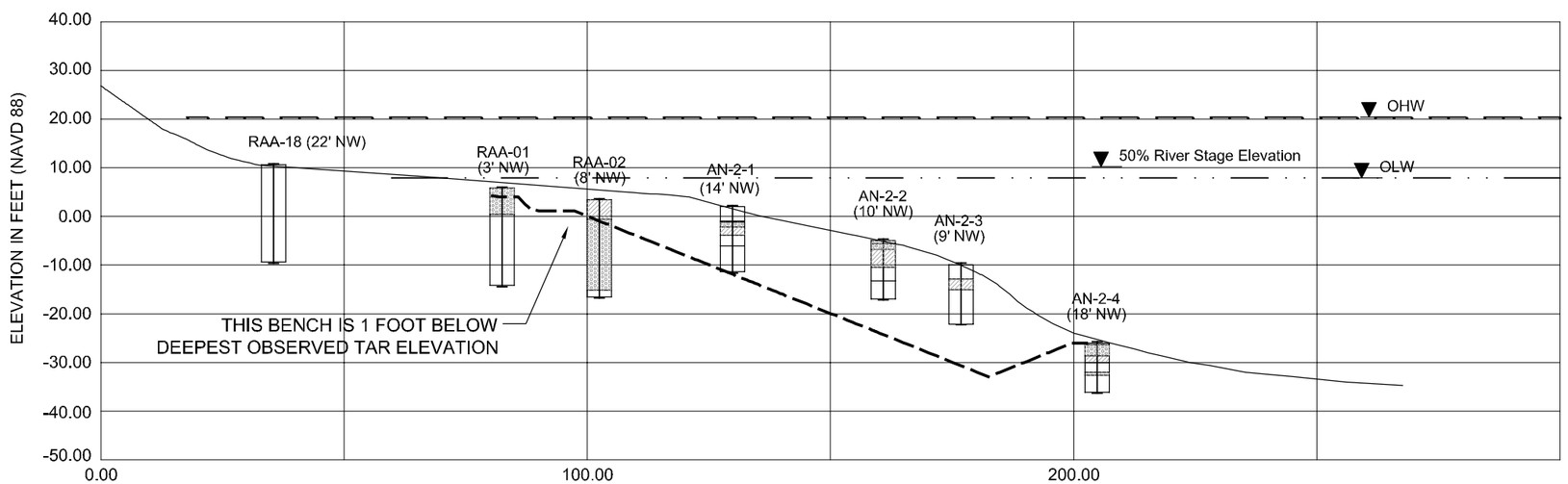
Jul 26, 2005 1:32pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-75.dwg Fig5a

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 5a
Cross Sections at Stations 0+50 and 1+00
NW Natural "Gasco" Site



STATION 1+50



STATION 2+00

Legend:

- Existing Surface
- Proposed Dredge Surface (2.5H:1V)
- Tar Present
- Visual Contamination (Oil, Sheen, Pitch, Odor)
- Visually Uncontaminated

0 30
Scale in Feet

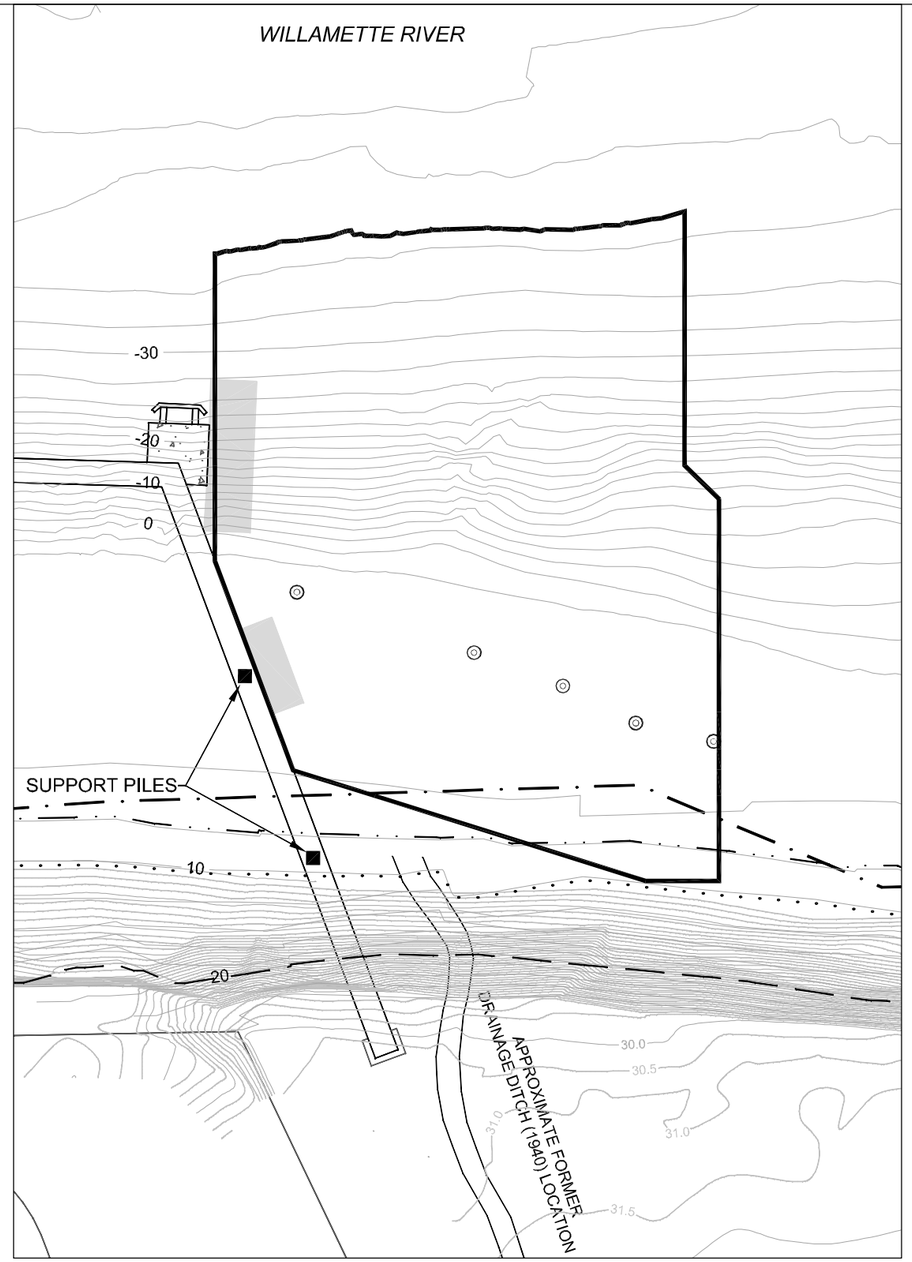
Jul 26, 2005 1:29pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-75.dwg Fig5b

ANCHOR ENVIRONMENTAL, L.L.C.

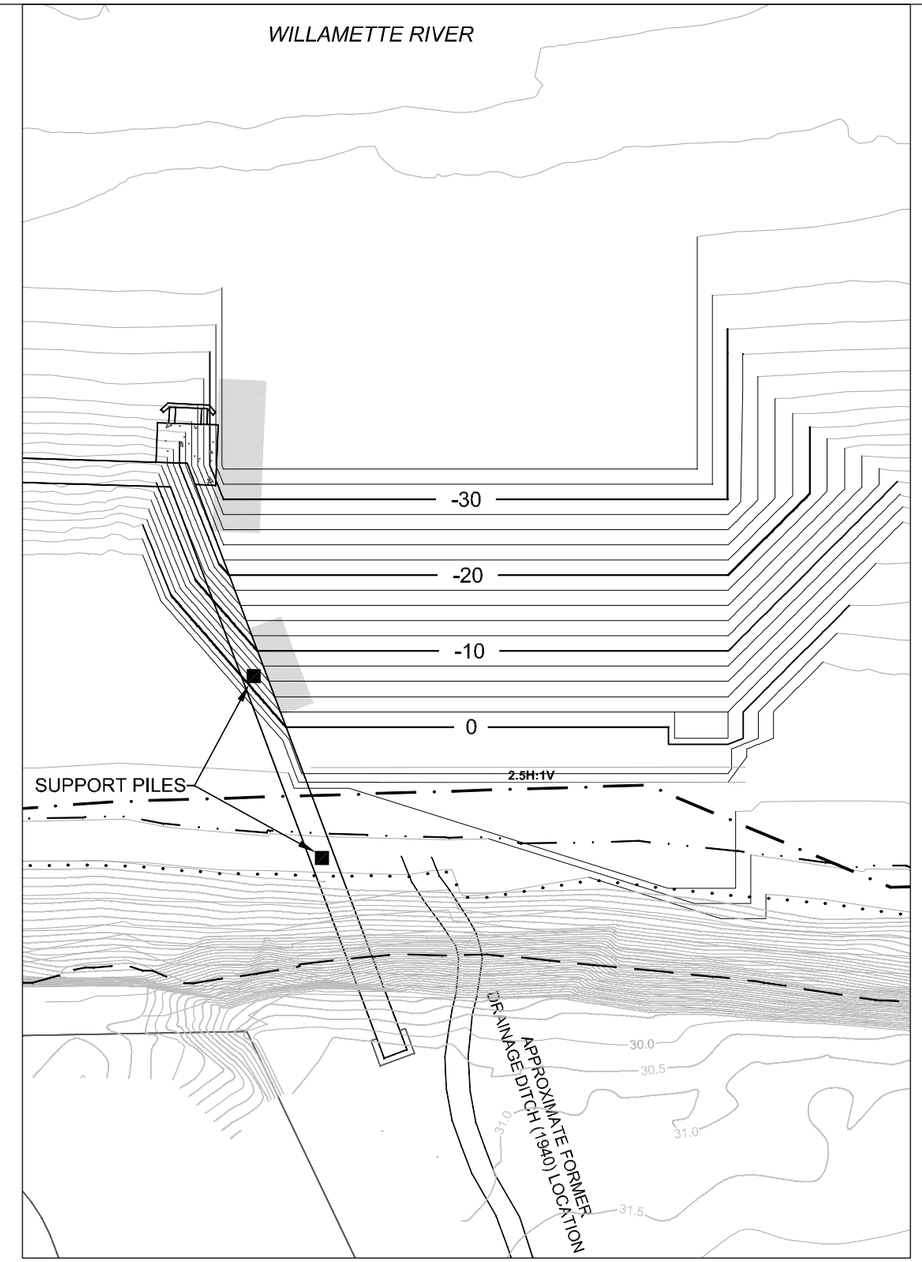
Figure 5b
Cross Sections at Stations 1+50 and 2+00
NW Natural "Gasco" Site

Legend:

- Lateral Extent of Removal Action Area
- Pile Location (To be removed during dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88



Pre-Dredge Bathymetry



Post-Dredge Bathymetry

0 50
Scale in Feet

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002).
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD 88 (ft).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report (HAI 1998).

Jul 26, 2005 1:35pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-45.dwg Fig6

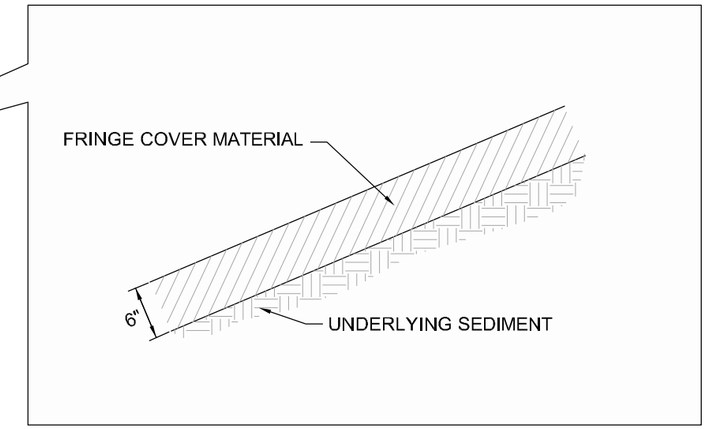
ANCHOR ENVIRONMENTAL, L.L.C.

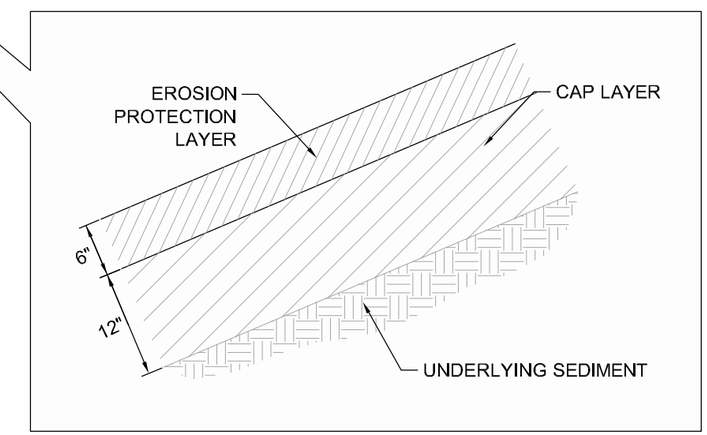
Figure 6
Pre-Dredge and Post-Dredge Bathymetry
NW Natural "Gasco" Site

Legend:

- Support Pile Location
- 15' Dredging Offset to Protect Piles
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- 3 — Extent and Elevation of 18 in Thick Cap
- -34 — Extent and Elevation of 6 in Thick Cover
- Oil Absorbent Boom (mobile)
- Full Length Silt Curtain (anchored)
- Oil Containment Boom With Skirt (2 Ft) (mobile)
- Partial Length Silt Curtain (anchored)
- Bed Load Baffle
- Bubble Curtain

Post Cap and Cover Bathymetry





0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002).
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD 88 (ft).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report (HAI 1998).
6. Slope beneath pipeline support structure allowed to settle to angle of repose - shown at 1H:1V.

Jul 26, 2005 1:39pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-83.dwg FIG 7

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 7
Post Cap and Cover Bathymetry
NW Natural "Gasco" Site

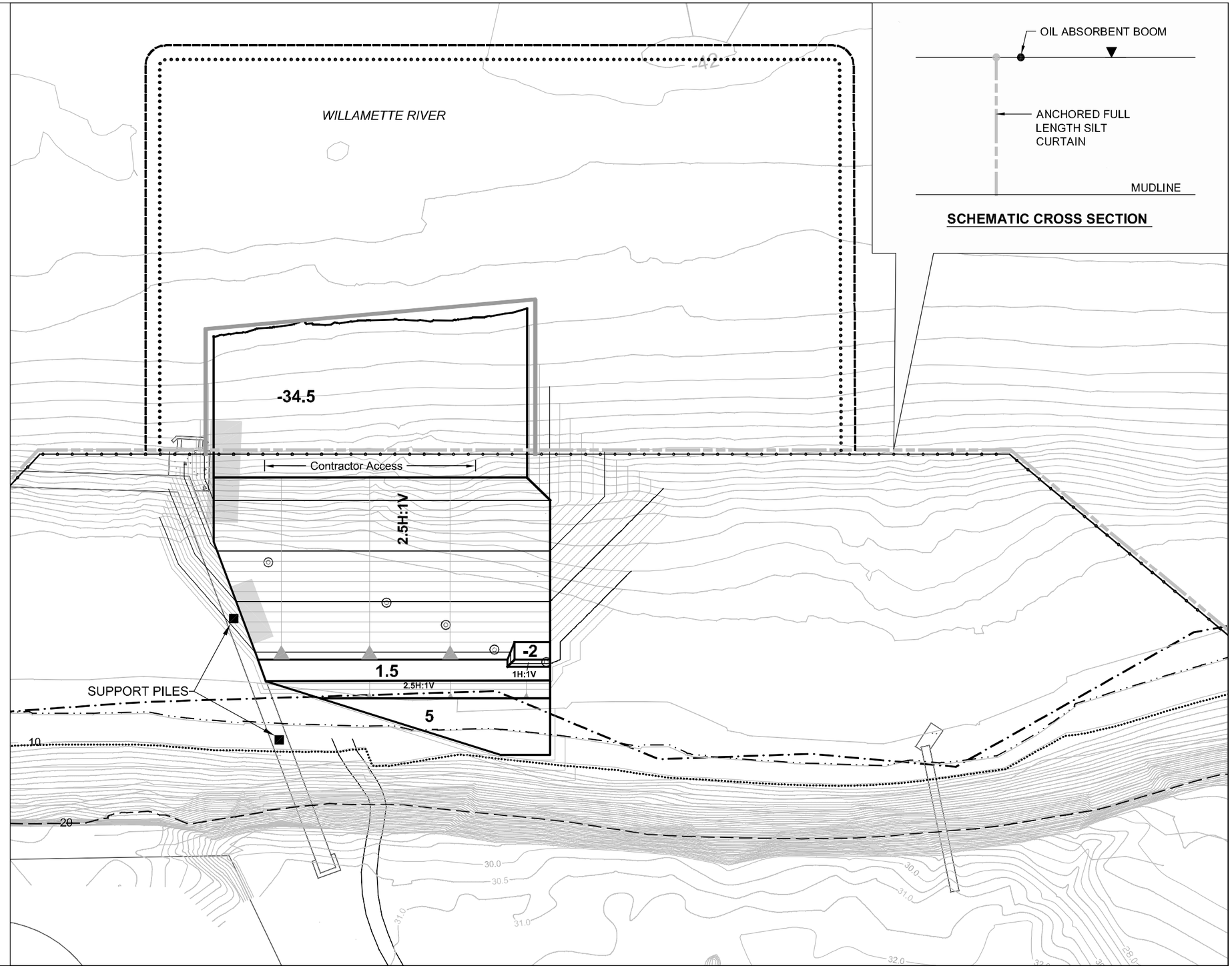
Legend:

- **1.5** Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.



Jul 26, 2005 1:43pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-88.dwg FIG 8a

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 8a
Inner Removal Area - Non-Rigid Containment Configuration
NW Natural "Gasco" Site

Legend:

- 1.5 Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Partial Length Silt Curtain (Anchored)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.

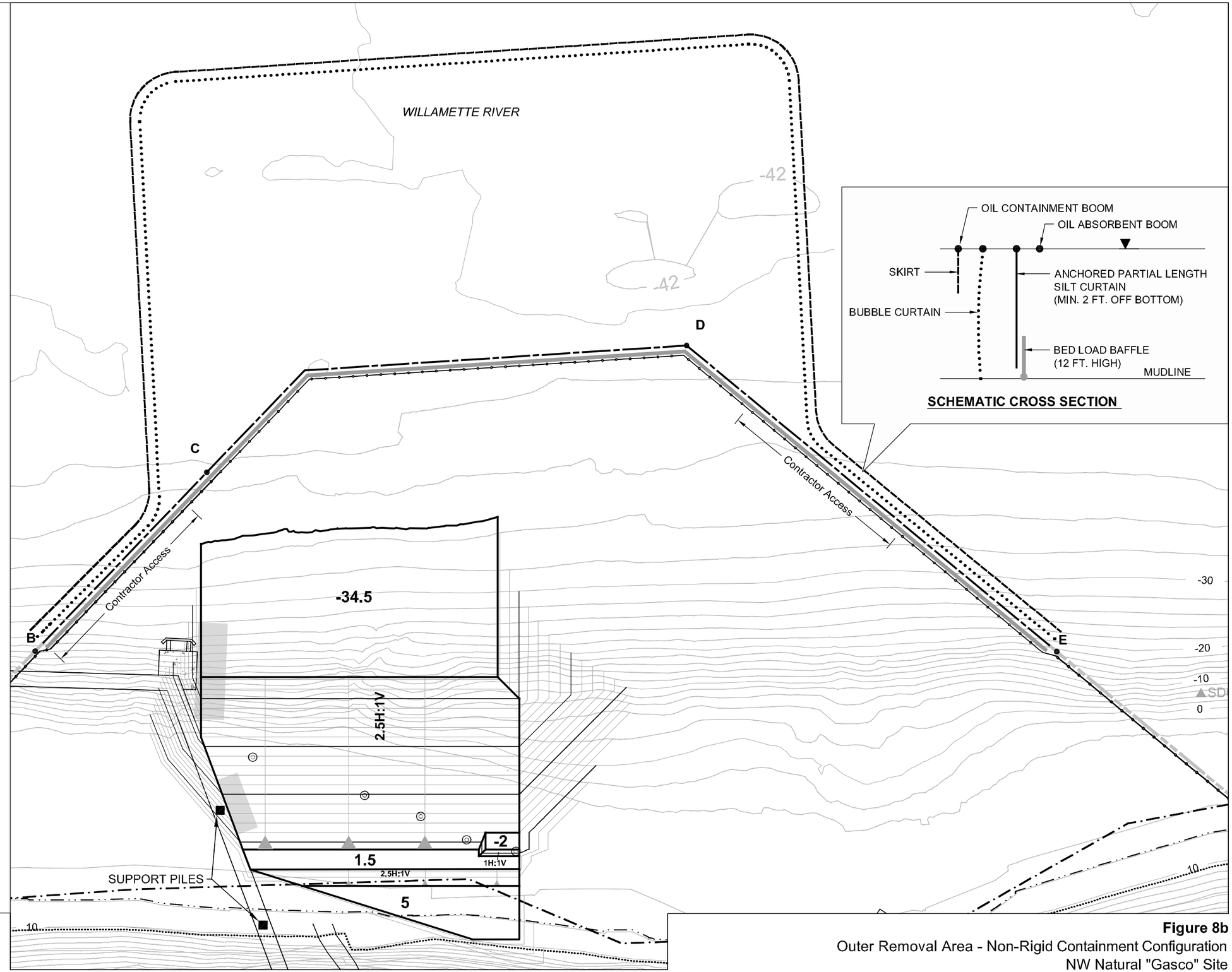


Figure 8b
Outer Removal Area - Non-Rigid Containment Configuration
NW Natural "Gasco" Site

ANCHOR ENVIRONMENTAL, L.L.C.

Jul 26, 2005 1:45pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-90.dwg FIG 8b

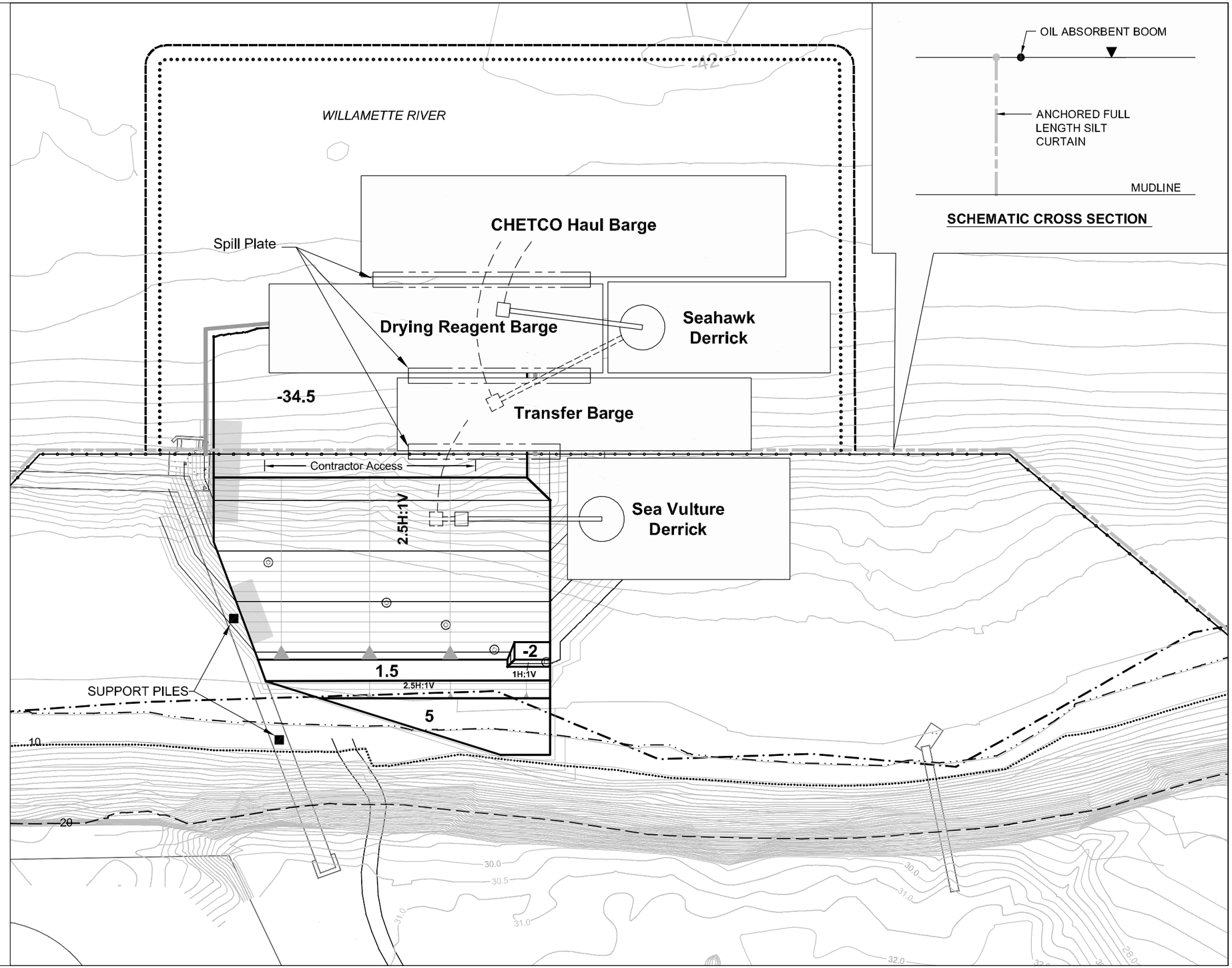
Legend:

- 1.5 Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.



Jul 26, 2005 1:42pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-88.dwg FIG 9a

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 9a
Inner Removal Area - Haul Barge Holding Area and Transfer Location
NW Natural "Gasco" Site

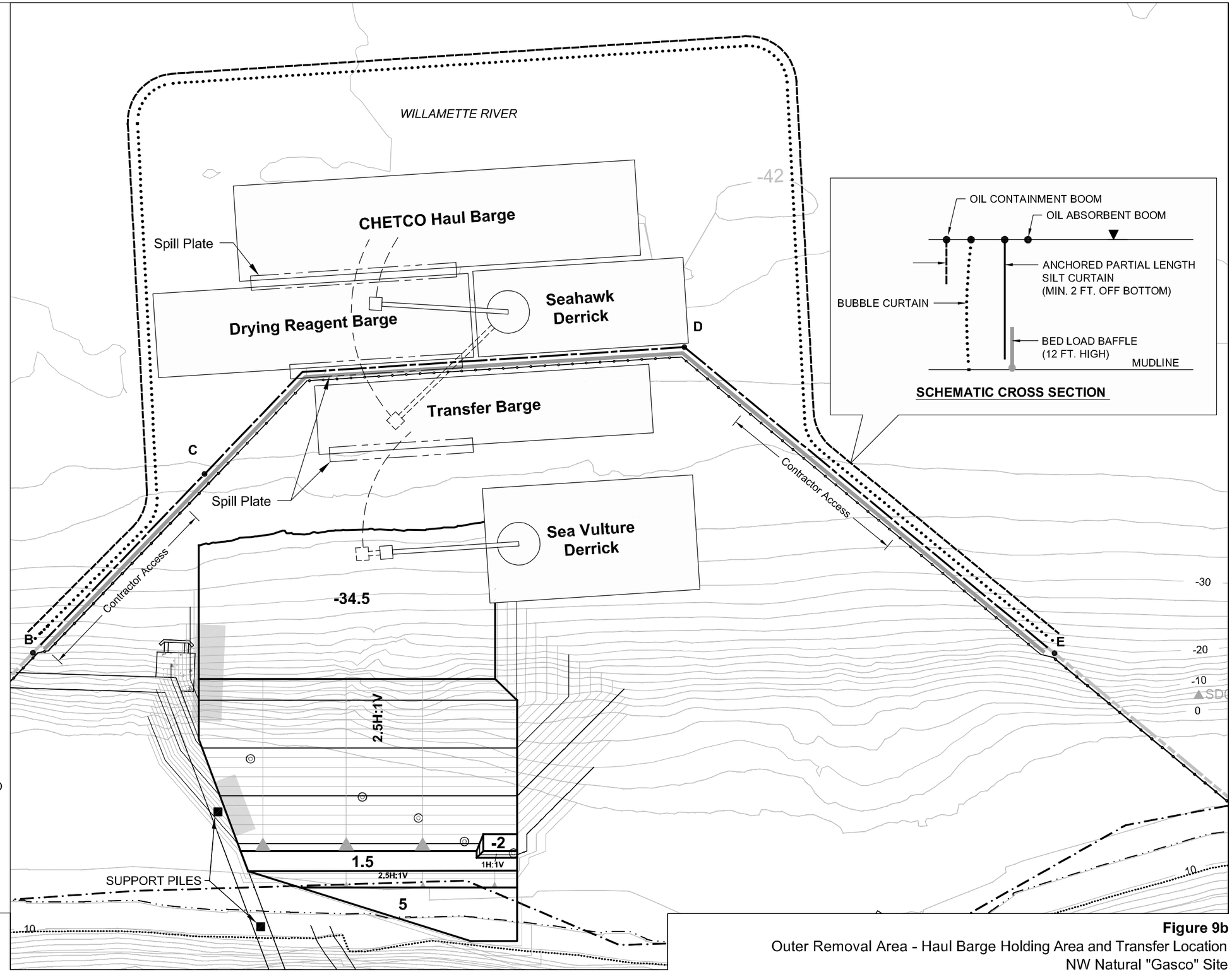
Legend:

- 1.5 Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Partial Length Silt Curtain (Anchored)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 9b
Outer Removal Area - Haul Barge Holding Area and Transfer Location
NW Natural "Gasco" Site

Jul 26, 2005 1:45pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-90.dwg FIG 9b

APPENDIX A

TRANSPORTATION AND DISPOSAL PLAN

APPENDIX A

TRANSPORTATION AND DISPOSAL PLAN
FINAL DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.

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Portland, Oregon 97224

On Behalf of

Northwest Natural

220 NW Second Avenue

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July 2005

Table of Contents

1 INTRODUCTION 1

2 TRANSPORTATION 2
- 2.1 Loading 2
- 2.2 Sediment Drying 4
- 2.3 Transloading 5

3 IMPORTED MATERIAL 8

4 ENVIRONMENTAL PROTECTION 9
- 4.1 Spill Prevention 9
- 4.2 Contingencies for Spills 10
- 4.3 Sediment Drying Process 12
- 4.4 Transfer Facility 12
- 4.5 Transfer Facility Soil Sampling 13

5 DISPOSAL 14
- 5.1 Disposal Facility 14
- 5.2 Waste Profiling 15
- 5.3 Compliance Status 16
- 5.4 Documentation and Tracking 16

List of Figures

Figure A-1 Inner Removal Area – Transfer Barge Holding Area and Transfer Location

Figure A-2 Outer Removal Area – Transfer Barge Holding Area and Transfer Location

Figure A-3 Port of Morrow to CWMNW Landfill Haul Route

Figure A-4 Schematic of Material Transfer from Barge to Trucks

List of Attachments

Attachment A-1 Transportation and Disposal Performance Standards Compliance Summary

Attachment A-2 Field Sampling Plan Offsite Tracking Monitoring – Transfer Facility

Attachment A-3 Quality Assurance Project Plan Offsite Tracking Monitoring – Transfer Facility

Attachment A-4 Waste Profile Form

Attachment A-5 Letter of Off-Site Rule Compliance

1 INTRODUCTION

The Draft Final Transportation and Disposal Plan (TDP) is an appendix to the Draft Final Remedial Action Project Plan (RAPP) and one of the design documents submitted to U.S. Environmental Protection Agency (EPA) for the removal action at the "Gasco" Site (Site). The Statement of Work (SOW) for the Project indicates that a TDP will be developed for any material that is to be removed from the Site. The purpose of this document is to address the following information:

- Details regarding the transportation of dredged materials including loading materials onto barges, adding the drying reagent to the sediments on the barge, transferring materials from barges to trucks, and transport by truck to the disposal facility.
- The transport of imported cover/cap materials.
- Precautions that will be used while mixing sediments, and during transport and disposal of the material.
- Contingencies for any spills that might occur.
- Details regarding the disposal of waste materials including the disposal facility location and the EPA defined disposal performance standards.

2 TRANSPORTATION

The loading and transportation of dredged materials and waste from the removal action are described in the following sections. Environmental protection measures during these steps are described in the Removal Action Environmental Protection Plan (RAEPP), Appendix E. Health and Safety procedures described in the Construction Health and Safety Plan (CHASP), Appendix B will apply throughout all steps of the transportation process described below. This includes monitoring for volatile and other air emissions, OSHA action levels, and contingency measures should action levels be exceeded.

2.1 Loading

The following estimates were used to determine the appropriate number of water-tight haul barges needed to complete the construction within the summer work window:

- Production rate: 500 – 1,000 cubic yards (cy) per day (2 days)
- Time required for the sediment drying reagent to dry material: 2 days
- Travel time to the Port of Morrow transfer facility: 24 hours
- Time required to transfer material from the barge to trucks: 1 – 2 days
- Travel time of empty barge back to the Site: 24 hours

Based on these estimates, the total round trip for a single barge after it has been loaded at the Site, including the transfer of the dry sediments at the offloading facility, and return to the Site will take approximately 6 days. Therefore, three haul barges will be dedicated for this project. If production is increased above the projected rate, an additional barge will be added. The available identified sealed barges vary in size.

The haul and transfer barges will be positioned following the two configurations described in the RAPP and shown in Figures A-1 and A-2. The exact position of the barges will be dependent on where removal is occurring and these figures provide a general indication of the equipment locations. One scenario (Figure A-1) will apply while dredging the inner portion of the dredge prism shoreward of the river channel. This area is referred to as the inner removal area. The other scenario (Figure A-2) will apply while dredging in the river channel. This area is referred to as the outer removal area. The main differences between the two scenarios is the location of the transfer barge relative to the primary silt curtain containment and the arrangement of containment barriers as shown in Figures A-1 and A-2.

A derrick crane ("Sea Vulture") and dredge bucket will excavate the material and load the material onto a sealed flat deck transfer barge. The sealed flat deck surface is surrounded by a perimeter that extends above the deck to contain material and water during loading and prevent splashing outside of the haul barge. Excess water in the transfer barge will be decanted using pumps placed in the barges' four corners. The excess water will be pumped into the inside of the silt curtain primary containment within the active dredge prism. From the transfer barge, the material will then be rehandled by another derrick and crane ("Seahawk") to the sealed haul barge ("CHETCO" is shown in the figure, but three different haul barges will be used). A minimum of 5 percent cement would be added to the haul barge at this time as indicated by the bench scale sediment drying results to achieve the required bearing capacity. Ability to pass the paint filter test will be measured in the field and more cement may be added as necessary. The reagent and dredged material will be mixed in the haul barge using the transfer crane bucket.

During dredging in the inner area removal, the sealed transfer barge will be outside the silt curtain (because of the limited space inside the silt curtain). During dredging in the outer area removal the transfer barge will be inside the silt curtain. Otherwise the configuration of barges and derricks relative to the containment features are very similar in the two removal areas. In addition, in both configurations, the drying reagent barge will be in between the transfer barge and haul barge (Figures A-1 and A-2) effectively acting as a form of spill protection during transfer of the material.

To minimize spillage between the dredge bucket and the transfer barge as well as between transfer and haul barges three cantilevered spill aprons will be attached to these barges to direct spilled material into the barges. As shown in Figures A-1 and A-2, no part of any bucket swing path will be allowed to occur over open water outside the primary silt curtain barriers in each configuration. This system will also minimize any spillage of drying reagent into the water.

Once the haul barge has been loaded with dredged material and drying reagent, it will be transported to the transfer facility. The derrick within the silt curtain will remain there until the dredging is completed. The contractor access door will be used for the transport of

personnel to and from the derrick and may be used to rearrange or service equipment periodically. For the inner removal area, the access door location is approximate in Figure A-1.

Environmental controls to be used while loading the transfer barges in both scenarios are summarized in Section 4 and described in detail in the RAEPP (Appendix E) and include measures to prevent any spillage of materials from the bucket to the water outside the silt curtain.

Other materials that will be removed from the work site, including removed piles and spent absorbent materials (if any), will also be placed in the same haul barges as dredged material for disposal. Prior to exiting the containment, the contractor will visually inspect the barge to ensure that no spilled material is present along the deck with the potential to enter the river during transport to the offloading facility. Contingency actions for cleaning of spilled material on the deck surface are described in detail in the RAEPP (Appendix E).

2.2 Sediment Drying

Free liquids are prohibited in the Arlington Chemical Waste Management North West (CWMNW) Subtitle C landfill so the dredged material will require drying to meet the paint filter test prior to trucking and disposal. In addition, the landfill requires that all wastes satisfy a 1 ton per square foot (tsf) load bearing capacity. Drying reagent will be added to the haul barge at the Site as described above. To determine the approximate amount of drying reagent that will be required to meet the paint filter and load bearing capacity tests, a bench scale drying test was performed (June 2005) using sediments collected from the dredge prism (results are shown in Appendix J of the RAPP). Based on these tests, it is anticipated that both tar and visually contaminated sediments with approximately 25 to 40 percent water by weight will require the addition of a minimum 5 percent Portland cement to meet the 1 tsf load bearing capacity requirements and may require additional cement to meet the paint filter test, which will be conducted in the field.

The reagent will be delivered directly to the Site in a drying reagent storage barge. The reagent will be mixed into the material directly in the haul barge as described above. The reagent will be mixed throughout the entire barge load of material using a clamshell bucket.

The sediment drying agent will be added to the haul barge periodically so that the entire volume of material is amended as the barge is filled. All mixing will occur within the haul barge and precautions will be taken to ensure that no material spills from the barge. Following addition of the reagent the operator will determine whether sufficient reagent has been added to the dredged material by conducting three paint filter tests per barge load of material transferred. The tests will be conducted in different areas of the barge to account for the potential spatial heterogeneity of the disposal material is adequately assessed. Because additional drying will take place over time, the haul barge may be sent to the transfer facility even though one or more paint filter tests fail at the time of testing at the Site. The decision to either send the barge in anticipation of further drying in transit or to add additional drying reagent at the Gasco Site will be made in the field based on experience and specific consistency of the material at the time.

Environmental protection measures during this process are described in the RAEPP (Appendix E).

2.3 Transloading

The material from the Site will be transferred from haul barges to trucks by Tidewater Marine at the Port of Morrow, which is near Boardman, Oregon (Figure A-3). The Oregon Department of Environmental Quality (DEQ) is currently reviewing a permit application for a temporary transfer station at the Tidewater Marine facility for this project. The permit application was submitted in June 2005, and action by DEQ is expected by August. Waste Management Inc. has also already received the prerequisite approvals from the Port of Morrow and the Morrow County Planning Office (Land Use Compatibility Statement).

The sediment will dry to some extent in the haul barge during transit to the transfer facility, which takes approximately 24 hours. Once the receiving barge is properly secured at the transfer facility, the sediment will be allowed to dry further if necessary and the material in the barge will be inspected for free water. (Free water may occur in transit do to settling and vibration or from rain.) If free water is identified, additional drying reagent will be added to the barge from an upland storage bin using the same transfer crane (discussed below) that will be used to transfer dredged material to trucks. The storage bin will be placed on the site such that retrieval of reagent requires no over water swing of the bucket

containing the reagent. No free water will be allowed to drain into the water at any time. Additional paint filter tests may be conducted at the transfer facility if the material did not pass the same test at the time it left the Site. If applicable, additional drying reagent would be added until the material passes the paint filter test at the transfer facility.

The operator will be required to maintain the swing path of the crane over a constructed spill apron (Figure A-4) for both material transfer and mixing in of any supplemental drying reagent. The drying reagent will be mixed into the material in the haul barge using a clam shell bucket. If drying reagent is added, the oversight contractor will record the quantity applied. The quantity of material added will be matched to the individual barge loads. Once the material contains no visible free water and/or passes the paint filter test, the crane with a standard clamshell bucket will remove material from the haul barge and place it directly into an upland hopper which will guide the material into the transport trucks (Figure A-4).

Trucks with water-tight beds will be loaded directly from the hopper. The trucks will be driven onto a lined, bermed pad under the hopper (Figure A-4). The loading pad provides secondary containment in case any material is spilled from the hopper. The operator will discharge material from the hopper until the truck is filled up to the point that "sloshing" of material out of the truck during transport is very unlikely. Following loading of each truck, the truck and area immediately around the truck will be inspected for spilled material and the truck will be covered. Once the truck is cleared to leave the facility following inspection and cleaning (Section 4.4), if applicable, the load will be documented on a manifest that will be carried by the driver. Copies of all project records, including manifests and weigh tickets, will be maintained for the project file, as specified in the CQAP, and summarized in the RACR. The trucks will be covered before leaving the transfer facility.

The trucks will take the material from the transfer facility to the CWMNW landfill following the route shown on Figure A-3. The driver will weigh the load at the disposal facility and report the weight of the load upon returning to the transfer facility for the next load. The driver will provide copies of the manifest and documentation that the load was received by the landfill. The oversight contractor will verify that weigh tickets are received for all loads

that leave the transfer facility and will be reported in final project documentation (RACR) as noted above.

Environmental protection measures during this process are described further in Section 4.4 and in the Removal Action Environmental Protection Plan (RAEPP) (Appendix E).

3 IMPORTED MATERIAL

After the dredging is completed, the cap will be installed as described in the RAPP. Figure 7 in the RAPP shows the area to be covered and the design cross-section of the cap and the fringe cover material. The RAPP also presents the required gradation for the fringing cover material, the filter layer material, and the erosion protection material. The amount of material for the fringe cover material is estimated to range from approximately 600 cy to 900 cy. The volume of pilot cap erosion layer is approximately 300 cy. The volume of pilot cap filter layer is approximately 700 cy.

Once at the site the cover/cap material will be off-loaded and placed immediately by the barge-mounted clamshell bucket. The barge will be located within environmental perimeter controls (detailed in RAEPP Appendix E) during cover/cap placement to contain suspended sediments. Imported material will not be stockpiled.

All materials used in cap/cover placement will meet the requirements established in the December 2003 Technical Plans and Specifications (Ecology and the Environment 2003) for the McCormick & Baxter sediment cap located within the Willamette River, as discussed in the CQAP.

4 ENVIRONMENTAL PROTECTION

Precautions to protect the environment will be implemented throughout the removal action, including during transfer to upland transport and transportation to the disposal site. Environmental controls for these processes, and contingencies for potential spills, are mentioned below, but are discussed in greater detail in the Removal Action Environmental Project Plan (RAEPP; Appendix E). The environmental controls are consistent with EPA's transport related disposal standards, as shown in Attachment A-1.

4.1 Spill Prevention

Best Management Practices (BMPs) will be implemented during transport to prevent accidental spills on land or in water. The primary goals of the environmental controls and BMPs at the Site, during transport, and at the upland transfer facility will be:

- Prevent spilling contaminated material or sediment drying reagent into surface water at the Site, in transit, or at the upland transfer facility.
- Prevent tracking contaminated material off-site or into any area where it may contact water that would be uncontrolled by containment measures at the transfer facility.
- Control surface runoff from the upland portion of the transfer facility so that contaminated runoff does not enter the river.
- Prevent material spilling from the truck during transport from the transfer facility to the CWMNW disposal facility.

Operations will be visually observed at all times. If there is a threat of the above goals not being met, work will be stopped and controls will be modified as needed until these goals are met. If despite these controls temporary accidental releases of material occur, conditions leading to the accident will be corrected, and the releases will be documented and reported to EPA at that time. The BMPs are described in greater detail in the RAEPP (Appendix E). BMPs for transport include:

- Spill plates over all crane swing paths at the removal site
- No excessive piling of drying reagent in storage barge to prevent windborne loss and tarping (or similar covering) of unused portions of drying reagent in the event that windborne loss is observed.
- Addition of the drying reagent at a minimal height above the material surface to prevent windborne loss and spilling of the reagent outside of the barge

- Slow addition of the drying reagent to avoid spills beyond the barge deck rails
- Visual inspection of the haul barge deck area (and removal of any material to barge interior) prior to transport from the Site to the transfer facility
- Overwater spill apron at transfer facility
- Spill/material return control curbing on the dock at the transfer facility
- Truck hopper at the transfer facility
- Water-tight trucks to prevent leakage during transport
- Under loading of trucks to prevent sloshing loss
- Clean tarping of truck loading area to prevent tire contact with materials
- Visual inspection of the truck loading area and the truck prior to releasing the truck and visual inspection of the access route for tracking prior to releasing the truck from the offload facility to public roads
- Cleaning of tires (if necessary) before leaving offloading site including dry brushing and/or tire/wheel washing
- Covering the truck containers during transport to the disposal facility
- Cleaning and decontamination of offloading area and all equipment used in offloading

4.2 Contingencies for Spills

The marine and trucking contractors and their subcontractors have been informed prior to start of construction that they are hauling a contaminated substance and have acknowledged in writing their understanding and responsibility for preventing spills and conducting spill contingency procedures in the event of spills. If a barge (either at the Site, in transport to the upland transfer facility, or docked at the transfer facility) accidentally spills (e.g., turns over, breaks, or collides with something) or a spill occurs into water at the transfer facility the following will immediately occur:

- Once equipment is under control and safety of personnel is ensured, the tug operator will note the exact area of the spill by recording GPS coordinates and visual notes (e.g., 300 yards upstream of visible landmark). The operator will also note to the best of their ability the approximate quantity of material lost (i.e., 25 percent of barge load).

- If substantial visual sheen or oil is present on the water the tug operator will notify the Construction QA officer (CQAO) and/or the spill response team immediately via radio or cell phone.
- The CQAO will notify EPA immediately of the spill.
- As notified, the spill response team will deploy booms, absorbent materials, etc. and operate oil skimming boats as necessary to contain the sheen/floating oil to the extent practicable. Cleanup will be completed as soon as possible and take precedence over normal site related activities.
- The CQAO set up a site meeting with EPA for determination of further actions.
- In consultation with agencies, further actions may include conducting bathymetry or other testing in spill area to determine location of spilled material, dredging spilled material for reloading onto another barge, subsequent monitoring of spill location after dredging. Depending on the quantity of the spill all of these actions may not be necessary or other actions may be warranted.

If a truck accidentally spills (e.g., collision during transport, turns over, etc.) the following will immediately occur:

- Once safety of personnel is ensured, the truck driver will estimate to the best of their ability the approximate quantity of material lost (e.g., 25 percent of load).
- The driver will notify the Oregon Department of Environmental Quality, the CQAO and/or the spill response team immediately via radio or cell phone. The Oregon Emergency Response System (OERS) will also be contacted at 1-800-452-0311.
- As notified, the spill response team will deploy booms, absorbent materials, etc., as necessary to contain the material to the extent practicable. Cleanup will be completed as soon as possible and take precedence over normal site related activities.
- The CQAO will notify EPA for a site meeting and determination of further actions.
- In consultation with agencies, further actions may include conducting testing in the spill area to extent of the spilled material (if not on paved surfaces) and removing all affected materials. Depending on the quantity of the spill all these actions may not be necessary or other actions may be warranted.

4.3 Sediment Drying Process

The primary BMP for the addition of sediment drying reagent will be visual monitoring during the loading operation to avoid spilling material that is being transferred from transfer barge to the haul barge. The operator will be required to maintain the swing path over the spill plates and open the transfer bucket the smallest amount possible at a minimum height above the material surface to avoid spilling and splashing.

Secondary protection will be achieved through additional visual monitoring following addition and mixing. The barge will be visually inspected following reagent addition and mixing to ensure that no reagent or sediment resides on the barge decks and has the potential to enter the river during transport to the offloading facility. Any material present will be swept into the interior of the haul barge. The material will be removed by sweeping as necessary either with our without additional water (e.g., river water from buckets or hoses) so that all material is forced into the haul barge. No wash water or swept material will be allowed to escape to the river.

4.4 Transfer Facility

The primary BMP to avoid releasing contaminants at the transfer facility is visual monitoring of the loading operation to avoid spilling material that is being transferred from the barge to the hopper and subsequently to the trucks (see Section 2.3). The operator will be required to maintain the swing path of the crane over the spill apron and open the transfer bucket the smallest amount possible to unload the material into the hopper slowly to avoid spilling material. Transfer into the hopper will help minimize spilling that could potentially occur during direct filling of the trucks. The hopper area will be lined to collect any material that potentially spills in the direct vicinity of the hopper. During hopper loading visual monitoring will be conducted continuously by the offloading personnel and transfer oversight contractor to ensure that no spilled material is tracked offsite. Spilled material will be removed from the liner until no visual signs of the material remain. If the material cannot be adequately removed the liner will be removed and disposed (at the disposal facility) and replaced with a new liner.

Following loading of each truck, the truck and area immediately around the truck will be inspected for spilled material and the truck will be covered. Spilled material will be

removed and placed into the barge. Trucks with visual signs of material outside the truck bed will be moved to the lined area immediately adjacent to the hopper to facilitate additional visual inspection and cleaning of the truck and uninterrupted transfer of material from the hopper to other trucks. Any signs of material outside the truck bed will be steam cleaned on the lined area until no visual signs of material remain. Personnel and/or the oversight contractor will complete a walk-a-round for each truck to ensure that the cleaning successfully removed all signs of visible material. Contaminated material that cannot be removed from the pad will be covered prior to moving the truck to avoid contaminating tires. Following moving of the truck the liner will be disposed of (placed into the next available truck for landfill disposal) and replaced.

The transfer facility is paved and all areas of the spill plate and loading area shown in Figure A-4 will be sumped, bermed, or curbed (or similar containment controls) such that all potentially spilled material, decontamination fluids, and/or rainfall runoff will be contained within this area and at no time will any water or solids be allowed to discharge to the river. Any rainfall runoff will be collected within the sump area shown in Figure A-4 and pumped to baker tanks, if necessary, for storage and eventual disposal. Disposal options for liquid waste include taking it to the local sanitary sewer district (if permits can be obtained), a liquid waste disposal facility, or the DNAPL recovery system at the Gasco Site, depending on the quantities and quality of the water. Because the project will be conducted primarily in months when very little rainfall (average less than half an inch per month in Boardman) is expected, preparations for large amounts of rainfall will not be made. In the event of unusually heavy rainfall, offloading will be postponed until high intensity rain has subsided. Regardless of the source of water, free water will be removed from the haul barge via application of additional drying reagent prior to initiating offloading into the upland hopper.

4.5 Transfer Facility Soil Sampling

EPA has requested sampling of soils on or near road surfaces at or near the transfer facility. This is intended as confirmation that no off-site tracking of materials occurred during the transfer process. The offsite tracking monitoring protocols are described in detail in the field sampling plan (FSP) (Attachment A-2) and quality assurance plan (QAPP) (Attachment A-3).

5 DISPOSAL

Material from the removal action will be taken to the CWMNW landfill near Arlington, Oregon, for disposal. CWMNW has two requirements for accepting the material for disposal:

- The waste must pass the paint filter test to demonstrate that there is no free liquid
- The waste must have a minimum load bearing capacity of 1 ton per square foot (tsf)

The CWMNW landfill passes all of the disposal performance standards required by EPA's letter of January 14, 2005 for Subtitle C disposal sites and is operating in compliance with its hazardous waste operations permit as required for CERCLA waste by the Off-Site Rule. A review of the compliance with the disposal performance standards is provided in Attachment A-1. The following sections describe waste profiling for disposal, operations at the disposal facility, and the administrative requirements for documenting and tracking the disposal process.

5.1 Disposal Facility

Trucks will enter the CWMNW facility via the Main Access Road and proceed to the Sampling Area. Drivers will conform to the facility's health and safety procedures at all times while on-site. Transportation of the material from the barge unloading facility to the landfill will be performed by an approved CWMNW subcontractor familiar with the procedures and layout of the CWMNW facility.

The truck driver will check in at the Sampling Area, provide a copy of the manifest for the load, and obtain approval from a material handler to proceed into the facility. The driver will then remove the tarp covering the material, and CWMNW will inspect the load and sample the material before allowing the truck to proceed. The full load will be weighed at the on-site scale, and the weight will be recorded on the trip ticket and compared to the weight recorded at the transfer facility. Any significant discrepancy (variation of 10% or more) in the weight of the load between the transfer station and the landfill will be documented and reconciled with the loading point.

Once the load is approved by CWMNW, the driver will be instructed where to unload the material. The driver will take the truck to the designated unloading area at the landfill working face and discharge the load. CWMNW operators will assist, as needed, in

removing the load from the truck and will manage the material once it is removed from the truck. The driver will proceed with the empty truck to the truck wash area where the truck will have the wheels and undercarriage washed, if necessary.

The empty truck will be weighed, and the weight will be recorded to calculate the weight of the material delivered to the landfill. The driver will obtain completed disposal paperwork from the CWMNW clerk before leaving the landfill facility. Copies of all transportation paperwork will be provided to SES and Anchor to reconcile disposal costs, confirm the disposal of all material removed from the site, and to track the progress of the removal action. The gross, net, and tare weights of all loads of material removed from the Site will be tabulated for the Removal Action Completion Report

5.2 Waste Profiling

Sediment cores were collected from the Site on July 19 to 22, 2004. As directed by EPA, specific samples were analyzed for total petroleum hydrocarbons (TPH), toxicity characteristic leaching procedure (TCLP), and benzene. The results of the analyses are described in the RAPP, and indicate that only benzene in tar body samples exceed the RCRA toxicity criteria. Benzene is a common component of Manufactured Gas Plant (MGP) wastes throughout the site. Because the tar is an MGP waste, it is not subject to regulation as hazardous under Federal or Oregon law (40 CFR 261.24(a) and OAR 340-100-002(1)). The visually contaminated sediments passed the TCLP test; no contaminants exceeded the maximum concentrations allowed in the toxicity characteristic rule. Although the material is nonhazardous by definition, EPA's site-specific disposal performance standards can only be met at a Subtitle C hazardous waste disposal facility, such as the CWMNW landfill at Arlington.

The CWMNW disposal facility has reviewed all the waste profiling data including original validated data reports from the laboratory and has determined that the material is suitable for disposal at this facility. Additional bench scale testing was performed in June 2005 to determine the quantity of drying reagent that would be required to pass the CWMNW waste acceptance requirements (i.e., pass the paint filter test and have a load bearing capacity greater than 1 tsf). The testing was conducted using surface tar/sediments collected (June 2005) from various areas within the dredge prism to ensure that the sample was

spatially representative. The results of this testing are shown in Appendix J of the RAPP. In summary, approximately 5 percent (by weight) Portland cement will meet the 1 tsf requirement in 1 day of curing time. Greater than 5 percent cement may be needed to pass the paint filter test in the same 1 day curing time and/or a greater curing time may be needed. Paint filter tests will be conducted in the field during the operation to refine the cement additive and curing time requirements as the project progresses. The disposal facility has accepted the bench scale test as a means to verify that the load bearing capacity will be reached at approximately 5 percent cement, and this will be the minimum amount added to all barge loads. Thus, the load bearing capacity will not require field verification testing. A copy of the waste profile form is provided as Attachment A-4 to this Appendix. The facility has indicated they would issue a permit within a week of formal submittal of the waste profile. This submittal will be conducted once EPA has approved the final design and location for disposal.

5.3 Compliance Status

Materials shipped off-site as part of the removal action are being sent to a facility (CWMNW) that is operating in accordance with the "Off-Site Rule," as per 40 CFR 300.440. EPA's letter acknowledging CWMNW's compliance is provided as Attachment A-5.

5.4 Documentation and Tracking

Accurate documentation of transport and disposal will be collected and tracked during the transportation process. The approximate volume of material loaded onto the receiving haul barge and the date of the removal operation will be recorded in the field log. Manifests from the truck scales, and bills of lading indicating cargo contents, weight, and date, will be collected for each overland trip transporting waste for disposal. The disposal facility will verify receipt of the contents and record the weight and the time that it is received. These records will be tracked during the project and then compiled into a spreadsheet which will be reflected in the weekly progress reports.

Figures

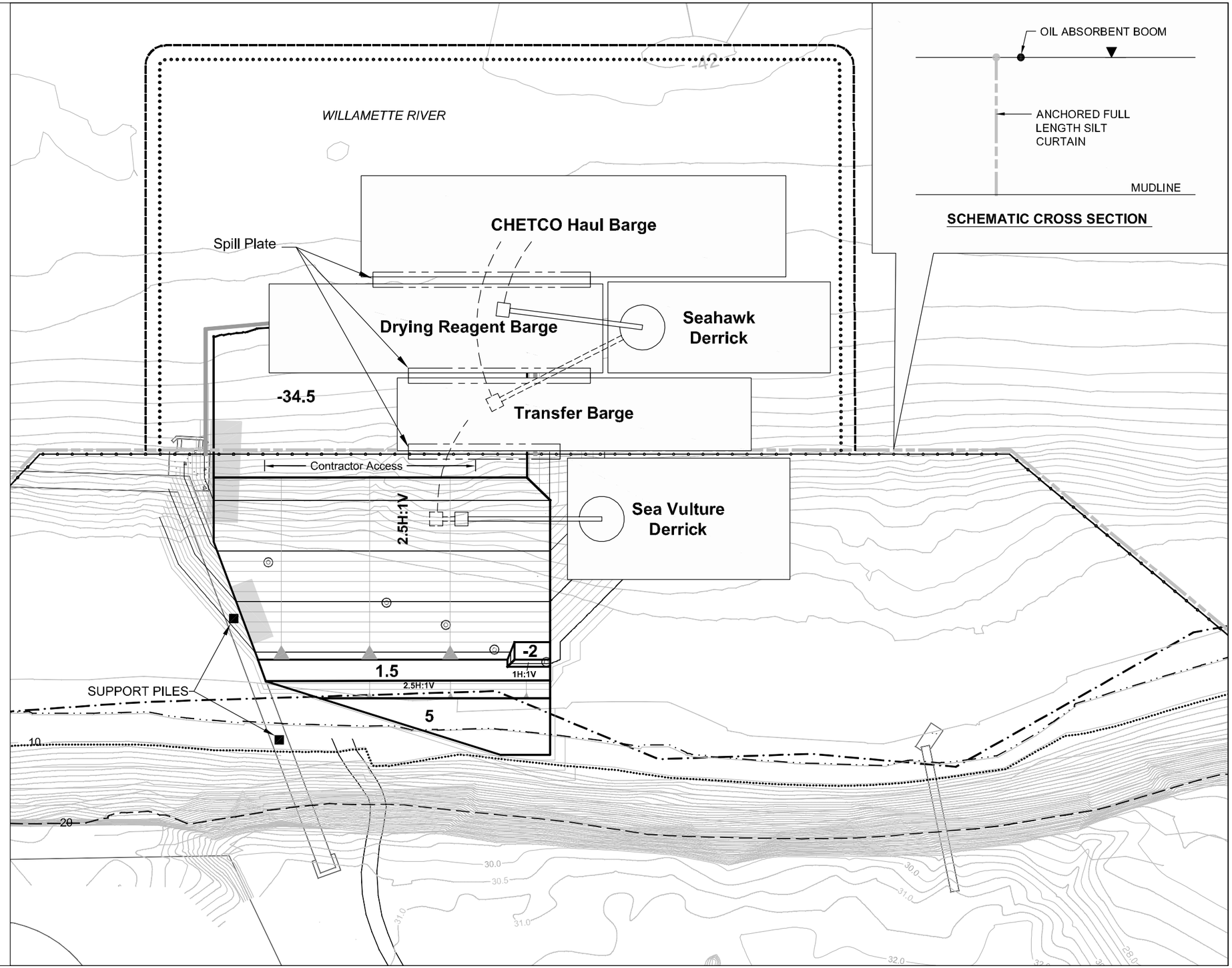
Legend:

- 1.5 — Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.



Jul 26, 2005 1:42pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-88.dwg FIG A-1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure A-1
Inner Removal Area - Non-Rigid Containment Configuration
NW Natural "Gasco" Site

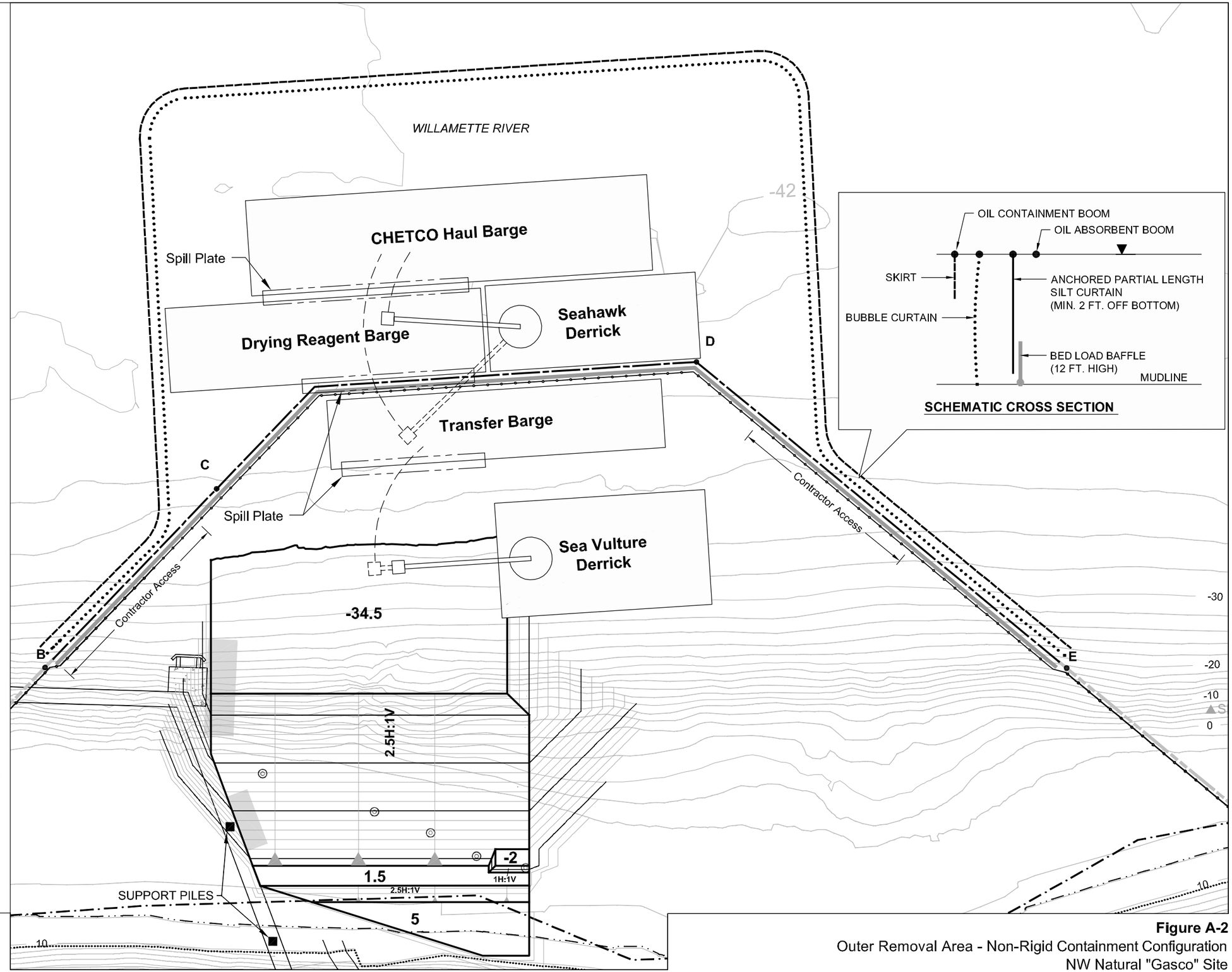
Legend:

- 1.5 Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Partial Length Silt Curtain (Anchored)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

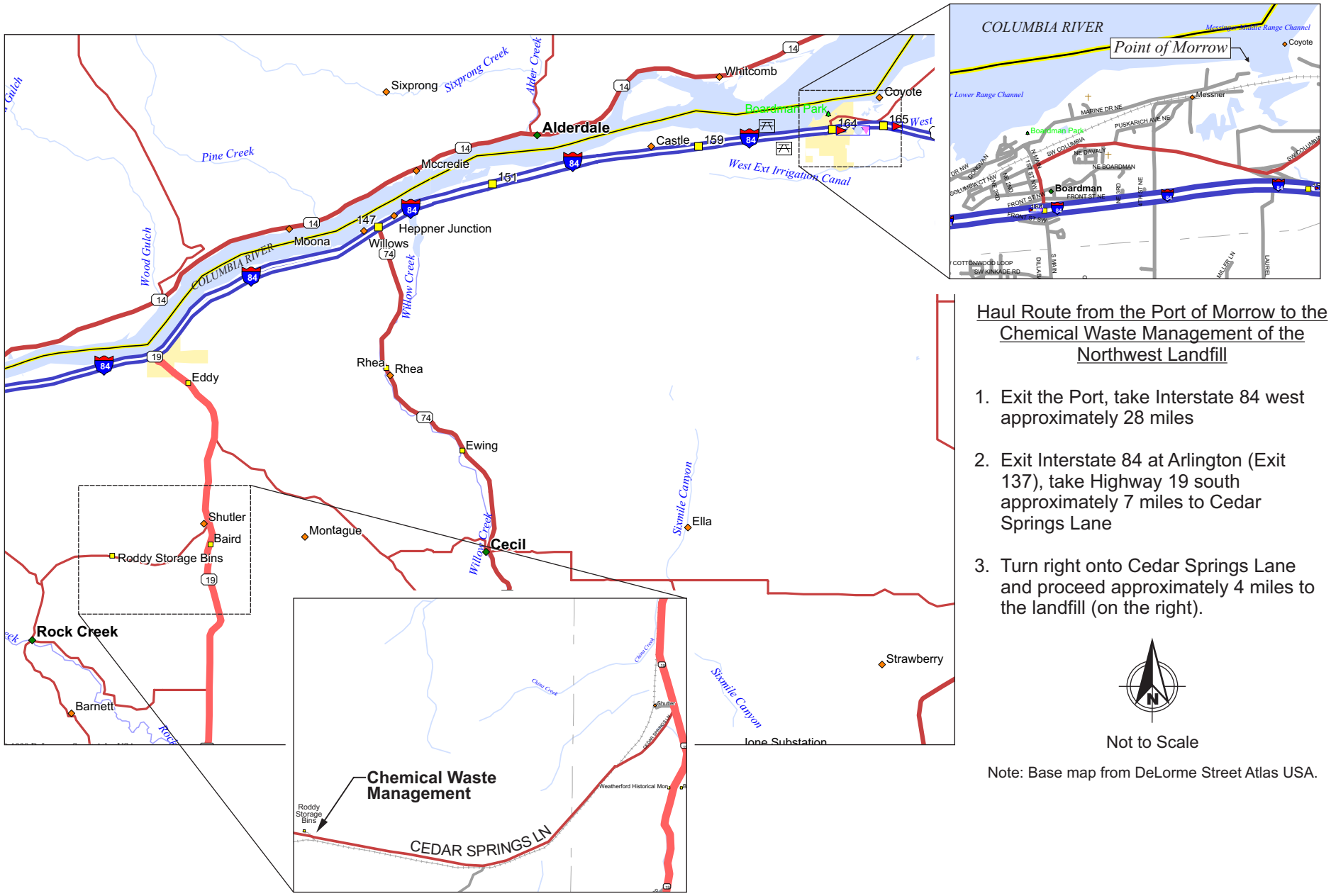
1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.



ANCHOR ENVIRONMENTAL, L.L.C.

Figure A-2
Outer Removal Area - Non-Rigid Containment Configuration
NW Natural "Gasco" Site

Jul 26, 2005 1:46pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-90.dwg FIG A-2



Haul Route from the Port of Morrow to the Chemical Waste Management of the Northwest Landfill

1. Exit the Port, take Interstate 84 west approximately 28 miles
2. Exit Interstate 84 at Arlington (Exit 137), take Highway 19 south approximately 7 miles to Cedar Springs Lane
3. Turn right onto Cedar Springs Lane and proceed approximately 4 miles to the landfill (on the right).

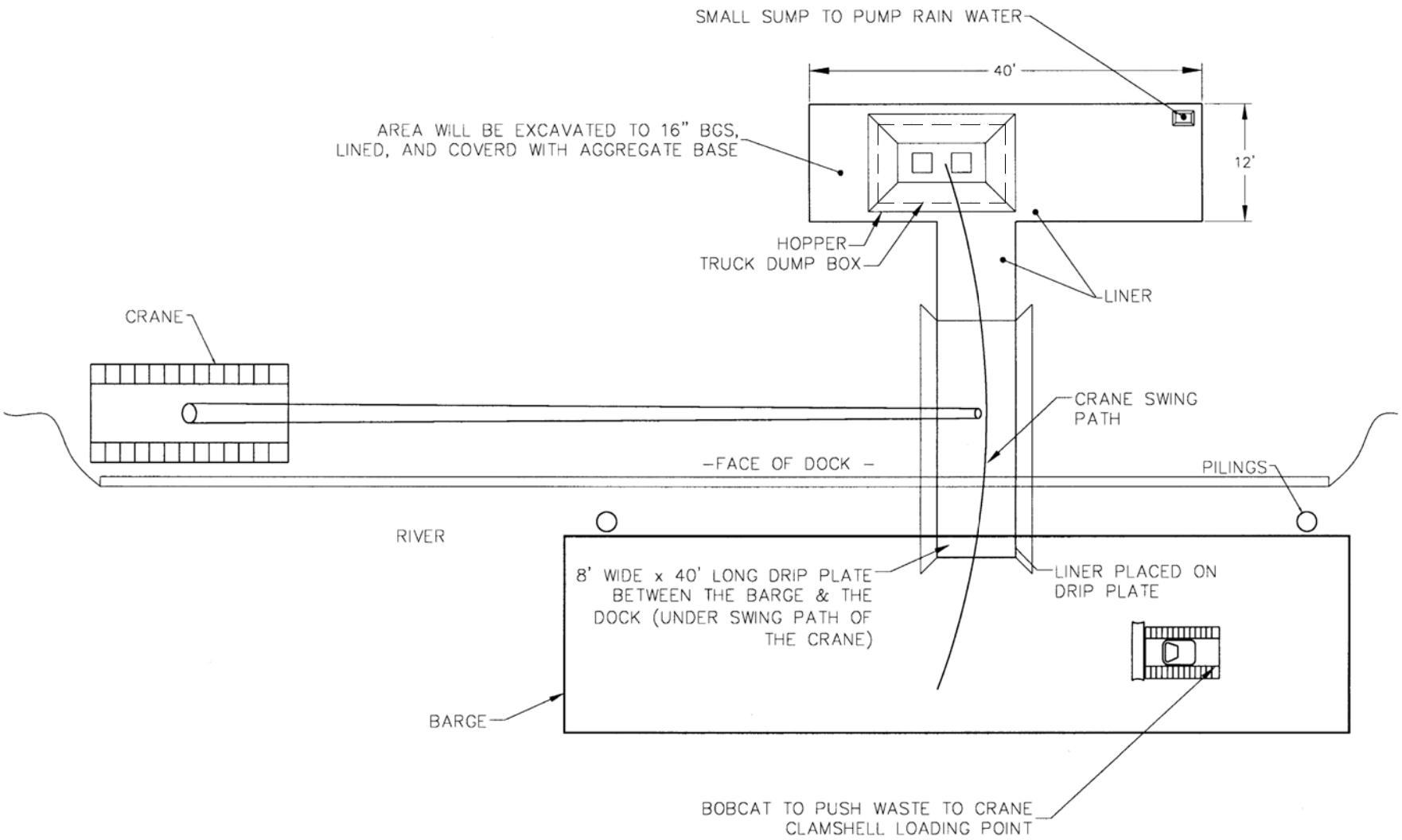
Not to Scale

Note: Base map from DeLorme Street Atlas USA.

7/8/05 cvd K:\Jobs\000029-GASCO\00002902\Fig A-3.cdr

ANCHOR ENVIRONMENTAL, L.L.C.

Figure A-3
Port of Morrow to CWMNW Landfill Haul Route
NW Natural "Gasco" Site



NOTES:

1. LINERS WILL BE PLACED APPROX. 18" BELOW GROUND SURFACE.

Jul 08, 2005 10:24am cdavidson K:\Jobs\000029-GASCO\00002902\00002902-68.dwg FIG A-4

ANCHOR ENVIRONMENTAL, L.L.C.

Figure A-4
Schematic of Material Transfer from Barge to Trucks
NW Natural "Gasco" Site

ATTACHMENT A-1

TRANSPORTATION AND DISPOSAL PERFORMANCE STANDARDS COMPLIANCE SUMMARY

Attachment A-1
Transportation and Disposal Performance Standards (as described in EPA's Letter dated January 14, 2005 regarding "Waste Material Disposal") -
Compliance Summary

Disposal Performance Standard	Compliance with Standard
Risk of Release During Transport	
1. Measures taken at the disposal facility shall be commensurate with those at the on-site transloading facility to ensure offsite tracking is controlled at the disposal facility tipping pad area(s) (e.g. chemical testing, disposable truck pad, dry brushing, etc.).	In compliance with its operating permit (RCRA Subtitle C), Chemical Waste Management of the Northwest, Inc. (CWMNW) inspects and decontaminates trucks prior to releasing them from the working area of the landfill.
2. Transporting vehicles shall be sealed and tarped to limit contaminant migration.	All vehicles transporting material from the Gasco removal action will be sealed and tarped.
3. Spill response and contingency plans for over water and overland transport of waste material shall be included in the RAPP.	Spill response and contingency measures are included in the final TDP.
Worker protection	
1. NW Natural has indicated that the material may be treated to eliminate free liquid prior to disposal. Treatment may include dewatering directly within the haul barge and application of a drying agent (Portland cement, quicklime, or paper-based additive). The primary concern to worker health and safety with the sediment waste material is the presence of elevated concentrations of benzene as a result of dewatering/treatment. This information shall be included in the revised RAPP and provided to the disposal facility for inclusion into the special waste management plan.	Water will be removed from dredged material via application of a drying agent at the Site. All of the transportation and disposal contractors that will work on the removal action have been provided the waste profile and summary of the analytical data. The special waste management plan is a requirement that is applicable to Municipal Landfills and does not apply to hazardous waste landfills, such as CWMNW. Monitoring for volatile air emissions and safety precautions (e.g., donning respirators if specified levels are exceeded) is included in the Construction Health and Safety Plan (CHASP) (Appendix B).
2. Based on conversations with the landfill operators, landfill personnel at the Columbia Ridge Landfill and the Wasco County Landfill are not, in general, trained for handling of hazardous waste in accordance with OSHA regulations 29 CFR 1910.120. In addition, they are generally not equipped for spill response or have the necessary monitoring equipment to ensure worker safety for materials such as the contaminated sediment removed from the Gasco site. It is required that all site personnel working with the Gasco material be adequately trained to safely perform their assigned job duties. Specifically, landfill personnel and offloading facility personnel who have the potential to come into contact with the Gasco waste shall be OSHA 40-hour trained for hazardous waste operations (HAZWOPER). Documentation will be required from landfill operators demonstrating that landfill workers have current training prior to approving a specific disposal facility.	Disposal at a Subtitle C facility was selected in the EE/CA. Workers at the CWMNW landfill comply with the applicable OSHA regulations, including the requirement for 24-hour HAZWOPER training. CWMNW maintains training records and is regularly audited.
3. Airborne contaminants (specifically benzene) can present a threat to the health and safety of site workers. NW Natural is required to evaluate respirator use for all personnel handling the waste. This may be accomplished through air monitoring. NW Natural must ensure that no worker is exposed to a substance that exceeds the 8-hour time weighted average exposure value, short-term exposure value, or ceiling limit, as appropriate. Air monitoring may be reduced or eliminated after sufficient air quality data has been established.	Air monitoring will be performed, per the CHASP. All workers at the disposal facility in contact with waste, including truck drivers, will comply with the CWMNW HASP, which requires that workers have respirators.

Attachment A-1
Transportation and Disposal Performance Standards (as described in EPA's Letter dated January 14, 2005 regarding "Waste Material Disposal") -
Compliance Summary

Disposal Performance Standard	Compliance with Standard
4. Health and safety information shall be conveyed to workers via formal briefing sessions and daily health and safety meetings. The meetings shall include potential hazardous contaminant issues, required PPE, physical hazards, other issues as appropriate.	A preconstruction briefing and daily meetings will be held to review the work to be performed, associated hazards, and appropriate safety equipment and protocol.
5. Site inspections shall be conducted on a daily basis by an independent entity (e.g. NWN contractor construction quality assurance personnel) at the disposal landfill and offloading facilities to ensure compliance with the special waste management plan, the RAPP, and other relevant requirements. EPA will conduct periodic site inspections of the landfill facility and offloading facility during the course of the project.	Independent inspections will be performed at the transfer station and the disposal facility to monitor for compliance with the RAPP and other relevant requirements. A special waste management plan is not required for Subtitle C disposal facilities.
6. A site control plan shall be developed and implemented at the disposal facility and offloading facility in order to prevent unauthorized worker or public contact with waste material. Due to the use of municipal landfills (Subtitle D) by the general public, a specific work zone shall be set up and used exclusively for the Gasco material. The work zone shall be located away from any area of the site that has public access. In addition, landfill personnel who are not adequately trained and equipped to handle the waste material will not be allowed in the work zone. It is required that the site control plan and associated methods and procedures be included in the special waste management plan and RAPP.	CWMNW strictly controls access to the landfill as required by its operating permit. As the EE/CA concluded that the material will be managed at a Subtitle C facility, there is no potential for public access to the material at the disposal site and a special waste management plan (which is required for municipal landfills by Oregon solid waste regulations) is not required.
7. It should be noted that all personnel working at the Chemical Waste Management Landfill are appropriately OSHA 40-hour trained for hazardous waste operations. In addition, ***all site workers within the landfill area wear respirators at all times*** when handling waste at the facility. Air monitoring equipment is used on site and available for the type of contaminants expected (primarily VOCs). Therefore, if the Chemical Waste Management Landfill is selected as the disposal facility, significant modifications to their procedures are not expected.	CWMNW is the selected disposal facility. As noted in the comment, significant modifications to the facility's procedures are not required. Workers at the landfill are required to carry respirators and workers at the working face of the landfill wear respirators. See compliance statement above regarding required training.
Risk of release from disposal facility	
1. Decontamination of heavy equipment at the offloading facility or disposal landfill is required to prevent tracking to other parts of the facility(s). Decontamination protocols, as presented in the RAPP do not provide sufficient detail regarding barge, dredge, truck, and landfill equipment decontamination protocols. Specific information about decontamination methods, waste handling, containment, performance measures, and action triggers are necessary. NW Natural shall present a detailed decontamination plan that includes location specific information, frequency, decontamination areas and controls, and methods to demonstrate the effectiveness of equipment decontamination. Equipment shall be decontaminated at a minimum to a visually clean standard.	The final TDP (Appendix A) contains descriptions of the operating procedures, including requirements for inspection and decontamination of vehicles and equipment, at the transfer station and the disposal facility.

Attachment A-1
Transportation and Disposal Performance Standards (as described in EPA's Letter dated January 14, 2005 regarding "Waste Material Disposal") -
Compliance Summary

Disposal Performance Standard	Compliance with Standard
2. If possible the landfill should use dedicated machinery during the course of the project which would significantly reduce the amount of decontamination required and limit offsite tracking.	Equipment at the working face of the landfill generally remains at the location. CWMNW can not guarantee that equipment will be dedicated to the Gasco project. This requirement was probably intended for municipal landfills, which are no longer in consideration for management of the material from the removal action.
3. The decontamination procedures and best management practices shall be included in the special waste management plan.	The decontamination procedures and best management practices are included in the final TDP (Appendix A). There is no special waste management plan, as the material will not be managed at a municipal landfill.
4. Wet material shall be ***dewatered*** and/or treated to eliminate potential releases of contaminated liquids during transfer/disposal.	The material will be dried to meet the paint-filter test through application of Portland cement.
5. Based on the samples collected, benzene appears to be highly leachable from the tar material and special precautions shall be taken for placement of the material within the landfill to minimize the potential for benzene (and other contaminants) to leach into the landfill leachate collection system. Maximizing the underlying thickness of solid waste should increase the biodegradation of benzene and other organics before they enter the leachate disposal system. The material shall be placed such that at least 20 feet of other landfill waste is present between the Gasco sediment material and the bottom of the landfill cell, or as otherwise approved in the special waste management plan.	This requirement applied to municipal landfills and is no longer applicable to the project as the material will be managed at a Subtitle C facility.
6. All disposed Gasco material shall be covered at the end of each work day with a minimum of 2 feet of daily cover to prevent any site personnel or the public from contacting the waste material. The cover will also limit the potential for offgasing of benzene or other volatile contaminants.	This requirement applied to municipal landfills and is no longer applicable to the project as the material will be managed at a Subtitle C facility.
7. The special waste management plan and RAPP shall address spill response procedures, equipment, and personnel in the event of a spill of the Gasco sediment waste.	The final TDP (Appendix A) describes spill response procedures, equipment, and personnel. The special waste management plan is a requirement that is applicable to Municipal Landfills and does not apply to hazardous waste landfills, such as CWMNW.
8. Waste material shall be taken to a facility with leak detection, leachate collection, and a double-underliner system.	The CWMNW landfill has leak detection, leachate collection, and a double liner.
Treatment	
1. Alternately, the material may be treated to limit benzene leachability to the TCLP standard and be taken to a single-underliner landfill (all other requirements still apply).	This alternate approach is not part of the EE/CA selected alternative, although some reductions in benzene leaching are expected from the application of the drying agent.

Attachment A-1
Transportation and Disposal Performance Standards (as described in EPA's Letter dated January 14, 2005 regarding "Waste Material Disposal") -
Compliance Summary

Disposal Performance Standard	Compliance with Standard
2. Treatment of the material shall be verified by chemical testing. 10% of trucks will be tested each day after appropriate cure time and composited into one sample. First, the material will be tested for benzene concentration as fast as possible, but with a turnaround time (results reported to EPA) not to exceed 24 hours. Should this test fail the 1:20 dilution factor rule, TCLP will be run as quickly as is commercially available, but with a turnaround time not to exceed 48 hours. If approved by ODEQ and acceptable to the receiving facility, receipt of test results may lag disposal of materials at the landfill.	This alternate approach is not part of the EE/CA selected alternative.
3. Should any results indicate that treatment is ineffective in achieving a passing result for TCLP, treatment will be modified immediately (e.g. increased reagent ratio) before any additional offsite shipment. NWN shall propose a number of possible treatment modifications to address this possibility.	This alternate approach is not part of the EE/CA selected alternative.

ATTACHMENT A-2

FIELD SAMPLING PLAN
OFFSITE TRACKING MONITORING PLAN – TRANSFER FACILITY

ATTACHMENT A-2

FIELD SAMPLING PLAN
OFFSITE TRACKING MONITORING–TRANSFER FACILITY

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

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July 2005

1 INTRODUCTION 1
1.1 Purpose and Objectives 1
1.2 Document Organization 1

2 PROJECT MANAGEMENT AND RESPONSIBILITIES 3

3 SAMPLING AND HANDLING 4
3.1 Field Sampling Schedule 4
3.2 Sampling Platform 4
3.3 Horizontal Positioning and Vertical Control 4
3.4 Station and Sample Identification 4
3.5 Sample Collection and Processing 5
3.5.1 Sample Collection 5
3.5.2 Sample Processing 5
3.6 Field Documentation 6
3.7 Sample Handling 7
3.7.1 Sample Containers for Analysis 7
3.7.2 General Sample Handling and Storage 7
3.7.3 Sample Transport and Chain-of-Custody Procedures 8
3.8 Field Equipment Decontamination 8
3.9 Disposal of Excess Soils and Other Materials 9

4 CHEMICAL/PHYSICAL TESTING 10

5 REFERENCES 11

List of Figures

Figure 1 Transfer Station Haul Route and Sampling Locations

List of Tables

Table 1 Guideline for Sampling Handling and Storage

Table 2 Analytes, Analysis Methods, and Targeted Reporting Limits

Attachments

Attachment 1 Surface Soil Field Sample Record

Anchor	Anchor Environmental, L.L.C.
AST	above ground storage tank
COC	Chain-of-Custody
DGPS	Differential Global Positioning System
DNAPL	dense non-aqueous phase liquid
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
FC	Field Coordinator
FSP	Field Sampling Plan
GPS	Global Positioning System
NAD	North American Datum
Order	Administrative Order on Consent
PAH	Polycyclic Aromatic Hydrocarbons
PM	Project Manager
PTFE	polytetrafluoroethylene
QA/QC	Quality assurance/quality control
QAPP	Quality Assurance Project Plan
RAA	Removal Action Area
RAPP	Remedial Action Project Plan
RAWP	Remedial Action Work Plan
SOW	Statement of Work
TDP	Transportation and Disposal Plan
TOC	Total Organic Carbon
RACR	Remedial Action Completion Report

1 INTRODUCTION

NW Natural entered into an Administrative Order on Consent (Order) with the U.S. Environmental Protection Agency (EPA) on April 28, 2004 to perform a time-critical removal action at the "Gasco" site (Site) located on the Willamette River in Portland, Oregon (EPA 2004). The Order requires that NW Natural perform a number of actions associated with removing a tar body from the riverbank and nearshore sediment adjacent to the site. The Statement of Work (SOW) for the removal action requires that a Transportation and Disposal Plan (TDP) be developed for any material that is to be removed from the Site. This Field Sampling Plan (FSP) is an attachment to the TDP (Appendix A of the Remedial Action Project Plan [RAPP]). This FSP is one of the design documents required by EPA following multiple discussions regarding the potential for offsite tracking of contaminants from the offloading facility as part of the dredging removal action at the Site. This FSP is consistent with EPA's June 20, 2005 Action Memorandum. Although Section 4 of the TDP details the daily monitoring protocols to prevent offsite tracking of contaminants during transfer activities and response mechanisms if tracking is identified, EPA requires that additional pre- and post- characterization be conducted at the transfer facility as a final check to ensure that offsite tracking did not occur during the transfer process.

1.1 Purpose and Objectives

The purpose of the FSP is to provide sufficient sampling and analysis protocols to document that, following completion of all waste transfer activities, offsite tracking of contaminants to communities surrounding the transfer facility has not occurred. This FSP provides detailed information regarding the monitoring objectives, sample location and frequency, equipment and procedures to be used during the monitoring, and sample handling and analysis that will be used during the monitoring activities. This FSP also provides the basis for planning field activities, and establishes the specific quality assurance requirements, which are presented in the Quality Assurance Project Plan (QAPP) (Attachment A-3).

1.2 Document Organization

This FSP is organized into the following sections:

- Section 2 – Project Management and Responsibilities
- Section 3 – Sampling and Handling
- Section 4 – Chemical/Physical Testing

- Section 5 – References

2 PROJECT MANAGEMENT AND RESPONSIBILITIES

This section describes the overall project management strategy for implementing and reporting for the FSP. Personnel responsible for project management and other roles are identified in the QAPP (Attachment A-3).

The Project Manager (PM) for Anchor Environmental L.L.C. (Anchor) will be responsible for overall project coordination, including production of all project deliverables and administrative coordination to assure timely and successful completion of the project.

Field personnel from Anchor will provide overall direction for the field sampling effort in terms of logistics, personnel assignments, and field operations. They will supervise field collection of all samples. They will also be responsible for positioning samples accurately, recording sample locations, depths, and identification, assuring conformance to sampling and handling requirements including field decontamination procedures, physical evaluation and logging the samples, and completing chain-of-custody (COC) forms.

The sampling and analysis will be completed with equipment owned or rented by Anchor. All subconsultants will follow the protocols established in this FSP. Anchor will be responsible for the submittal of environmental samples to an Oregon certified laboratory for chemical and physical analyses. The Laboratory Project Manager at will provide analytical support and will be responsible for providing certified, pre-cleaned sample containers, sample preservatives (as appropriate), ensuring that all chemical analyses meet the project Data Quality Objectives (DQOs) and other quality specifications of the QAPP (Attachment A-3).

3 SAMPLING AND HANDLING

3.1 Field Sampling Schedule

The transfer facility monitoring will begin in August 2005, and is expected to be completed within 60 working days. The actual start and end dates for the sampling event will depend on EPA approval of the project plans and coordination with subcontractors. Other conditions that may affect the sampling schedule are weather, dredging productivity, and offloading efficiency. Sampling will be conducted once prior to start of any offloading of material at the facility and once after all material transfer is complete and all equipment related to this project has left the site. The post operation soil sample will be taken in the immediate vicinity of the pre-operation sample location to facilitate accurate comparison between the two samples.

3.2 Sampling Platform

Samples will be collected by foot at the transfer facility.

3.3 Horizontal Positioning and Vertical Control

Horizontal positioning at each sampling location will be determined using a differential global positioning system (DGPS) with a handheld global positioning system (GPS) unit as backup if necessary. Station positions will be recorded in latitude and longitude to the nearest 0.01 second in the North American Datum (NAD) 1983. The accuracy of the horizontal coordinates will be within 3 meters.

3.4 Station and Sample Identification

Each discrete soil sample will be assigned a unique alphanumeric identifier according to the method described below. The identifiers facilitate sample tracking by incorporating identifying information. The alphanumeric identifiers will be assigned as follows:

- The first three characters identify the sample location by the project descriptor: GTM = Gasco Transfer Monitoring
- The next two characters identify the sample station: -01 = Station 01
- The next two characters identify the sampling matrix: SO = Soil
- The next two characters identify the sampling interval: 02 = 0 to 2 cm.

For example, sample number GTM-01SO-02 indicates a soil sample obtained from Station 01 within the 0 to 2 cm sampling interval.

3.5 Sample Collection and Processing

The following subsections provide details of the field procedures to be used to meet the objectives presented in Section 1.1. These procedures are in accordance with the guidance set forth in the "Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual" (EPA, 2001).

3.5.1 Sample Collection

As formally agreed upon by EPA during design discussions, surface (0 to 2 cm) soil samples will be collected from the shoulder of the primary transfer facility access road and from the shoulder of the nearest public road that intersects the access road. The non-access road sample must be collected from a shoulder area within 100 feet from the intersection with the access road. One sample will be taken from the access road and one from the nearest public road. Based on the current configuration of the transfer facility at the time of this report, sampling will be performed in the approximate areas shown in Figure 1. The exact configuration for the staging operations has yet to be finalized so these may be slightly revised based on observed conditions and availability of sample volume. Baseline sampling will be conducted immediately prior to initiation of construction activities at the transfer facility to document the baseline conditions in the chosen shoulder areas and will also be conducted following completion and removal of all construction activities (i.e., post-construction conditions).

3.5.2 Sample Processing

The collected soil will be placed in a decontaminated stainless-steel mixing container and homogenized using a decontaminated stainless-steel spoon until uniform color and texture is achieved. The physical characteristics of the soil sample will then be logged noting the characteristics discussed in Section 3.6. Following logging, the homogenized sample will be transferred via a stainless steel spoon into pre-labeled, pre-cleaned sample containers for the proposed analyses (see sections 3.5.2 to 3.5.4). Each container will be clearly labeled with the name of the project, sample number, type of analysis, date, time, and initials of the person preparing the sample. This information will be

recorded in the logbook and on the COC forms. All samples will be double checked to ensure proper sample identification, analytical parameters, and lid tightness. Each jar will be carefully packed using bubble wrap or similar material to prevent breakage and placed inside of a cooler on ice for storage at approximately 4°C during transport to the analytical laboratory courier. Completed COC forms will be enclosed in a plastic bag and taped to the inside lid of the cooler. The shipping containers will be clearly labeled and addressed, and affixed with signed and dated custody seals. Each cooler containing iced samples will be delivered to the analytical laboratory by courier. The custody seal will be broken upon receipt of samples at the analytical laboratory; the receiver will record the temperature and condition of the samples and cross-check the sample inventory with the COC form.

The container type, method of preservation and maximum holding times for the categories of analytes are discussed in Section 3.7.

3.6 Field Documentation

A complete record of all field activities will be maintained including the following:

- Documentation of all field activities in a field logbook
- Documentation of all samples collected for analysis

The field coordinator (FC) or their designee will maintain the field logbook, which will consist of bound, numbered pages. All on-site activities, including health and safety entries, and field observations will be documented in a site logbook. All entries will be made in indelible ink. The field logbook is intended to provide sufficient data and observations to enable readers to reconstruct events that occurred during the sampling period. These entries will include the following:

- Date and time
- Sampling personnel
- Weather
- Sampling location
- Sample depth
- Characteristics or other observations of soil sample
- Penetration depth

- Where applicable, agreements reached with EPA project manager on field decisions, including the time and method of agreement (e.g. telephone, email, etc.)
- Other comments

The field logbook will include clear information concerning any modifications to the details and procedures identified in this FSP. Surface soil collection log sheets will be completed for each sampling station. In addition to standard entries of personnel, date, and time, the log sheet will also include information regarding station coordinates, penetration/recovery of the sampler, and physical characteristics of the sediment such as texture, color, odor, stratification, and sheens.

3.7 Sample Handling

This section describes the sample containers, sample handling and storage, COC forms, and sample shipping for all sediment sampling activities.

3.7.1 Sample Containers for Analysis

All sample containers received from the analytical lab will be pre-cleaned, certified, and EPA-approved. Prior to shipping, the analytical laboratory will add preservative, where required. Sample container types are listed in Table 1.

3.7.2 General Sample Handling and Storage

The guidelines for sample handling and storage for collected sediment are provided in Table 1. Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sediment sample material must meet high standards of cleanliness. All equipment and instruments used to remove sediment from the sampler will be made of glass, stainless steel, or polytetrafluoroethylene (PTFE), and will be cleaned prior to each day's use and between sampling or compositing events.

All working surfaces and instruments will be thoroughly cleaned, decontaminated, and covered with aluminum foil to minimize outside contamination between sampling events. Disposable gloves will be discarded after processing each station and replaced prior to handling decontaminated instruments or work surfaces. Sample containers will

be kept in packaging as received from the analytical lab until use; a sample container will be withdrawn only when a sample is to be collected and returned to a cooler containing completed samples.

3.7.3 Sample Transport and Chain-of-Custody Procedures

All containerized sediment samples will be transported to the analytical laboratory after preparation is completed. Specific sample shipping procedures will be as follows:

1. The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification
2. Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage and transported in a sealed ice chest or other suitable container
3. Glass jars will be separated in the shipping container by shock absorbent material (e.g., bubble wrap) to prevent breakage
4. Ice will be placed in separate plastic bags and sealed
5. A sealed envelope containing COC forms will be enclosed in a plastic bag and taped to the inside lid of the cooler
6. The cooler lids will be secured by wrapping the coolers in strapping tape
7. Signed and dated COC seals will be placed on all coolers prior to shipping
8. Each cooler or container containing the sediment samples for analysis will be either shipped to the laboratory or picked up at the transfer facility by a laboratory courier.

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the COC form. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples recorded by the recipient. COC forms will be used internally in the lab to track sample handling and final disposition.

3.8 Field Equipment Decontamination

To prevent sample cross contamination, sampling and processing equipment in contact with the sediment samples will undergo the following decontamination procedures prior to and between collection activities in accordance with EPA protocols (EPA 2001). Between

samples, the core sampler, including the piston tip and attached rod, will be decontaminated prior to use by the following procedure:

1. Rinse with potable water and wash with scrub brush until free of sediment.
2. Wash with phosphate-free detergent (e.g., Alconox®).
3. Visually inspect the sampler and repeat the scrub and rinse step, if necessary. If scrubbing and rinsing with Alconox® is insufficient to remove visually observable tar/oil-related contamination on the core tubes and extension rods, the equipment will be scrubbed and rinsed using hexane (or similar type solution) until all visual signs of contamination are absent.
4. Rinse with potable water three times.

All sample homogenizing equipment will be decontaminated prior to and between processing cores at each station using the following procedure:

1. Rinse with potable water and wash with scrub brush until free of sediment.
2. Wash with Alconox®.
3. Visually inspect the sampler and repeat the scrub and rinse step, if necessary. If scrubbing and rinsing with Alconox® is insufficient to remove visually observable tar/oil-related contamination on the core tubes and extension, the equipment will be scrubbed and rinsed using hexane (or similar type solution) until all visual signs of contamination are absent.
4. Rinse with potable water.
5. Rinse three times with distilled water.

3.9 Disposal of Excess Soils and Other Materials

All remaining soils, fluids used for decontamination of sampling equipment, and sample collection disposable wastes (e.g., gloves, paper towels, foil, etc.) will be placed into appropriate containers and staged at the transfer facility for disposal. Soils remaining following collection and processing will be placed back in the hole where the soils came from. The decontamination fluids will be stored in sealable containers and will be disposed into a 250-gallon aboveground storage tank (AST) at the Gasco Facility for treatment via the Gasco facility carbon treatment unit. When the containers are not being used, they will be sealed to prevent spills. All disposable wastes will be placed into two heavy duty plastic bags (i.e., double-bagged) and disposed at a permitted solid waste disposal facility.

4 CHEMICAL/PHYSICAL TESTING

This section summarizes the target physical and chemical analyses for the characterization of sediments in the removal action area. All sample analyses will be conducted in accordance with EPA-approved methods and the QAPP (Attachment A-2). Prior to analysis, all samples will be maintained according to the appropriate holding times and temperatures for each analysis (Table 1). Table 2 presents the proposed analytes, the analytical methods to be used, and the targeted detection limits for the evaluation of sediment and field QA/QC samples. In addition, the following methods will be used for physical testing of sediments:

1. TOC – EPA 160.3
2. Moisture content – PSEP

The laboratory will prepare a detailed report in accordance with the QAPP (Attachment A-2) to be included as an Appendix in the Remedial Action Completion Report (RACR) documenting all activities associated with the monitoring.

5 REFERENCES

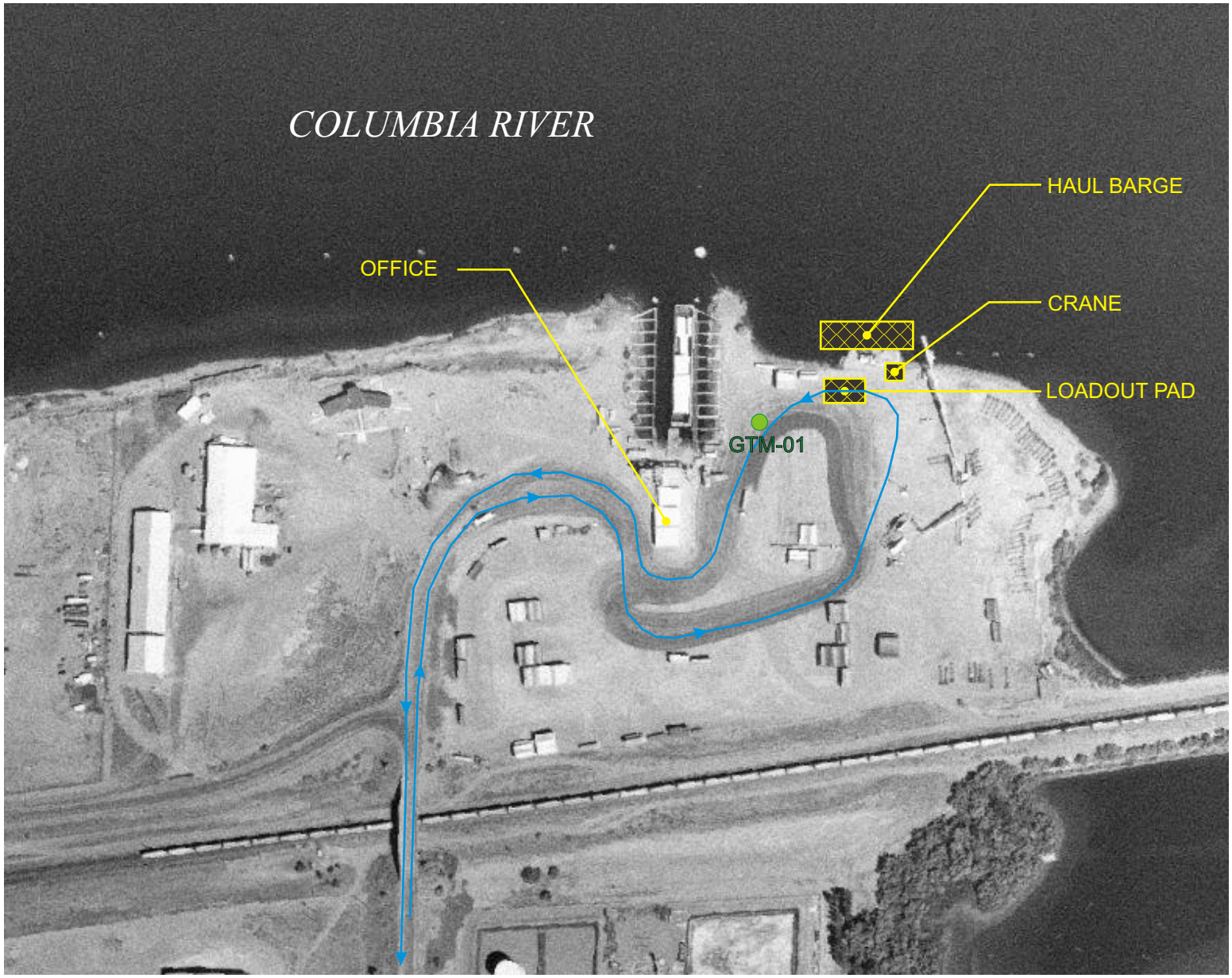
Anchor Environmental, L.L.C., 2005a. "Public Review Draft Engineering Analysis/Cost Evaluation, Removal Action NW Natural "Gasco" Site." Prepared for the Environmental Protection Agency.

U.S. Environmental Protection Agency (EPA), 2004. Administrative Order on Consent for Removal Action between NW Natural and the U.S. Environmental Protection Agency. April 28, 2004.

U.S. Environmental Protection Agency (EPA), 2001. *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual*. EPA/823/B-01-022, October 2001.

U.S. Environmental Protection Agency (EPA), 1993. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods – 3rd Edition, Update 4A*. EPA SW-846, August 1993.

FIGURES



LEGEND

GTM-01 PROPOSED SOIL SAMPLING LOCATION

HAUL ROUTE

NOTES

1. PROPOSED SOIL SAMPLING LOCATION GTM-02 WILL BE COLLECTED FROM THE SHOULDER OF THE PUBLIC ROAD (NOT SHOWN) WITHIN 100 FEET OF THE ENTRANCE TO THE PORT OF MORROW ACCESS ROAD.

2. ACTUAL HAUL ROUTE AND SAMPLING LOCATIONS WILL BE ADJUSTED, AS NEEDED, TO ACCOMMODATE FACILITY OPERATIONS.

N

Not to scale

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ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Transfer Station Haul Route and Sampling Locations
NW Natural "Gasco" Site

TABLES

Table 1
Guidelines for Sample Handling and Storage

Parameter	Container Size and Type	Holding Time	Preservation
Polycyclic Aromatic Hydrocarbons (PAHs)	16-oz Glass	14 days until extraction	Cool/4° C
		1 year until extraction 40 days after extraction	Freeze/ -18°C
Moisture content	From SVOC container	6 months	Freeze/ -18°C
		14 days	Cool/4° C
Total organic carbon (TOC)	From SVOC container	6 months	Freeze/ -18°C
		14 days	Cool/4° C

Table 2
Analytes, Analysis Methods, and Targeted Reporting Limits

Parameter	CAS Number	Preparation Method	Analytical Method	Targeted Reporting Limit
Sediments				
Conventionals				
Moisture content (%)	NA	NA	EPA 160.M	0.1
Total organic carbon (%)	NA	NA	PSEP	0.1
Semivolatile Organic Compounds (µg/kg dry weight) (Partial List)				
LPAHs				
Naphthalene	91203	US EPA Method 3550	US EPA Method 8270C-SIM	5
Acenaphthylene	208968	US EPA Method 3550	US EPA Method 8270C-SIM	5
Acenaphthene	83329	US EPA Method 3550	US EPA Method 8270C-SIM	5
Fluorene	86737	US EPA Method 3550	US EPA Method 8270C-SIM	5
Phenanthrene	85018	US EPA Method 3550	US EPA Method 8270C-SIM	5
Anthracene	1201727	US EPA Method 3550	US EPA Method 8270C-SIM	5
2-Methylnaphthalene	91576	US EPA Method 3550	US EPA Method 8270C-SIM	5
HPAHs				
Fluoranthene	206440	US EPA Method 3550	US EPA Method 8270C-SIM	5
Pyrene	129000	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benz(a)anthracene	56553	US EPA Method 3550	US EPA Method 8270C-SIM	5
Chrysene	218019	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benzofluoranthene	205992	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benzo(a)pyrene	50328	US EPA Method 3550	US EPA Method 8270C-SIM	5
Indeno(1,2,3-cd)pyrene	193395	US EPA Method 3550	US EPA Method 8270C-SIM	5
Dibenz(a,h)anthracene	53703	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benzo(g,h,i)perylene	191242	US EPA Method 3550	US EPA Method 8270C-SIM	5

ATTACHMENT 1

SURFACE SOIL FIELD SAMPLE RECORD

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Soil Field Sample Record

Collection Date:
Shipping Date:

Project Name: Gasco - Offsite Tracking Monitoring **Station ID:**

Sampling Crew: _____
Sampling Method: _____ _____
Subcontractor(s): _____
Station Coordinates: N / Lat. _____ Weather: _____
E / W / Long. _____ _____
Datum: NAD 83 / WGS 84 Zone:

Sample Number: _____
Analysis: Metals / PAHs / VOCs / PCBs / Pest / Herb / TBTs / Diox-Furans
Moisture Content / Grain Size / TOC / TVS / Ammonia / Sulfides
(Circle Appropriate Analyses)

Field Test Results Comments: _____
Salinity: _____ ppt _____
Ammonia: _____ mg/L _____
Grain Size: ml Coarse: _____ ml Fines: _____ _____

Grab Number: _____ Penetration/Sampled Depth: _____ Time: _____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Soil Type:	Soil Color:	Soil Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Grab Number: _____ Penetration/Sampled Depth: _____ Time: _____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Soil Type:	Soil Color:	Soil Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Grab Number: _____ Penetration/Sampled Depth: _____ Time: _____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Soil Type:	Soil Color:	Soil Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Grab Number: _____ Penetration/Sampled Depth: _____ Time: _____
Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Soil Type:	Soil Color:	Soil Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Recorded by:_____

ATTACHMENT A-3

QUALITY ASSURANCE PROJECT PLAN
OFFSITE TRACKING MONITORING – TRANSFER FACILITY

DRAFT
ATTACHMENT A-3

QUALITY ASSURANCE PROJECT PLAN
OFFSITE TRACKING MONITORING – TRANSFER FACILITY

REMOVAL ACTION
NW NATURAL "GASCO" SITE

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July 2005

Title and Approval Page:

QUALITY ASSURANCE PROJECT PLAN

OFF-SITE TRACKING MONITORING - TRANSFER FACILITY

NW NATURAL "GASCO" SITE

July 12, 2005

Anchor Project Manager	Carl Stivers	July 13, 2005 Date
Anchor QA Manager	Susan Snyder	July 13, 2005 Date
EPA Project Coordinator	Sean Sheldrake	Date

Table of Contents

1 DISTRIBUTION LIST 1

2 INTRODUCTION 2

3 PROJECT MANAGEMENT 3
- 3.1 Project/Task Organization 3
- 3.2 Problem Definition/Background 4
- 3.3 Project/Task Description and Schedule 4
- 3.4 Sediment Reporting Limit Objectives 5
- 3.5 Off-Site Tracking Monitoring Schedule 5

4 DATA QUALITY OBJECTIVES AND CRITERIA 6
- 4.1 Precision 6
- 4.2 Accuracy 7
- 4.3 Representativeness 8
- 4.4 Comparability 8
- 4.5 Completeness 8

5 SPECIAL TRAINING/CERTIFICATION 9

6 DOCUMENTATION AND RECORDS 10

7 SAMPLING PROCESS DESIGN 13
- 7.1 Sampling Number and Locations 13
- 7.2 Selection of Indicator Chemicals 13

8 SAMPLING METHODS 14

9 SAMPLE HANDLING AND CUSTODY 15

10 ANALYTICAL METHODS 16

11 LABORATORY QUALITY CONTROL 17
- 11.1 Laboratory QC Criteria 17
- 11.2 Initial and Continuing Calibration 17
- 11.3 Laboratory Duplicates 18
- 11.4 Matrix Spikes and Matrix Spike Duplicates (MS/MSD) 18
- 11.5 Method Blanks 18

12 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE 20

13 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY 21

14 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES 22

15 NON-DIRECT MEASUREMENTS 23

16 DATA MANAGEMENT 24
Required Hardware 24

17 ASSESSMENTS AND RESPONSE ACTIONS 25
17.1 Laboratory Data Quality Review 25
17.2 Laboratory and Field Performance Assessment 25

18 REPORTS TO MANAGEMENT 27

19 DATA REVIEW, VALIDATION, AND VERIFICATION 28

20 VERIFICATION AND VALIDATION METHODS 29

21 RECONCILIATION WITH USER REQUIREMENTS 31

22 REFERENCES 32

List of Tables

Table 1 Offsite Tracking Monitoring Schedule

Table 2 Laboratory QA/QC Guidelines

Table 3 Guidelines for Sample Handling and Storage

Table 4 Analytes, Analysis Methods, and Targeted Reporting Limits

%RSD	percent relative standard deviation
CAS	Columbia Analytical Services
CCB	continuing calibration blank
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
COC	chain of custody
DGPS	differential global positioning system
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
EPA	US Environmental Protection Agency
FC	field coordinator
FSP	Field Sampling Plan
ICV	Initial (or independent) calibration verification
MS/MSD	matrix spike/matrix spike duplicate
Order	Administrative Order on Consent
PAH	polycyclic aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, completeness
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RACR	Remedial Action Completion Report
RAPP	Remedial Action Project Plan
RAWP	Removal Action Work Plan
RPD	relative percent difference
SDG	sample delivery group
Site	Gasco site
SOP	standard operating procedure
SOW	Statement of Work
TDP	Transportation and Disposal Plan
TOC	total organic carbon

1 DISTRIBUTION LIST

All group leaders and technical advisors will receive copies of this Quality Assurance Project Plan (QAPP), and any approved revisions of this plan. Once approved, this QAPP will be available to any authorized party by requesting a copy from the NW Natural Project Manager, Mr. Robert J. Wyatt or the EPA Project Coordinator, Mr. Sean Sheldrake.

2 INTRODUCTION

NW Natural entered into an Administrative Order on Consent (Order) with the U.S. Environmental Protection Agency (EPA) on April 28, 2004 to perform a time-critical removal action at the "Gasco site" (Site) located on the Willamette River in Portland, Oregon (EPA 2004). The Order requires that NW Natural perform a number of actions associated with removing a tar body from the riverbank and nearshore sediment adjacent to the site. The Statement of Work (SOW) for the removal action requires that a Transportation and Disposal Plan (TDP) be developed for any material that is to be removed from the Site. This Quality Assurance Project Plan (QAPP) accompanies the off-site tracking monitoring Field Sampling Plan (FSP) and is an attachment to Appendix A (Transportation and Disposal Plan [TDP]) of the Draft Final Remedial Action Project Plan (RAPP). This QAPP is one of the design documents required by EPA following multiple discussions regarding the potential for offsite tracking of contaminants from the upland offloading facility as part of the dredging removal action at the Site. This QAPP incorporates the EPA and public comments received following submittal of the Engineering Analysis/Cost Analysis (EE/CA) (Anchor 2005). Although Section 4 of the TDP details the daily monitoring protocols to prevent offsite tracking of contaminants during transfer activities and response mechanisms if tracking is identified, EPA required that additional pre- and post- characterization be conducted at the transfer facility as a final check to ensure that offsite tracking did not occur during the transfer process.

In accordance with the EPA request, this QAPP is prepared following the EPA QA/R-5 (EPA, 2001) and QA/G-5 (EPA 1998) protocols, and follows the guidance set forth in the OSWER Directive No. 9360.4-01 (EPA 1990). In addition, a number of other EPA documents were used as aids in preparing this document (EPA 1996 and 1998). The laboratory chosen for physical and chemical analyses (Columbia Analytical Services [CAS]) is qualified to conduct the proposed analyses and complies with ANSI/ASQC E-4 1994 and/or equivalent documentation.

3 PROJECT MANAGEMENT

3.1 Project/Task Organization

The overall project organization and the individuals responsible for the various tasks required for the implementation of the monitoring program are discussed below.

Mr. Sean Sheldrake, the EPA Project Coordinator, will be involved in all aspects of this project, including discussion, review, and approval of this QAPP, and interpretation of the results of the investigation.

Mr. Carl Stivers, Anchor Environmental, will serve as Project Manager for the monitoring team. He will be responsible for overall project coordination, planning, and implementation, production of work plans and other project deliverables, and performing the administrative tasks needed to ensure timely and successful completion of the project.

Mr. Stivers will select qualified, experienced individuals to serve as the Field Coordinator (FC) for the field sampling activities. The FC is responsible for day-to-day technical oversight, and for quality assurance/quality control (QA/QC) oversight of field activities, ensuring that appropriate protocols are followed for collection of environmental data and any associated field samples. The FC will also be responsible for ensuring that reporting of monitoring results is performed.

Susan Snyder, Anchor, will serve as the QA/QC coordinator. The QA/QC coordinator will provide QA oversight for both the field sampling and laboratory programs. The QA/QC coordinator will ensure that samples are collected and documented appropriately, coordinate with the analytical laboratories, ensure data quality, oversee data validation, and supervise project QA coordination.

CAS will perform chemical analyses of the water samples. The contact at CAS will be Abbie Spielman. CAS will:

- Perform the methods outlined in this QAPP, including those methods referenced for each analytical procedure
- Follow documentation, custody, and sample logbook procedures
- Oversee the receipt of sediment samples from field team

- Supervise chemical analyses in laboratory
- Review laboratory reports and prepare case narrative describing any anomalies and exceptions that occurred during analysis

3.2 Problem Definition/Background

As part of the removal actions at the Gasco site, dredged sediments will need to be transported overland from the transfer facility to the disposal facility. This QAPP presents the necessary protocols to assess potential off-site impacts that may occur as a result of truck loading activities at the transfer facility. The types of information include:

- Field procedures and schedule for conducting the monitoring program
- Analyte list
- Responses to address contingency measures that might be used if there are exceedances of monitoring criteria
- Requirements for the timing and reporting of the monitoring results

Additional project background information regarding the transportation and disposal activities is presented in the main text of the TDP (Appendix A).

3.3 Project/Task Description and Schedule

Removal action activities will be initiated in August 2005. Dredged material will be transferred to barges, sediment drying reagent will be applied and mixed into the barge sufficiently to pass the Paint Filter test (at a minimum 5 percent by volume), and the barge will be transported to the Port of Morrow transfer facility. Once at the transfer facility, the dry material will be transferred to an upland hopper and subsequently into water-tight trucks. The trucks will be covered and driven to the Chemical Waste Management North West (CWMNW) Subtitle C disposal facility.

Transfer facility monitoring will occur prior to initiation of the transfer activities (i.e., baseline sampling) and following completion of all waste transfer activities at the transfer facility. Monitoring will consist of the sampling and analysis of discrete surface (0 to 2 cm) soil samples from field identified locations where trucks depart from the facility. Monitoring activities will be used to evaluate whether offsite tracking of dredged material occurred during the waste transfer activities. Section 4 of the TDP describes the monitoring

protocols established to determine if offsite tracking is occurring during the waste transfer activities and describes the response mechanisms is offsite tracking is identified.

3.4 Sediment Reporting Limit Objectives

The targeted reporting limits for the pre- and post-construction monitoring samples will be identical to the sediment reporting limits identified in Table 3 of the EPA-approved Field Sampling Plan (FSP), which is Appendix A of the Removal Action Work Plan (RAWP) (Anchor 2004).

3.5 Off-Site Tracking Monitoring Schedule

The monitoring schedule for offsite tracking is presented in Table 1.

4 DATA QUALITY OBJECTIVES AND CRITERIA

The QA objective for this project is to ensure that the data collected are of known and acceptable quality so that the goal of determining whether offsite tracking occurred during waste transfer activities is achieved. The quality of the laboratory data is assessed by precision, accuracy, representativeness, comparability, and completeness (the "PARCC" parameters). For completeness, definitions of these parameters and the applicable QC procedures are given below. Laboratory analysis is expected to be limited to total organic carbon (TOC), moisture content, and polycyclic aromatic hydrocarbon (PAH) concentrations. Applicable quantitative goals for these data quality parameters are listed or referenced in Table 2.

4.1 Precision

Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling, and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability—the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility—the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

In the laboratory, "within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

Precision measurements can be affected by the nearness of a chemical concentration to the MDL, where the percent error (expressed as RPD) increases. The equations used to express precision are as follows:

$$\mathrm{RPD} = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:

RPD = relative percent difference

C_1 = larger of the two observed values

C_2 = smaller of the two observed values

4.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery (%R) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination). CAS utilizes several QC measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples, and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement.

Laboratory accuracy will be evaluated against quantitative matrix spike and surrogate spike recovery performance criteria provided by the laboratory. Accuracy can be expressed as a percentage of the true or reference value, or as a %R in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U)/C_{sa}$$

Where:

%R = percent recovery

S = measured concentration in the spiked aliquot

U = measured concentration in the unspiked aliquot

C_{sa} = actual concentration of spike added

Field accuracy will be controlled by adherence to sample collection procedures outlined in the FSP.

4.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents an environmental condition. For the transfer facility soil sampling program, the list of analytes has been identified to provide a comprehensive assessment of the tar related contamination at the Gasco site.

4.4 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this program, comparability of data will be established through the use of standard analytical methodologies and reporting formats, and of common traceable calibration and reference materials.

4.5 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:

$$C = \frac{\text{(Number of acceptable data points)} \times 100}{\text{(Total number of data points)}}$$

The data quality objective (DQO) for completeness for all components of this project is 90 percent. Data that have been qualified as estimated because the QC criteria were not met 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.

5 SPECIAL TRAINING/CERTIFICATION

For the collection of the samples it is important that field crews are trained in standardized logging and data collection requirements, so that data are consistent among the field crew. All field crew are fully trained in decontamination protocols, visual inspections, and chain-of-custody procedures. All field crew are also required to be 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certified.

6 DOCUMENTATION AND RECORDS

Sample documentation is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis to the time sample results are potentially introduced as evidence. A sample log form and field logbook entries will be completed for each location occupied and each sample collected.

Sample labeling and custody documentation will be performed as described in the FSP. Custody procedures will be used for all samples at all stages in the analytical or transfer process and for all data and data documentation whether in hard copy or electronic format.

The analytical laboratory will be required, where applicable, to report the following:

- **Project Narrative.** This summary, in the form of a cover letter, will discuss problems, if any, encountered during any aspect of analysis. This summary should discuss, but not be limited to, QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate.
- **Chain of Custody Records.** Legible copies of the custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.
- **Sample Results.** The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:
  - Field sample identification code and the corresponding laboratory identification code
  - Sample matrix
  - Date of sample extraction
  - Date and time of analysis
  - Weight and/or volume used for analysis
  - Final dilution volumes or concentration factor for the sample
  - Identification of the instrument used for analysis
  - Method reporting and quantitation limits
  - Analytical results with reporting units identified

  - Data qualifiers and their definitions
  - A computer disk with the data in a format specified in advance by NW Natural or their designee (Anchor)
- **QA/QC Summaries.** This section will contain the results of the laboratory QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results (see above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.
- **Calibration Data Summary.** Report the concentrations of the initial calibration and daily calibration standards, and the date and time of analysis. List the response factor, percent relative standard deviation, percent difference, and retention time for each analyte as appropriate. Report results for standards to indicate instrument sensitivity.
- **Internal Standard Area Summary.** Report the stability of internal standard areas.
- **Method Blank Analysis.** Report the method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks.
- **Surrogate Spike Recovery.** Report all surrogate spike recovery data for organic compounds. List the name and concentration of all compounds added, percent recoveries, and range of recoveries.
- **Matrix Spike Recovery.** Report all matrix spike recovery data for organic and metal compounds. List the name and concentration of all compounds added, percent recoveries, and range of recoveries. Report the RPD for all duplicate analyses.
- **Matrix Duplicate.** Report the RPD for all matrix duplicate analyses.
- **Relative Retention Time.** Report the relative retention time of each analyte detected in the samples for both primary and conformational analyses.
- **Original Data.** Legible copies of the original data generated by the laboratory will include:
  - Sample extraction, preparation, and cleanup logs
  - Instrument specifications and analysis logs for all instruments used on days of calibration and analysis
  - Reconstructed ion chromatograms for all samples, standards, blanks, calibrations, spikes, replicates, and reference materials
  - Enhanced spectra of detected compounds with associated best-match spectra for each sample

- Printouts and quantitation reports for each instrument used, including reports for all samples, standards, blanks, calibrations, spikes, replicates, and reference materials
- Original data quantification reports for each sample
- Original data for blanks and samples not reported

All data collected from this project will be kept at Anchor for 10 years after NW Natural's receipt of EPA's Notice of Completion of Work (see Order ¶30).

7 SAMPLING PROCESS DESIGN

7.1 Sampling Number and Locations

To maintain flexibility in the field the monitoring locations will be chosen in the field based on observed conditions and availability of sample volume. As formally agreed upon by EPA during design discussions, surface (0 to 2 cm) soil samples will be collected from the shoulder of the primary transfer facility access road and from the shoulder of the nearest public road that intersects the access road. The non-access road sample must be collected from a shoulder area within 100 feet from the intersection with the access road. One sample will be taken from the access road and one from the nearest public road. Baseline sampling will be conducted immediately prior to initiation of construction activities at the transfer facility to document the baseline conditions in the chosen shoulder areas and will also be conducted following completion and removal of all construction activities (i.e., post-construction conditions). Pre- and post-construction monitoring stations will be approximately co-located.

7.2 Selection of Indicator Chemicals

Following multiple discussions with EPA during the design process, PAHs were identified to be the most appropriate indicator chemicals to use to assess off-tracking. These constituents will be analyzed via EPA Method 8270. In addition, physical testing of sediments will include TOC via Method 160.3 and moisture content via PSEP protocol.

8 SAMPLING METHODS

Discrete surface sampling methods and procedures for the removal action design characterization are described in detail in the FSP.

9 SAMPLE HANDLING AND CUSTODY

Sample collection and handling procedures are detailed in the FSP. To control the integrity of the samples during transit to the laboratory and during hold prior to analysis, established preservation and storage measures will be taken. Table 3 presents container type, preservation, and maximum holding times for various chemical analyses of sediment. Sample containers will be labeled with the client name, survey number, sample number, sampling date and time, required analyses, and initials of the individual processing the sample. The Field QA Manager or designee will check all container labels, custody form entries, and logbook entries for completeness and accuracy at the end of each sampling day.

Sample labeling and chain-of-custody documentation will be performed as described in the FSP. Custody procedures will be used for all samples at all stages in the analytical or transfer process and for all data and data documentation whether in hard copy or electronic format.

10 ANALYTICAL METHODS

In completing chemical analyses for this project, the contract laboratories are expected to meet the following minimum requirements:

1. Adhere to the methods outlined in the QAPP, including methods referenced for each analytical procedure
2. Deliver fax, hard copy, and electronic data as specified
3. Meet reporting requirements for deliverables
4. Meet turnaround times for deliverables
5. Implement QA/QC procedures, including the QAPP data quality requirements, laboratory QA requirements, and performance evaluation testing requirements
6. Allow laboratory and data audits to be performed, if deemed necessary

The laboratory chosen for physical and chemical analyses (CAS) is qualified to conduct the proposed analyses and complies with ANSI/ASQC E-4 1994 and QA/R-2 or equivalent documentation per the removal action Order.

Table 4 presents the analysis methods and the target reporting limits for the proposed samples. These reporting limits are were chose based on the evaluation described in Section 3.4 above.

11 LABORATORY QUALITY CONTROL

11.1 Laboratory QC Criteria

Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the Project QA Manager will be contacted immediately and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis.

11.2 Initial and Continuing Calibration

Calibration standards are solutions of known concentration prepared from primary standard solutions that are, in turn, prepared from stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

Initial (or independent) calibration verification (ICVs) standards are standards that are analyzed *after* calibration with newly prepared standard(s), but *prior to* sample analysis in order to verify the validity of the standards used in the calibration. Once it is determined that there is no systematic error in preparation of the calibration standard(s), they are considered valid standards and may be used for subsequent calibrations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards. ICVs are also analyzed in accordance with method-specific requirements.

Continuing calibration verification (CCVs) standards are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every 10 samples, or as indicated in the method.

All project samples analyzed while instrument calibration was out of control will be reanalyzed.

11.3 Laboratory Duplicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample and are prepared and analyzed as a separate sample. A minimum of one duplicate will be analyzed per sample group or for every 20 samples, whichever is more frequent.

11.4 Matrix Spikes and Matrix Spike Duplicates (MS/MSD)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte(s) has been added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as the routine samples. The stock solutions used for spiking the sample(s) are purchased and prepared independently of calibration standards. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Surrogate recoveries will be reported by the laboratory; however, no sample result will be corrected for recovery using these values.

11.5 Method Blanks

The method blank is either analyte-free water or analyte-free soil (when available) subjected to the entire analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, or an acceptable substitute may be used instead. The method blank is analyzed to demonstrate that the analytical system itself is not contaminated with the analyte(s) being measured. The method blank results should be below the MRL or, below half of the MRL for the analyte(s) being tested. Otherwise, corrective action must be

taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

12 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Instruments and equipment will be tested and inspected before each sampling event and laboratory analyses. Any field equipment that is faulty or not functioning properly will not be used for sampling.

13 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Multipoint initial calibration will be performed on each instrument at the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet control criteria.

Instrument blanks or continuing calibration blanks (CCBs) provide information on the stability of the baseline established. CCBs are solutions of either analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed. The frequency of CCB analysis is either once every 10 samples or as indicated in the method, whichever is greater.

All project samples analyzed while instrument calibration was out of control will be reanalyzed.

14 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Inspection and acceptance of field supplies including laboratory prepared sampling bottles will be performed by the FC. All primary chemical standards and standard solutions used in this project either in the field or laboratory will be traceable to documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

15 NON-DIRECT MEASUREMENTS

Additional information may be obtained from NW Natural or EPA. If such information is needed, NW Natural or EPA will be asked to provide any information on data limitations. This information will be maintained with the data files.

16 DATA MANAGEMENT

Field data sheets will be checked for completeness and accuracy by the field supervisor. Samples and sample information will be examined by the laboratory manager upon receipt to be sure samples are within holding times, sample identification information is correct, and samples have been held and handled appropriately. Any samples that are not acceptable will be marked and not entered into the database or given an appropriate qualifier.

All data generated in the field will be documented on hardcopy and provided to the office data manager for review and to whoever is responsible for the data's entry into an EQuIS database. All manually entered data will be checked by a second party. Field documentation will be filed in the main project file, after data entry and backchecking is complete.

Laboratory data will be provided to the data manager in the EQuIS electronic format. Laboratory data, which is electronically provided and loaded into the database, will undergo a 10 percent check against the laboratory hardcopy data. Data is validated or reviewed manually, and qualifiers, if assigned, are entered manually. All manually entered data is backchecked by a second party.

Data tables and reports are exported from EQuIS to Microsoft Excel tables.

Required Hardware

EQuIS Chemistry is developed as a 32-bit application. The following minimum system is required to install and properly operate *EQuIS Chemistry*:

Pentium Processor

Processor speed of 500 MHz or faster

Microsoft Windows 95 or higher

64 MB RAM

40 MB hard disk space available

600 x 800 screen resolution

17 ASSESSMENTS AND RESPONSE ACTIONS

Once data are received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

17.1 Laboratory Data Quality Review

An EPA Level III data quality review will be performed by a qualified Data Validation Specialist on the data, in accordance with EPA National Functional Guidelines. The data will be evaluated in accordance with the QAPP. All chemical data will be reviewed with regard to the following, as appropriate to the particular analysis.

- Chain of custody/documentation
- Holding times
- Instrument calibration
- Method blanks
- Detection limits
- Surrogate recoveries
- MS/MS recoveries
- Laboratory control sample recoveries
- Laboratory and field duplicate RPDs

The results of the data quality review, including text assigning qualifiers in accordance with the EPA National Functional Guidelines and a tabular summary of qualifiers, will be generated by the Data Validation Specialists and submitted to the Project QA Officer for final review and confirmation of the validity of the data (EPA, 1999). A QA summary of the review will be generated by the Project QA Officer. This summary and copies of the complete review will be presented as an appendix to the remedial removal action report.

17.2 Laboratory and Field Performance Assessment

Laboratory and field performance audits consist of on-site reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted as part of this study; however, all laboratory audit reports will be made available to the Project QA Officer upon request. All laboratories are required to have written procedures addressing internal QA/QC; these procedures have been submitted and will be

reviewed by the Project QA Officer to ensure compliance with the QAPP. All laboratories must ensure that personnel engaged in sampling and analysis tasks have appropriate training.

The laboratory will, as part of the audit process, provide written details of any and all planned method modifications for the consultant's review.

Responsive Action for Laboratory Analyses. All laboratories are required to comply with their Standard Operating Procedures (SOPs). The Laboratory Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The Laboratory Project Manager will be notified immediately if any QC sample exceeds the project-specified control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. The Laboratory Project Manager will document the corrective action taken in a memorandum submitted to the Project QA Officer within 5 days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) will be submitted with the data package in the form of a cover letter.

18 REPORTS TO MANAGEMENT

Following finalization of the data validation, a report will be prepared as a part of Remedial Action Completion Report (RACR). This report will contain all results, data qualifiers, results of QA checks, and sampling and/or laboratory deviations covered by this QAPP.

19 DATA REVIEW, VALIDATION, AND VERIFICATION

Data files will be reviewed by the data manager to identify outliers, spurious results, or omissions. Any problems will be reported to the Technical PM. The QA Officer will review data for compliance with DQOs. Any problems with data quality will be included in the RACR.

20 VERIFICATION AND VALIDATION METHODS

Data validation includes signed entries by the field and laboratory technicians on field data sheets and laboratory datasheets, respectively; review for completeness and accuracy by the field supervisor and laboratory manager; review by the data manager for outliers and omissions; and the use of QC criteria to accept or reject specific data. All data will be entered into the EQuIS database and a raw data file printed. One hundred percent verification of database raw data file will be performed by a second data manager or designee. Any errors found will be corrected on the raw data printout sheet. After the raw data is checked, the top sheet will be marked with the date the checking is completed and the initials of the person doing the checking. Any errors in the raw data file will be corrected, and the database established.

All laboratory data will be reviewed and verified to determine whether all data quality objectives (DQO, Section 5) have been met, and that appropriate corrective actions have been taken, when necessary. The Project QA Officer or designee will be responsible for the final review of all data generated from analyses of samples.

The first level of review will take place in the laboratory as the data are generated. The laboratory department manager or designee will be responsible for ensuring that the data generated meet minimum QA/QC requirements and that the instruments were operating under acceptable conditions during generation of data. DQOs will also be assessed at this point by comparing the results of QC measurements with pre-established criteria as a measure of data acceptability.

The analysts and/or laboratory department manager will prepare a preliminary QC checklist for each parameter and for each sample delivery group as soon as analysis of a sample delivery group has been completed. Any deviations from the DQOs listed on the checklist will be brought to the attention of the Laboratory Project Manager to determine whether corrective action is needed and to determine the impact on the reporting schedule.

Data packages will be checked for EPA Level II completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. Data quality

will be assessed by a reviewer using current EPA Level III validation requirements and ODEQ protocols by considering the following:

1. Holding times
2. Initial calibrations
3. Continuing calibrations
4. Method blanks
5. Surrogate recoveries
6. Detection limits
7. Laboratory Control samples
8. Matrix spike (MS)/ Matrix Spike Duplicate (MSD) samples
9. Standard reference material results

The data will be validated in accordance with the project specific data quality objectives described above, analytical method criteria, and the laboratory's internal performance standards based on their SOPs.

21 RECONCILIATION WITH USER REQUIREMENTS

The QA Officer will review data after each survey to determine if DQOs have been met. If data do not meet the project's specifications, the QA Officer will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors. The QA officer will suggest corrective action. It is expected that the problem would be able to be corrected by retraining, revision of techniques, or replacement of supplies/equipment. If not, then the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA Officer will recommend appropriate modifications. Any revisions would need approval by the EPA.

22 REFERENCES

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TABLES

Table 1
Project Schedule - Removal Action Sediment Characterization

Activity	Duration	Start Date
Baseline Field Sampling	1 day	August 25, 2005
Construction Field Sampling	None	None
Post-Construction Field Sampling	1 days	November 1, 2005
Reporting	45 days	December 16, 2005

Table 2
Laboratory QA/QC Guidelines

Analyte	Precision (RPD)	Accuracy (%REC)
Conventionals		
Moisture content	20	NA
Total Organic Carbon	20	85-115
Semivolatile Organic Compounds (Partial List)		
LPAHs		
Naphthalene	40	43-102
Acenaphthylene	40	51-107
Acenaphthene	40	50-105
Fluorene	40	54-108
Phenanthrene	40	58-106
Anthracene	40	61-113
2-Methylnaphthalene	40	44-105
HPAHs		
Fluoranthene	40	63-117
Pyrene	40	59-121
Benz(a)anthracene	40	57-120
Chrysene	40	64-116
Benzofluoranthene	40	58-126
Benzo(a)pyrene	40	58-128
Indeno(1,2,3-cd)pyrene	40	46-133
Dibenz(a,h)anthracene	40	50-128
Benzo(g,h,i)perylene	40	52-125

Table 3
Guidelines for Sample Handling and Storage

Parameter	Container Size and Type	Holding Time	Preservation
Polycyclic Aromatic Hydrocarbons (PAHs)	16-oz Glass	14 days until extraction	Cool/4° C
		1 year until extraction 40 days after extraction	Freeze/ -18°C
Moisture content	From SVOC container	6 months	Freeze/ -18°C
		14 days	Cool/4° C
Total organic carbon (TOC)	From SVOC container	6 months	Freeze/ -18°C
		14 days	Cool/4° C

Table 4
Analytes, Analysis Methods, and Targeted Reporting Limits

Parameter	CAS Number	Preparation Method	Analytical Method	Targeted Reporting Limit
Conventionals				
Moisture content (%)	NA	NA	EPA 160.M	0.1
Total organic carbon (%)	NA	NA	PSEP	0.1
Semivolatile Organic Compounds (µg/kg dry weight) (Partial List)				
LPAHs				
Naphthalene	91203	US EPA Method 3550	US EPA Method 8270C-SIM	5
Acenaphthylene	208968	US EPA Method 3550	US EPA Method 8270C-SIM	5
Acenaphthene	83329	US EPA Method 3550	US EPA Method 8270C-SIM	5
Fluorene	86737	US EPA Method 3550	US EPA Method 8270C-SIM	5
Phenanthrene	85018	US EPA Method 3550	US EPA Method 8270C-SIM	5
Anthracene	1201727	US EPA Method 3550	US EPA Method 8270C-SIM	5
2-Methylnaphthalene	91576	US EPA Method 3550	US EPA Method 8270C-SIM	5
HPAHs				
Fluoranthene	206440	US EPA Method 3550	US EPA Method 8270C-SIM	5
Pyrene	129000	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benz(a)anthracene	56553	US EPA Method 3550	US EPA Method 8270C-SIM	5
Chrysene	218019	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benzofluoranthene	205992	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benzo(a)pyrene	50328	US EPA Method 3550	US EPA Method 8270C-SIM	5
Indeno(1,2,3-cd)pyrene	193395	US EPA Method 3550	US EPA Method 8270C-SIM	5
Dibenz(a,h)anthracene	53703	US EPA Method 3550	US EPA Method 8270C-SIM	5
Benzo(g,h,i)perylene	191242	US EPA Method 3550	US EPA Method 8270C-SIM	5

ATTACHMENT A-4

WASTE PROFILE FORM

WASTE MANAGEMENT

GENERATOR'S WASTE PROFILE SHEET

PLEASE PRINT IN INK OR TYPE

Profile Number: WM CW 0989
Renewal Date: / /

Service Agreement on File? ☐ YES ☒ NO
☐ Hazardous ☒ Non-Hazardous ☐ TSCA

A. Waste Generator Information

1. Generator Name: GASCO
2. SIC Code: 4923
3. Facility Street Address: 7900 NW St Helens Rd
4. Phone: ( )
5. Facility City: Portland
6. State/Province: OR
7. Zip/Postal Code: 97210
8. Generator USEPA/Federal ID #: NA / Nonhaz. Waste
9. County: Multnomah
10. State/Province ID #: ECSI #84
11. Customer Name: NW Natural
12. Customer Phone: (503) 226-4211
13. Customer Contact: Bob Wyatt
14. Customer Fax: (503) 273-4815
15. Billing Address: 2200 NW 2nd Ave, Portland, OR 97209 ☐ Same as above

B. Waste Stream Information

1. **Description**
   a. Name of Waste: Contaminated Sediment
   b. Process Generating Waste: Cercla Clean-up of Manufactured Gas Plant Waste in Sediment

c. Color	d. Strong odor (describe):	e. Physical state @ 70°F	f. Layers	g. Free liquid range
Grayish Brown to Black	Petroleum Hydrocarbon	☒ Solid ☐ Liquid ☐ Gas ☒ Sludge ☐ Other	☐ Single Layer ☒ Multi-layer	to ○ %
				h. pH: Range to %

i. Liquid Flash Point: ☐ <73°F ☐ 73-99°F ☐ 100-139°F ☐ 140-199°F ☐ ≥ 200°F ☒ Not applicable

j. Chemical Composition (List all constituents [including halogenated organics, debris, and UHC's] present in any concentration and submit representative analysis):

Constituents	Concentration Range	Constituents	Concentration Range
Benzo(a) Pyrene	22 – 500,000 µg/kg	Inert Silt + Sand	75%
Chrysene	23 – 500,000 µg/kg	Organic Contaminants	up to 2%
Benzene	1.3 – 18,000 µg/kg	Water *	25%
(See att table for complete analysis)		*Waste will be treated to eliminate free wa	

TOTAL COMPOSITION MUST EQUAL OR EXCEED 100%

k. ☐ Oxidizer ☐ Pyrophoric ☐ Explosive ☐ Radioactive
☒ Carcinogen ☐ Infectious ☐ Shock Sensitive ☐ Water Reactive

l. Does the waste represented by this profile contain any of the carcinogens which require OSHA notification? (list in Section B.1.j) (Not > 0.1%) ☐ YES ☒ NO
m. Does the waste represented by this profile contain dioxins? (list in Section B.1.j) (No knowledge) ☐ YES ☒ NO
n. Does the waste represented by this profile contain asbestos? ☐ YES ☒ NO
If yes ☐ friable ☐ non-friable
o. Does the waste represented by this profile contain benzene? ☒ YES ☐ NO
If yes, concentration Max 18 ppm
Is the waste subject to the benzene waste operations NESHAP? ☐ YES ☒ NO
p. Is the waste subject to RCRA Subpart CC controls? ☐ YES ☒ NO N/A
If no, does the waste meet the organic LDR Exemption? ☐ YES ☒ NO N/A
If no, does the waste contain <500 ppmw volatile organic (VO)? ☒ YES ☐ NO
Volatile organic concentration Maximum 84.8 ppmw
q. Does the waste contain any Class I or Class II ozone-depleting substances? ☐ YES ☒ NO
r. Does the waste contain debris? (list in Ssection B.1.j) (May contain minor amts of broken concrete/masonry) ☒ YES ☐ NO

2. **Quantity of Waste**
Estimated Annual Volume 15,000 CY ☐ Tons ☒ Yards ☐ Drums ☒ Other (specify) One-Time Generation

3. **Shipping Information**
a. Packaging:
☒ Bulk Solid; Type/Size: Truck ☐ Bulk Liquid; Type/Size:
☐ Drum; Type; Size: ☐ Other:
b. Shipping Frequency: Units Per: ☐ Month ☐ Quarter ☐ Year ☒ One time ☐ Other
c. Is this a U.S. Department of Transportation (USDOT) Hazardous Material? (If no, skip d, e, and f) ☒ YES ☐ NO

WASTE MANAGEMENT

GENERATOR'S WASTE PROFILE SHEET

PLEASE PRINT IN INK OR TYPE

d. Reportable Quantity (lbs.; kgs.): 1 LB. e. Hazard Class/ID #: 9 / NA3077

f. USDOT Shipping Name: OTHER REGULATED SUBSTANCES, SOLID, N.O.S.

g. Personal Protective Equipment Requirements: ECTI

h. Transporter/Transfer Station: HICKEY MARINE (BARGE), TIDEWATER (PORT OF MORROW), ~~WMI~~ (TRUCK)

C. Generator's Certification. (Please check appropriate responses, sign, and date below.)

1. Is this a USEPA hazardous waste (40 CFR Part 261)? If the answer is no, skip to 2 ☐YES ☒NO
   a. If yes, identify ALL USEPA listed and characteristic waste code numbers (D, F, K, P, U)
   b. If a characteristic hazardous waste, do underlying hazardous constituents (UHCs) apply? (if yes, list in Section B.1.j) ☐YES ☐NO
   c. Does this waste contain debris? (if yes, list size and type in Chemical Composition - B.1.) ☐YES ☐NO

2. Is this a state hazardous waste? ☐YES ☒NO
   Identify ALL state hazardous waste codes

3. Is the waste from a CERCLA (40 CFR 300, Appendix B) or state mandated clean-up? ☒YES ☐NO
   If yes, attach Record of Decision (ROD), 104/106 or 122 order or court order that governs site clean-up activity. For state mandated clean-up, provide relevant documentation.

4. Does the waste represented by this waste profile sheet contain radioactive material, or is disposal regulated by the Nuclear Regulatory Commission? ☐YES ☒NO

5. Does the waste represented by this waste profile sheet contain concentrations of Polychlorinated Biphenyls (PCBs) regulated by 40 CFR 7617 (if yes, list in Chemical Composition - B.1.j) ☐YES ☒NO
   a. If yes, were the PCBs imported into the U.S.? ☐YES ☐NO

6. Do the waste profile sheet and all attachments contain true and accurate descriptions of the waste material, and has all relevant information within the possession of the Generator regarding known or suspected hazards pertaining to the waste been disclosed to the Contractor? ☒YES ☐NO

7. Will all changes which occur in the character of the waste be identified by the Generator and disclosed to the Contractor prior to providing the waste to the Contractor? ☒YES ☐NO

☒Check here if a Certificate of Destruction or Disposal is required.

Any sample submitted is representative as defined in 40 CFR 261 - Appendix I or by using an equivalent method. I authorize WM to obtain a sample from any waste shipment for purposes of recertification. If this certification is made by a broker, the undersigned signs as authorized agent of the generator and has confirmed the information contained in this Profile Sheet from information provided by the generator and additional information as it has determined to be reasonably necessary. If approved for management, Contractor has all the necessary permits and licenses for the waste that has been characterized and identified by this approved profile.

Certification Signature: Title: Env. Compliance Specialist

Name (Type or Print): Robert Wyatt Company Name: NW Natural Date: 6-15-05

☒Check if additional information is attached. Indicate the number of attached pages 6

D. WM Management's Decision — FOR WM USE ONLY

1. Management Method ☐Landfill ☐Non-hazardous Solidification ☐Bioremediation ☐Incineration ☐Hazardous Stabilization ☐Other (Specify)
2. Proposed Ultimate Management Facility:
3. Precautions, Special Handling Procedures, or Limitation on Approval:

4. Waste Form 5. Source 6. System Type

Special Waste Decision ☐Approved ☐Disapproved

Salesperson's Signature: Date:

Division Approval Signature (Optional): Date:

Special Waste Approvals Person Signature: Date:

ATTACHMENT A-5

LETTER OF OFF-SITE RULE COMPLIANCE

From: Ge.Xiang-Yu@epamail.epa.gov
Sent: Tuesday, June 21, 2005 10:08 AM
To: Ryan Barth
Cc: Ryan Barth; Rick Schwarz
Subject: RE: Landfill Off-Site Rule Status

Hi Ryan,

Chemical Waste Management of NW at 17629 Cedar Spring LN, Arlington, OR is currently acceptable under the CERCLA Off-Site Rule to receive waste. Their last evaluation was 3/17/2005. When will shipping start for your site? Thanks

Xiang-Yu Ge
U.S. Environmental Protection Agency, Region 10
Office of Compliance and Enforcement
Air and RCRA Compliance Unit
e-mail: ge.xiang-yu@epa.gov
phone: 206-553-2859
fax: 206-553-8509

Ryan Barth
<rbarth@anchorenv.com>
06/20/2005 08:49 AM

To
XIANG-YU GE/R10/USEPA/US@EPA
cc
Rick Schwarz <rschwarz@anchorenv.com>, Ryan Barth <rbarth@anchorenv.com>
Subject
RE: Landfill Off-Site Rule Status

Mrs. Xiang-Yu -

We (Anchor Environmental) are currently completing the design for a CERCLA non-time-critical removal action at the GASCO site in Portland, Oregon. The Region 10 OSC for this action is Sean Sheldrake. An EE/CA for this action was issued to the public last month. The preferred alternative for the removal is to remove petroleum manufactured gas plant waste (a non-hazardous waste) and contaminated sediment and dispose of the material at the Chemical Waste Management of the Northwest (CWMNW) landfill near Arlington, Oregon. The purpose of this communication is to verify that this landfill is still ACCEPTABLE relative to the requirements of the Off-Site Rule.

Please advise us of the current status of this landfill at your earliest convenience.
Thank you for your attention to this matter.

Regards,

Ryan Barth, P.E.

Anchor Environmental LLC

1423 3rd Avenue, Suite 300

Seattle, Washington 98101

(206) 903-3334 Direct Line

(206) 287-9130 Office Line

(206) 287-9131 Fax

rbarth@anchorenv.com

www.anchorenv.com

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APPENDIX B

CONSTRUCTION HEALTH AND SAFETY PLAN

APPENDIX B

CONSTRUCTION HEALTH AND SAFETY PLAN
FINAL DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

Sevenson Environmental Services, Inc.

2749 Lockport Road

Niagara Falls, New York 14305

On behalf of

NW Natural

220 NW Second Avenue

Portland, Oregon 97209

July 2005

SITE/PROJECT OVERVIEW 1

1 EXPLANATORY STATEMENT 2
1.1 Regulatory Compliance 2
1.2 CHASP Distribution 2

2 PROJECT ORGANIZATION AND RESPONSIBILITIES 4
2.1 Project Manager 4
2.2 Project Health and Safety Manager 4
2.3 Site Safety Officer 4
2.4 Field Operation Leads 5

3 HAZARD EVALUATION AND CONTROL MEASURES 6
3.1 Exposure Routes 6
3.1.1 Inhalation 6
3.1.2 Dermal Contact 6
3.1.3 Ingestion 7
3.2 Chemical Hazards 7
3.2.1 Cyanide 7
3.2.2 Metals 8
3.2.3 Total Petroleum Hydrocarbons/Volatile Organic Compounds (Benzene) 8
3.2.4 Polycyclic Aromatic Hydrocarbons 9
3.2.5 Hydrogen Sulfide 9
3.2.6 Hexane/Solvent Rinse 10
3.2.7 Sediment Drying Reagent (e.g., Portland Cement/Lime Dust) 10
3.3 Physical Hazards 10
3.3.1 Slips, Trips, and Falls 10
3.3.2 Vessel-Based Activities 11
3.3.3 Diver-Based Activities 11
3.3.4 Water Quality, Sediment Trap, and Sediment Characterization Monitoring Activities 12
3.3.5 Heavy Construction Equipment 13
3.3.6 Manual Lifting 14
3.3.7 Heat Stress 14
3.3.8 Hypothermia 14
3.3.9 Falling Overboard 15
3.3.10 Weather 15
3.3.11 Flammable Hazards 15
3.4 Activity Hazard Analysis 16

4 WORK ZONES AND ACCESS CONTROL 17
4.1 Removal Action Area Work Zones 18

4.2 Water Quality Monitoring, Sediment Trap Monitoring, Baseline Sediment Sampling and Diver-Related Work Zones 18
4.3 Offloading Facility 19
4.4 Decontamination Areas 19
4.5 Access Control 20

5 SAFE WORK PRACTICES 21
5.1 General Safety Rules 21
5.2 Diver Safety Rules 21

6 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT 23
6.1 Level D Personal Protective Equipment 23
6.2 Modified Level D Personal Protective Equipment 23
6.3 Level C Personal Protective Equipment 24
6.4 Safety Equipment 24
6.5 Diver-Related Equipment 24

7 MONITORING PROCEDURES FOR SITE ACTIVITIES 26
7.1 Crew Self Monitoring 26
7.2 Air Monitoring 26
7.2.1 Real Time Air Monitoring 28
7.2.2 Frequency and Location 28
7.2.3 Data Quality Assurance 28
7.3 Medical Monitoring 29

8 DECONTAMINATION 31
8.1 Minimization of Contamination 31
8.2 Personal Decontamination 32
8.3 Diver Decontamination 32
8.4 Handling of Work-Derived Waste 32

9 TRAINING REQUIREMENTS 34
9.1 Project Specific Training – Construction Monitoring Activities 34
9.2 Project Specific Training – Construction Implementation 35
9.3 Site Specific Safety and Hazard Awareness Briefing 35
9.4 Regular Safety Briefings 35

10 RECORDING AND RECORD KEEPING 36

11 EMERGENCY RESPONSE PLAN 37
11.1 Pre-Emergency Preparation 37
11.2 Site Emergency Coordinator 38
11.3 Emergency Response Contacts 38
11.4 Recognition of Emergency Situations 38
11.5 Decontamination 38

11.6 Fire 39
11.7 Falling Overboard 39
11.8 Personal Injury 39
11.9 Overt Personal Exposure or Injury 40
11.10 Spills and Spill Containment 41
11.11 Emergency Route to the Hospital 41

12 HEALTH AND SAFETY PLAN APPROVAL RECORD 43

13 REFERENCES 44

List of Tables

Table B-1 Activity Hazard Analysis

Table B-2 Real Time Air Monitoring Action Levels

Table B-3 Real Time Air Monitoring Action Levels (Environmental)

Table B-4 Frequency and Location of Air Monitoring

Table B-5 Emergency Response Contacts

List of Figures

Figure B-1 Offloading Facility – Work Zones Delineation

Figure B-2 Map to the Nearest Hospital

List of Attachments

Attachment B-1 – Field Team Health and Safety Review

SITE/PROJECT OVERVIEW

Site Name – Gasco Site

Location – Willamette River, Portland, Oregon

Client – NW Natural

Types of Land Based Facilities – Fuel Oil Distribution

Removal Action Activities – In-water removal of the tar body; vessel- and diver-based surveys; and, water quality monitoring, baseline sediment characterization and sediment trap monitoring.

Potential Site Contaminants – Metals, cyanide, volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAHs)

Potential Routes of Entry – Inhalation, dermal contact, ingestion

Protective Measures – Safety glasses, gloves, protective clothing, and possibly air-purifying respirators

Monitoring Equipment – Photo-ionization detector (PID) meter; Hydrogen sulfide monitor; dust meter, and detector tubes

1 EXPLANATORY STATEMENT

This Construction Health and Safety Plan (CHASP) is an appendix to the Remedial Action Project Plan (RAPP) and is one of the final design documents submitted to the U.S. Environmental Protection Agency (EPA) for the removal action at the "Gasco" Site (Site). This CHASP is written, developed, and maintained for the duration of the project by Sevenson Environmental Services, Inc. (Sevenson). This CHASP will cover all health and safety activities during construction including activities that may be required by consultants (e.g., Anchor) or subcontractors.

1.1 Regulatory Compliance

NW Natural entered into an Administrative Order on Consent (Order) with the EPA on April 28, 2004 to perform a removal action at the Gasco site (Site; EPA 2004). This document provides content that addresses the requirement of Section VIII.17 of the Order to submit a site-specific CHASP. The objective of the CHASP is to ensure the protection of health of all site workers during the performance of all work under the Order and SOW, including construction, construction monitoring, and long-term monitoring activities. The CHASP is prepared in accordance with EPA's Standard Operating Safety Guide (PUB 9285.1-03, PB 92-963414, June 2002) and complies with all currently applicable Occupational Safety and Health Administration (OSHA) regulations identified in 29 C.F.R. Part 1910. The site-specific plan meets all applicable regulatory requirements. Field activities covered under this CHASP include construction activities associated with the removal action, water quality monitoring during construction, and long-term monitoring activities following completion of the removal action.

1.2 CHASP Distribution

The CHASP will be made available to all personnel and subcontractors involved in the implementation of the Removal Action. This CHASP is written, developed, maintained, and implemented by Sevenson and will cover all activities conducted by Sevenson, Anchor, and all subcontractors. For subcontractors, this CHASP represents minimum safety procedures. Subcontractors are responsible for all of the safety guidelines addressed in this CHASP, as well as any other general safety and health practices not addressed in this CHASP.

By signing the documentation form provided with this plan (Attachment B-1), project workers certify their understanding and agreement to comply with the plan. Anchor and its subconsultants are independently responsible for the health and safety of their own employees on the project; however, subcontract employees will be required to review this plan and sign the documentation form provided to them.

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

All employees and workers on this project are expected to maintain vigilance at all times to ensure that the work is conducted in a safe and efficient manner. To provide an organizational structure that supports this objective, the following individuals are assigned specific responsibilities and lines of communication for the duration of this project. Note, this structure/nomenclature is based on previous project experience and may change slightly following coordination with Sevenson.

2.1 Project Manager

Michael Crystal is the designated Project Manager (PM) for this project. The PM is responsible for overall administration of the project. The PM's duties include project planning, budgeting, communications, and coordination. The PM is also responsible for ensuring that adequate personnel and equipment are available to complete the project safely. The PM may delegate all or part of his or her authority and responsibility to other designated field representatives.

2.2 Project Health and Safety Manager

Sevenson's Health and Safety Manager (HSM) has the responsibility and authority to oversee the development, revision, and approval of this site CHASP and to audit implementation of the plan in the field. The HSM is also responsible for reviewing health and safety issues that may arise during the project, approving Site Safety Officer (SSO) assignments and project responsibilities, coordinating changes in personal protective equipment (PPE) requirements with the SSO, conducting major accident investigations, and conducting periodic site audits and inspections. The HSM assigned to this project is Paul Hitcho. The HSM or his designated representative has discretionary authority to stop work on this project. This project may not start until the HSM has approved this site-specific CHASP.

2.3 Site Safety Officer

Scott Allaire is the designated SSO. He is responsible for verification and overall compliance with this CHASP. The SSO's duties include, but are not limited to 1) on-site monitoring to determine appropriate levels and use of PPE; 2) site surveillance, hazard identification, and health risk analysis; 3) implementation of procedures and programs to

eliminate risk to site personnel, including initiating changes to the CHASP; 4) implementation of site control measures; 5) assisting in conducting and documenting daily health and safety briefings; 6) maintaining health and safety field log books; 7) providing summaries of field operations and progress to HSM; and 8) instructing all site personnel on the content of this CHASP.

The SSO will report directly to the PM or a designated representative. Through the PM, the SSO also reports to the HSM. Depending upon the level of activity in the field, the HSM may re-assign the duties of the SSO to another qualified member of the field team in order to ensure adequate oversight of health and safety issues.

2.4 Field Operation Leads

The Field Operations Leads (FOLs), to be assigned by the PM, are responsible for the day-to-day activities in the field for their respective operations units. They will coordinate directly with the project's Technical Leads and the Project Manager, to implement all operations aspects of the project planning documents (i.e., CHASP, Construction Quality Assurance Plan [CQAP], Construction Water and Sediment Monitoring Plan [WSMP], and Removal Action Environmental Protection Plan [RAEPP]). They will maintain the site logbook, the official record of daily site activities.

3 HAZARD EVALUATION AND CONTROL MEASURES

This section covers potential chemical and physical hazards that may be associated with the proposed field activities, and presents control measures to address these potential hazards. Recent design characterization sampling identified the presence of VOCs, TPH, PAHs, and cyanide in sediments in the removal action area (see Removal Action Project Plan [RAPP] for details).

Confined space entry will not be necessary for this project; therefore, hazards associated with this activity are not discussed in this CHASP.

3.1 Exposure Routes

Potential routes of exposure to the chemicals include inhalation, dermal contact, and ingestion of dust, mist, gas, vapor, or liquid. Sediment samples are handled wet, so inhalation is not expected to be a route of exposure for most chemicals. The anticipated primary route of exposure for these chemicals would be via skin contact/absorption. Exposure will be minimized by using safe work practices and by wearing the appropriate PPE. Further discussion of PPE requirements is presented in Section 6.

3.1.1 Inhalation

Inhalation of particulates, dust, mist, gas, or vapor during construction activities is possible. Whenever possible, the construction equipment manipulating contaminated sediment will be oriented so that personnel are upwind of the work location. An organic vapor monitor (OVM), hydrogen sulfide monitor, dust meter, and detector tubes will be used to monitor ambient air and the breathing zone within the work area for organic compounds. Section 7.2 describes action levels and response procedures.

3.1.2 Dermal Contact

Dermal contact with potentially contaminated soil, sediment, or groundwater during shoreline and vessel-based operations is possible. Direct contact will be minimized through the use of appropriate PPE and decontamination procedures.

3.1.3 Ingestion

Ingestion of contaminants is a less likely route of exposure than inhalation or dermal contact for many of the contaminants of concern. Direct ingestion of contaminants can occur by inhaling airborne dust, mist, or vapors or swallowing contaminants trapped in the upper respiratory tract. Indirect ingestion can occur by introducing the contaminants into the mouth by way of food, tobacco, fingers, or other carriers. Although ingestion of contaminants can occur, proper decontamination/contamination reduction procedures should eliminate the probability of this route of exposure.

3.2 Chemical Hazards

Contaminants of concern at the Site include cyanide (at low levels), VOCs, TPH, and PAHs (see RAPP for details). Low levels of metals, typical for uncontaminated soils, are also present in the sediment samples. As a precaution, metals in sediments are assumed to present a potential chemical hazard for the purposes of this CHASP only. In addition, there is some potential for exposure to hydrogen sulfide gas from native sediments and hexane, which in rare cases, may be used as decontamination liquid. Potential exposure to sediment drying reagent (i.e., Portland cement or lime dust) may also occur during application of the sediment drying reagent. Human health hazards of these chemicals are discussed below. This information covers potential toxic effects that might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from the planned site activities. In general, the chemicals that may be encountered at this site are not expected to be present in concentrations that would produce significant exposures. The types of planned work activities, established safe work practices, and PPE will limit potential exposures at this site.

3.2.1 Cyanide

Cyanide most commonly occurs as hydrogen cyanide and its salts—sodium and potassium cyanide. Cyanides are readily absorbed by the inhalation, oral, and dermal routes of exposure. The central nervous system is the primary target organ for cyanide toxicity. Neurotoxicity has been observed in humans and animals following ingestion and inhalation of cyanides. Cardiac and respiratory effects, possibly central nervous system-mediated, have also been reported. Short-term exposure to high concentrations produces almost immediate collapse, respiratory arrest, and death. Symptoms resulting

from chronic exposure to lower concentrations include breathing difficulties, nervousness, vertigo, headache, nausea, vomiting, precardial pain, and electrocardiogram abnormalities. Thyroid toxicity has been observed in humans and animals following oral and inhalation exposure to cyanides.

3.2.2 Metals

The primary exposure routes for metals during construction activities are inhalation or ingestion of dust particles. Metal may also be indirectly ingested. A secondary route of exposure to metals is dermal contact. The target organs primarily affected by prolonged exposure to metals are the respiratory tract, gastrointestinal tract, central nervous system, kidneys, and liver.

Prolonged exposure to metals through any of the potential routes of exposure is not expected. Skin will be washed immediately when exposed to soil, sediment, dust, or water potentially impacted by metals.

3.2.3 Total Petroleum Hydrocarbons/Volatile Organic Compounds (Benzene)

Petroleum hydrocarbons likely at the site include tar and oil related materials in sediments and soils, which contain benzene and aromatic hydrocarbons. Gasoline, diesel, fuel, and waste oil, and heavier hydrocarbons such as grease may also be present associated with sampling equipment. Volatile components of gasoline include benzene, toluene, ethylbenzene, and xylenes (BTEX). The primary exposure routes for petroleum hydrocarbons during construction activities are inhalation, dermal contact, and ingestion of contaminated soil, sediment, dust, or water. Lighter petroleum hydrocarbons such as gasoline and benzene readily volatilize and are primarily an inhalation concern, whereas the primary route of exposure to heavier petroleum hydrocarbons such as aromatic hydrocarbons, oil, and grease is dermal contact. The target organs primarily affected by prolonged exposure to petroleum hydrocarbons are the respiratory system, central nervous system, kidneys, liver, and skin. Prolonged dermal contact with petroleum hydrocarbons can cause irritation or dermatitis. The BTEX compounds are known or suspected human carcinogens. An OVM equipped with a PID will be used to monitor ambient air and the breathing zone for VOCs such as benzene and naphthalene (an aromatic hydrocarbon). The presence of benzene will also

be determined using detector tubes. Respiratory protection will be employed if elevated levels of organic compounds are measured by the OVM and/or benzene specific detector tubes, if odors are present or other conditions warrant its use.

Petroleum hydrocarbons such as gasoline are also flammable and can be a physical hazard when present in high concentrations. Physical hazards associated with flammable compounds are addressed in Section 4.3.9. Combustion of petroleum hydrocarbons can produce carbon dioxide, carbon monoxide, aldehydes, fumes, smoke (particulate matter), and other products of incomplete combustion. Intentional and inadvertent combustion of petroleum hydrocarbons is not expected during construction activities; however, personnel will be removed from the area should a fire occur.

3.2.4 Polycyclic Aromatic Hydrocarbons

PAHs are hydrocarbons which are relatively nonvolatile due to their large molecular structure and high molecular weight. Consequently, the primary route of exposure to PAHs is through dermal contact. PAHs may also be indirectly ingested as described in Section 3.3.9. Inhalation of PAHs is unlikely due to their nonvolatile nature. Dermal or eye contact with PAHs can cause irritation or burning. PAHs can cause direct toxicity through a variety of organs. In addition, some PAHs have been linked to cancer after very high level and/or long term exposures.

3.2.5 Hydrogen Sulfide

Hydrogen sulfide is a naturally occurring gas often associated with organic clay and peat. Hydrogen sulfide gas is potentially toxic through inhalation, ingestion, and contact with the skin and eyes. Inhalation can result in respiratory irritation, rhinitis, and edema of the lungs. Inhalation of hydrogen sulfide gas can result in headache, dizziness, and agitation. Acute exposure at high concentrations may result in coma and death as a result of respiratory failure. Hydrogen sulfide gas has a distinct rotten egg odor, and will be noted if encountered in the field. Hydrogen sulfide will also be monitored using a H_2S specific electrochemical detector.

3.2.6 Hexane/Solvent Rinse

If necessary to achieve adequate decontamination of equipment, a hexane/solvent rinse may be applied to remove hydrocarbon-type compounds from the water quality, sediment sampling, and diver-related equipment. Exposure to high concentrations of hexane usually occurs by inhalation. Effects of inhalation may be slow and shallow breathing, possible tachycardia, vertigo or giddiness, nausea, and vomiting. Dermal exposure may result in dermatitis or conjunctival irritation. Eye exposure will cause irritation and requires irrigation.

3.2.7 Sediment Drying Reagent (e.g., Portland Cement/Lime Dust)

Portland cement or lime (i.e., calcium oxide) may be used to stabilize the sediment. If it is inhaled, it may cause sneezing, coughing, inflammation of the respiratory system, pneumonia, and mouth and nose sores. Both reagents may cause both heat burns and chemical burns to the nose and throat. When it comes into contact with the skin, it may cause both heat and chemical burns, sores, and scarring. Severity of the effects is increased if the skin is wet. Exposure to the eyes may cause chemical burns, sores, irritation, and permanent injury. If it is ingested, it will cause chemical burns to the mouth, throat, and stomach. The estimated lethal dose is 36 grams.

3.3 Physical Hazards

3.3.1 Slips, Trips, and Falls

As with all construction work, caution should be exercised to prevent slips on slick surfaces. In particular, working from a floating platform (e.g., dredging vessel and sediment and water quality monitoring vessels) requires careful attention to minimize the risk of falling down or falling overboard. The same care should be used in rainy conditions. Wearing boots with good tread, made of material that does not become overly slippery when wet, can minimize slips. Caution should also be exercised for any movement along the shoreline given the rocks can be slippery when wet.

Trips are always a hazard on the uneven floating platform or in a cluttered work area. The deck of the vessel may have numerous stationary fittings and tie-downs that present potential tripping hazards. Personnel will keep work areas as free as possible from items that interfere with walking and will be aware of stationary obstacles on deck.

Caution should also be exercised for any movement along the shoreline given the rocks create an uneven surface and can be unstable.

Falls may be avoided by working as far away from exposed edges as possible. For this project, the potential for falling is associated primarily with working from the dredging vessel, performing water quality sampling, boarding and disembarking the vessel at the dock, and while walking along the shoreline composed of loose rocks, if applicable. Personnel shall keep walkways and work areas clear when possible and use caution if/when walking along the shoreline.

3.3.2 Vessel-Based Activities

It is anticipated that the removal action activities will be conducted from the waterside using a floating platform. All activities performed from a vessel will be performed using basic principles of water safety, including, but not limited to, the following:

- Use Coast Guard-approved life jackets or other approved flotation garments or devices for all off-shore activities.
- Avoid standing near edge of boat; if work must be conducted over edge, secure workers with lifeline.
- Use caution when transferring from land to water. Make sure barges and boats are firmly secured to dock or pier before boarding or disembarking.
- Follow all Coast Guard rules for safe boating.

3.3.3 Diver-Based Activities

The dive team will support the prime contractor in the installation and monitoring of the primary containment barrier (i.e., silt curtain) for the inner and outer removal areas. Duties will include visual surveying of the Site, installation of manta anchors for supporting and securing the curtain, and other operations associated with maintenance of the curtain, if necessary. Currently, the diving subcontractor has not been selected for the removal action but several firms have been contacted and discussions are ongoing. When the diving subcontractor is selected the site-specific diver related safety protocols will be identified in a plan prepared by that subcontractor. At a minimum, the diving subcontractor will implement diver related safety protocols in accordance with full OSHA regulation 1910 Subpart T. Due to the potential hazardous diving environment

within the Willamette River at the Site due to potentially low visibility, high and low temperatures, obstructions, overhead environments, polluted water/sediment, and moving equipment associated with in-water construction, the diving subcontractor will be requested to provide a description of the following diver related safety information:

- Rationale for appropriate diver personal protective equipment (PPE) (i.e., drysuit, helmet, etc.)
- Methods of communication with topside support
- Method of air supply
- Training requirements and certificates
- Decontamination procedures
- Monitoring protocols
- Emergency response protocols

Following selection of the diving contractor and incorporation of the aforementioned diver related safety information, Anchor will coordinate with EPA to obtain approval of the dive plan.

3.3.4 Water Quality, Sediment Trap, and Sediment Characterization Monitoring Activities

Samples may be collected for a variety of monitoring purposes. Prior to initiation of any sampling, there will be a training session for all field personnel pertaining to the use and safety considerations for the sampling device(s), including, but not limited to, the following:

- Wear appropriate personal protective equipment in the exclusion zones.
- Do not place hands or fingers near moving parts of the sampler.
- Do not leave sampling equipment suspended when not in use or between deployments. Always secure equipment on the deck prior to moving the vessel.
- Do not handle sampling equipment or samples with ungloved hands.
- Never lift a non-manually operated sampler or other pieces of heavy equipment without the aid of a winch or other lifting device.
- Follow proper decontamination procedures when leaving the exclusion zone.

Water quality monitoring will be conducted using a variety of electronic meters (e.g., turbidimeter, dissolved oxygen meter, etc.) and a water sampling bottle deployed from a skiff. The crew performing the water quality monitoring should always don appropriate PPE (e.g., gloves and protective eye wear), follow safe boating practices, and retrieve the meters and water sampling bottles from the water column between deployments and when not in use.

3.3.5 Heavy Construction Equipment

The removal action consists of the following steps:

1. Sediment dredging into a transfer barge
2. Transfer of the sediment into haul barge
3. Addition and mixing of the sediment drying reagent within the haul barge
4. Transport to the offloading facility
5. Offloading of the sediment into trucks
6. Transfer of sediment to the landfill

Hazards and controls relevant to the operations in steps 1, 2, and 4 have been discussed in previous sections.

When the sediment is offloaded, it will be loaded into an upland hopper and subsequently transferred to trucks and transported to the CWMNW landfill. Equipment to be used during this operation would include a crane equipped with a clamshell bucket, a hopper and dump trucks. The predominant hazard to which workers would be exposed to during this operation would be the "struck by" hazard associated with equipment and truck movement.

The safety procedures to be implemented to protect workers during the transfer operation would include:

- Only trained, experienced operators will be used.
- Equipment will be inspected daily by the operator.
- An established set of hand signals will be used. There will only be one person permitted to give these signals to the operator.
- Personnel restricted in area of operation.

- All equipment will be shut down prior to fueling.
- Back up alarms functional.
- Personnel are to stay out of swing radius of equipment.
- Posted speed limit of 15 mph for all trucks.
- Workers to wear reflective vests.

3.3.6 Manual Lifting

Equipment associated with the removal and sampling activities must be lifted and carried both aboard the vessel and along the shoreline. Back strain can result if lifting is done improperly. During any manual handling tasks, personnel should lift with the load supported by their legs and not their backs. For heavy loads, an adequate number of people will be used, or if possible, a mechanical lifting/handling device.

3.3.7 Heat Stress

Scheduled operations will occur from August through October so high temperatures are expected. The potential for heat stress may occur if impermeable PPE is worn or if strenuous work is performed under hot conditions with inadequate water. When the core body temperature rises above 100.4° F, the body cannot sweat to cool down, and heat stress can occur. Heat stress may be identified by the following symptoms: dizziness, profuse sweating, skin color change, vision problems, confusion, nausea, fatigue, fainting, and clammy skin. Personnel exhibiting such symptoms will be removed to a cool shady area, given water, and allowed to rest. Fresh drinking water will be provided aboard the vessel. All field team members will monitor their own condition and that of their co-workers to detect signs of heat stress.

3.3.8 Hypothermia

Hypothermia is abnormal lowering of the core body temperature caused by exposure to a cold environment. Wind chill as well as wetness or water immersion can play a significant role. Typical signs of hypothermia include fatigue, weakness, lack of coordination, apathy, and drowsiness. Confusion is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink.

Body temperatures below 90° F require immediate treatment to restore the temperature to normal. Current medical practice recommends slow warming of the individual followed by professional medical care. Moving the person to a sheltered area and wrapping them in a blanket can accomplish the first portion of the task. If possible, the person should be placed in a warm room. In emergency situations where body temperature falls below 90° F and shelter is not available, a sleeping bag, blankets, and body heat from another individual can be used to help raise body temperature.

3.3.9 Falling Overboard

Monitoring and construction will be done from vessels. As with any work from a floating platform, there is a chance of falling overboard. A personal flotation device (PFD) for each crew person will be available in the boat at all times. PFDs will be worn while working from the vessel. If a person is knocked unconscious following falling overboard, the respondent should immediately follow the procedures summarized in Section 11.7.

3.3.10 Weather

In general, field team members will be equipped for the normal range of weather conditions. The SSO will be aware of current weather conditions, and of the potential for those conditions to pose a hazard to the field crew. Some conditions that might force work stoppage are electrical storms, high winds, or high waves resulting from winds. These conditions are different than those weather requirements that may cause work stoppage for environmental reasons as detailed in Appendix E. Weather conditions for health and safety will be judged by the SSO for the purposes of ensuring health and safety only.

3.3.11 Flammable Hazards

Petroleum hydrocarbons are flammable in moderate to high concentrations. Therefore smoking, open flames, and unprotected ignition sources will not be allowed in the work area. An OVM will be used to measure concentrations of organic vapors (i.e., benzene, toluene) in the work area. If elevated OVM measurements persist, work will be suspended until corrective measures are taken to ensure a safe work environment. Even though Portland cement and lime dust is not flammable, the heat produced when it is

combined with water has the potential to ignite combustible materials. The sediment drying bench scale testing (described in the RAPP) identified that approximately 5 percent sediment drying reagent will likely be required to amend the material sufficiently to pass the 1 ton per square foot bearing capacity landfill requirement. This percent of sediment drying reagent is highly unlikely to cause a flammable hazard. If this were to happen, the procedure would be to smother the ignited material with material in the barge. This will dissipate the material and prevent it from re-igniting.

3.4 Activity Hazard Analysis

The activity hazard analysis summarizes the field activities to be performed during the removal action activities, outlines the hazards associated with each activity, and presents controls that can reduce or eliminate the risk of the hazard occurring.

Table B-1 presents the activity hazard analysis for the following activities:

- Water-based removal activities
- Water quality monitoring
- Baseline sediment characterization
- Diver related activities
- Sample handling, packaging, processing, and shipping
- Equipment decontamination

4 WORK ZONES AND ACCESS CONTROL

The dredging vessel captain, monitoring vessel field leader, if applicable, and SSO will delineate the boundaries of the various in-water and shoreline work zones and will inform the field crews of the arrangement. At the removal action area and the transfer facility a three-zone approach will be utilized consisting of the following: exclusion zone, contamination reduction zone, and a support zone. The purpose of the zones is to limit the migration of sample material out of the zones and to restrict access to active work areas by defining work zone boundaries. Access to the work zone or exclusion zone will be limited to trained and medically certified personnel. This project is a hazardous waste remediation project, and any person working in an area where the potential for exposure to site contaminants exists, will only be allowed access after providing the SHSO with proper training and medical documentation (see Section 9). The configuration of the various zones at the Site and the transfer facility are based upon current knowledge of proposed construction staging and sequencing. It is possible that the zone configurations may be altered due to work plan revisions in the field. Should this occur, the work zones will be adjusted accordingly, and the revised areas will identified to all personnel in the daily safety meetings.

The following definitions shall be applied to each of the work zone designations:

- Exclusion Zone (EZ) - All activities which may involve exposure to site contaminants, hazardous materials and/or conditions should be considered an EZ. This zone will be clearly delineated by cones, fencing, caution tape or other means, where possible. The SHSO may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ shall be determined by the site SHSO allowing adequate space for the activity to be completed, field members and emergency equipment.
- Contamination Reduction Zone - The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides for an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for EZ entry and egress in addition to access for heavy equipment and emergency support services. A CRZ must be established whenever workers or equipment exit from an EZ.

- Support Zone - The SZ is the uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples, where applicable.

The following sections identify the preliminary locations of the various work zones at the Site, transfer facility, landfill and on sampling vessels.

4.1 Removal Action Area Work Zones

The currently proposed equipment staging and sequencing is depicted in Figures 9a and 9b of the RAPP. Based on this configuration, the entire in-water area within the primary containment and secondary containment barriers will be designated the EZ. The CRZ is delineated as the shoreline area directly shore ward of the dredging and capping operations (extending upstream and downstream approximately 100 feet) and the above water portion of the oil pipeline extending from the shoreline support foundation to the channel ward corner dolphin (this above water portion of the pipeline is customarily used as a walking pathway to connect equipment to incoming fuel barges and transoceanic ships). A temporary ladder will be installed on the corner dolphin extending down to the water surface elevation to allow personnel that have been working in the EZ to exit the in-water area. Personnel potentially in contact with contaminated material can access the ladder, ascend to the top of the pipeline and walk toward the shoreline to access the decontamination station which will be located directly adjacent to the shoreline pipeline foundation support. The SZ will be the upper portion of the shoreline outside of the CRZ.

4.2 Water Quality Monitoring, Sediment Trap Monitoring, Baseline Sediment Sampling and Diver-Related Work Zones

Only authorized vessel crew and divers will be allowed in the EZ. A single work zone will be observed during sediment trap and water quality monitoring and baseline sediment sample collection. This work zone is aboard the sampling skiff where the equipment will be deployed and recovered. The sample collection and processing area will be dedicated to those activities and only qualified personnel will enter the work zone area. Prior to

disembarking the vessels all crew and divers will be decontaminated on the vessel to ensure potentially contaminated material is not tracked offsite.

4.3 Offloading Facility

A schematic showing the various work zones at the offloading facility is provided in Figure B-1. In summary, the EZ will consist of the haul barge, spill plate, and loading area in the direct vicinity of the upland hopper. The CRZ is approximately 50 feet offset surrounding the upland portion of the EZ. The SZ is the remainder of the upland area surrounding the CRZ.

4.4 Decontamination Areas

A station will be set up for decontaminating personnel and their gear at the removal action area, on the various work skiffs (i.e., water quality sampling, baseline sediment characterization, sediment trap sampling, and diver-related activities), and at the transfer facility. As discussed above, the decontamination stations will be located as follows:

- Removal action area - at the shoreline support foundation of the oil pipeline
- Work Skiffs – field designated location of the vessel
- Offloading facility – at the various zones shown in Figure B-1

The stations will have the buckets, brushes, soapy water, rinse water, or wipes and portable eye wash stations necessary to perform decontamination operations. Plastic bags will be provided for expendable and disposable materials. The offloading facility will also have a decon pad in the event that contaminated material is observed on the outside of the disposal trucks. The decontamination fluids at the removal action area and offloading facility will be stored in sealable containers and will be disposed of in accordance with the procedures presented in Section 8.3. The decontamination fluids from any work skiff related activities will be disposed of within the primary silt curtain configuration if a solvent rinse is not necessary to remove visible signs of contamination. If a solvent rinse step is necessary the decontamination fluids will be stored in sealable containers and will be disposed of in accordance with the procedures presented in Section 8.3.

4.5 Access Control

Security and control of access to the various vessels and onshore area will be the responsibility of the captain(s) and SSO. Additional security measures may be placed into effect by NW Natural, as required by national security threat levels determined by the federal government. Access to the vessel and onshore areas will only be granted to necessary project personnel and authorized visitors. Any security or access control problems will be reported to the client or appropriate authorities.

5 SAFE WORK PRACTICES

5.1 General Safety Rules

Following common sense rules will minimize the risk of exposure or accidents at a work site. These general safety rules will be followed on site:

- Always use the buddy system
- Be aware of overhead and underfoot hazards at all times
- Do not eat, drink, smoke, or perform other hand-to-mouth transfers in the work zones
- Get immediate first aid for all cuts, scratches, abrasions, or other minor injuries
- Report all accidents and close calls, no matter how minor, to the SSO
- Be alert to your own and other workers' physical condition
- Do not climb over or under obstacles of questionable stability
- Make eye contact with equipment operators before moving into the range of their equipment
- Work under adequate lighting at all times

5.2 Diver Safety Rules

As discussed in Section 3.3.2, the diving contractor has not been selected yet. Therefore, diver related safety information specific to the Site has not yet been written. This Site-specific information will be finalized following selection of the contractor and provided to EPA for approval. Below are the anticipated diver-related safety rules that are likely to be applied for this project.

Diving will be conducted by a three member dive crew consisting of a diving supervisor, diver, and a tender. Diving personnel shall have their positions designated prior to the start of the dive and are subject to change. Work rotation will be determined by the on site diving supervisor as physical condition, health, and availability may change prior to the job date, or that the diving supervisor feels that the familiarization of an individual may provide a greater degree of safety. Divers will wait at least 12 hours before flying before and after any dive. This interval shall be extended to 24 hours following decompression or repetitive dives. No divers shall be exposed to hyperbaric conditions prior to the first planned dive. In addition, the following conditions will likely apply:

- Divers' documentation, which includes dive logs, medical records, and current first aid and CPR cards, will be located at the offices of the diving contractor.
- The divers will use surface supplied air with two way communications. High pressure air will be used as a primary air source and high pressure air will be used as a secondary back up source of supply. Divers shall carry a back up reserve breathing supply of 50 cubic feet which can be immediately turned on by the diver in the event of air loss.
- Divers will have a system of communication in place if communication is lost. Communication systems will be checked during dive preparation.
- During limited visibility, an adequate lighting device will be provided. A strain will be kept on the diver.
- In areas near pure tar product the diver shall wear a vulcanized rubber dry suit with locking gloves, a positive pressure surface supplied diving helmet with minimum double exhaust (triple recommended), and locking neck ring or yoke. For other project areas, the diver shall wear, at a minimum, a vulcanized rubber dry suit with locking valves and a positive pressure full face mask mating to the dry suit.

6 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT

Appropriate PPE will be worn as protection against potential hazards. In addition, a personal flotation device will be required when working onboard the floating platforms. Prior to donning PPE, the workers will inspect their equipment for any defects that might render the equipment ineffective.

Field work will be conducted in Level D, modified Level D, or Level C PPE as discussed below. Situations requiring PPE beyond Level C are not anticipated for this project. Should the SSO determine that PPE beyond Level C is necessary at a given work area, the SSO will notify the HSM to select an appropriate corrective action.

6.1 Level D Personal Protective Equipment

Workers performing general activities in which skin contact with contaminated materials is unlikely and in which inhalation risks are not expected will wear Level D PPE. Level D PPE includes the following:

- Cotton overalls or lab coats
- Chemical-resistant, steel-toed boots
- Leather, cotton, or chemical-resistant gloves, as the type of work requires
- Safety glasses
- Hard hat (if overhead hazard exists)
- Hearing protection, if necessary

6.2 Modified Level D Personal Protective Equipment

Workers performing activities where skin contact with contaminated materials is possible will wear chemical-resistant outer gloves and an impermeable outer suit. The type of outerwear will be chosen according to the types of chemical contaminants that might be encountered. Modified Level D PPE includes the following:

- Outer garb such as rain gear or rubber or vinyl aprons
- Chemical-resistant steel-toed boots
- Surgical rubber inner gloves
- Chemical-resistant outer gloves
- Chemical-resistant suit
- Safety glasses (or face shield, if significant splash hazard exists)

- Hard hat (if overhead hazard exists)
- Hearing protection, if necessary

6.3 Level C Personal Protective Equipment

If elevated (see Section 7.2) concentrations of vapors are measured with the OVM and/or detector tubes, significant contaminant odors are noted, or significant amounts of airborne particulate matter are generated, health and safety requirements may be upgraded to Level C, if implementation of controls (work practice, administrative, and/or engineering) do not decrease the airborne concentrations to acceptable levels. Level C PPE includes the equipment listed under modified Level D plus the following:

- Half-face or full face respirator
- Organic vapor/acid gas cartridges, if appropriate
- Particulate filter cartridge, if appropriate

6.4 Safety Equipment

In addition to PPE that will be worn by shipboard personnel, basic emergency and first aid equipment will also be provided. Equipment will include:

- A copy of this CHASP
- Personal Flotation Device
- First aid kit adequate for the number of personnel
- Emergency eyewash

Sevenson will provide this equipment, which will be at the location(s) where field activities are being performed. Equipment will be checked daily to ensure its readiness for use.

6.5 Diver-Related Equipment

Minimum equipment provided by the diving subcontractor will include:

- Emergency bailout air supply with valves and gauges
- Knife for each diver
- Watch for each diver
- Pneumo-fathometer
- Diving signal chart for tending lines
- Surface supplied diving equipment

- Communications equipment (two way voice communications)
- First aid kit
- Compressors with filters for breathing air
- High pressure reserve air back up
- Sufficient fuel for the job
- ABC fire extinguisher
- Minimum of two 200 foot dive hoses
- US Navy supervisors manual
- Emergency oxygen and Ambu bag
- Work boat large enough to accommodate diving crew and customer representatives

7 MONITORING PROCEDURES FOR SITE ACTIVITIES

A monitoring program that addresses the potential site hazards will be maintained. The monitoring program includes self-monitoring by the field crew and monitoring with instruments.

7.1 Crew Self Monitoring

All personnel will be instructed to look for and inform each other of any deleterious changes in their physical or mental condition during the performance of all field activities. Examples of such changes are as follows:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory system
- Changes in complexion or skin color
- Changes in apparent motor coordination
- Increased frequency of minor mistakes
- Excessive salivation or changes in papillary response
- Changes in speech ability or speech pattern
- Symptoms of heat stress or heat exhaustion (Section 3.3.6)
- Symptoms of hypothermia (Section 3.3.7)

If any of these conditions develop, the affected person(s) will be moved from the immediate work location and evaluated. If further assistance is needed, personnel at the local hospital will be notified, and an ambulance will be summoned if the condition is thought to be serious. If the condition is the result of sample collection or processing activities, procedures and/or PPE will be modified to address the problem.

7.2 Air Monitoring

Air monitoring will be performed to determine worker and environmental exposure to volatile organic compounds and airborne particulates. The following monitoring instruments will be used during all field operations:

- MultiRae (or equivalent) equipped with a 10.6 eV PID and a Hydrogen Sulfide specific sensor.
- Colorimetric detector tubes and pump for Benzene.
- Dust Trak model 8573 for particulates.

Organic vapor concentrations will be measured continuously using the PID, equipped with data logging capabilities, during intrusive and other activities where vapors may be generated. At a minimum this includes:

- On the transfer barge (when any workers are present there)
- On the haul/mixing barge (when any workers are present there) either at the Site, in transport to the upland transfer facility, or docked at the upland transfer facility.
- At the upland transfer facility at the point where trucks are being loaded

Air monitoring at the disposal facility will follow the requirements of a permitted Subtitle C hazardous waste landfill.

Air monitoring readings will be data logged every 15 minutes. A wind monitoring device will be used at both the Site and the transfer facility to enable easy detection of wind direction during all intrusive activities. Organic vapor concentrations will be measured upwind of the work site(s) to determine background concentrations at least twice a day (once in the morning and once in the afternoon). The SSO will interpret monitoring results using professional judgment.

Colorimetric detector tubes will be used to determine the presence of benzene when action levels found in Table B-2 have been exceeded. Use the following Benzene tube (requires double tube): Benzene – Range – 0.5 – 10 ppm, SKC Cat No. = 810-121SP.

A dust meter, equipped with data logging capabilities, will be used to measure airborne particulate matter during intrusive activities and other activities where dust may be generated. Monitoring will be continuous and readings will be observed over a 15-minute period and data logged every 15 minutes for comparison with the action levels.

The following sections contain information describing the types, frequency, and location of real time air monitoring.

7.2.1 Real Time Air Monitoring

Based on real time readings and site conditions, the SSO or designee may increase/decrease the frequency at which the readings are taken using professional judgment. Table B-2 provides the real time air monitoring action levels for worker exposure and Table B-3 provides the real time air monitoring action levels for environmental exposure.

Real time air monitoring results for on-site activities will be reviewed with craft labor periodically by the SSO at the daily site health and site briefings.

7.2.2 Frequency and Location

Table B-4 provides the frequency and location of real time air monitoring.

7.2.3 Data Quality Assurance

7.2.3.1 Calibration

Instrument calibration shall be documented and included in a dedicated Health and Safety Log Book or on separate calibration pages. All instruments shall be calibrated before and after each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

7.2.3.2 Operations

All instruments shall be operated in accordance with the manufacturer's specifications. Manufacturer's literature, including an operations manual for each piece of air monitoring equipment shall be maintained on-site by the SSO for reference.

7.2.3.3 Data Review

The SSO shall interpret all monitoring data based on Table B-2 and his professional judgment.

The SSO shall review the monitoring and sampling data, along with all sample documentation with the HSM to evaluate the potential for worker exposure and upgrades/downgrades in levels of protection. Periodically, personnel exposure results shall be discussed at the daily safety briefing.

7.3 Medical Monitoring

Sevenson will utilize the services of physicians who are board certified in occupational medicine to supervise the medical surveillance program.

The medical examination will consist of:

- Medical History
- General Physical, including evaluation of all major organ systems
- Pulmonary Function Examination (at least FVC and FEV 1.0)
- Electrocardiogram
- Stress Test (optional physician's discretion)
- Chest X-Ray (Baseline, one scheduled every 10 years, or upon leaving Sevenson's employment)
- Otoscopic Examination
- Audiometric Examination
- Visual Acuity Examination
- Blood Tests, Blood Count, Blood Profile – (SMAC 25)

A baseline examination will be given prior to the start of work activities. Medical examinations will be repeated in the following conditions:

- More than a year has passed since the employee's last examination.
- The employee experiences an acute exposure to a toxic, hazardous material, or an injury.
- The examining physician, the Project Manager, the HSM, or SSO recommends one.
- At the request of an employee with demonstrated symptoms of exposure to toxic or hazardous materials.

Sevenson will obtain a certification from the occupational physician that the employee is medically fit to wear respiratory protection and has no medical condition that would place him at an increased risk. No employee will be permitted to work in the Exclusion Zone until his certificate has been submitted.

If any employee who works in the Exclusion and/or Contaminated Reduction Zone is taking prescription medicines, this information will be transmitted to the consulting occupational health physician who will make a determination whether this drug enhances the effect of the contaminants present on-site.

All medical records will be kept for at least 30 years and will be made available to the Project Manager or regulatory agencies, as required.

8 DECONTAMINATION

Decontamination is necessary to prevent the migration of contaminants from the work zone(s) into the surrounding environment and to minimize the risk of exposure of personnel to contaminated materials that might adhere to PPE. The following sections discuss personnel and equipment decontamination. The following supplies will be available to perform decontamination activities:

- Wash and rinse buckets
- Tap water and phosphate-free detergent
- Scrub brushes
- Distilled/deionized water
- Deck pump with pressurized freshwater hose (aboard the vessel)
- Paper towels and plastic garbage bags
- Solvent rinse (if tap water rinse does not remove all signs of visible decontamination)

8.1 Minimization of Contamination

The following measures will be observed to prevent or minimize exposure to potentially contaminated materials:

Personnel

- Do not walk through spilled sediment or dredged material
- Do not handle, touch, or smell sediment or dredged material directly
- Make sure PPE has no cuts or tears prior to use
- Protect and cover any skin injuries
- Stay upwind of airborne dusts and vapors
- Do not eat, drink, chew tobacco, or smoke in the work zones

Sampling Equipment and Vessel

- Use care to avoid getting sampled media in the navigational/sample packaging area of the vessel
- Place clean equipment on a plastic sheet to avoid direct contact with contaminated media
- Keep contaminated equipment and tools separate from clean equipment and tools

- Clean up spilled material immediately to avoid tracking around the vessel

8.2 Personal Decontamination

The SSO will ensure that all site personnel are familiar with personnel decontamination procedures. Personnel will perform decontamination procedures, as appropriate, when exiting work areas. Following is a description of the procedure:

Decontamination Procedure

- Wash and rinse outer gloves and boots in portable buckets
- If suit is heavily soiled, rinse it off until all visible signs of contamination are removed
- If rinse does not remove all signs of visible contamination either dispose of PPE or use the appropriate solvent rinse
- Remove outer gloves, inspect and discard if damaged, leave inner gloves on
- Remove inner gloves and wash hands if taking a break
- Don necessary PPE before returning to work
- Dispose of soiled PPE before leaving for the day

8.3 Diver Decontamination

On exit from the dive vessel the diver shall be deconned with fresh water before removing his or her gear. All visible signs of contamination will be removed prior to the diver removing dive equipment and exiting the vessel. If freshwater rinse is unable to remove all visible signs of contamination additional decontamination will be conducted using alternate means (e.g., wiping with paper towels followed by solvent rinse).

8.4 Handling of Work-Derived Waste

All remaining trace sediment/dredge materials, fluids used for decontamination of equipment at the removal action area and offloading facility, decontamination fluids used during water quality/sediment characterization/sediment trap sampling/diver-related activities which required the use of a solvent rinse, and disposable wastes (e.g., gloves, paper towels, foil, etc.) will be placed into appropriate containers and staged on-site for disposal. Decontamination fluids used during water quality, sediment characterization, sediment trap sampling, and diver-related activities which do not require the use of a

solvent rinse will be disposed of within the primary silt curtain barrier at the removal action area. The decontamination fluids will be stored in sealable containers and will be disposed based on the amount of visibly apparent oil. If the fluid contains only a small amount of visibly apparent oil it will be transferred into an on-site 250-gallon aboveground storage tank (AST) for treatment via the Gasco facility carbon treatment unit. Alternatively, fluids containing a visibly apparent amount of oil will be transferred into a 500-gallon AST located at the MW-6 dense non-aqueous phase liquid (DNAPL) extraction system. All disposable wastes will be placed into two heavy duty plastic bags (i.e., double-bagged) and disposed at a permitted solid waste disposal facility.

9 TRAINING REQUIREMENTS

Many of the work tasks require that workers come in contact with potentially hazardous materials and construction safety hazards such as working on or near water, uneven and slippery work surfaces, manual lifting, and crane operations. It is not anticipated that personnel will routinely contact hazardous concentrations of contaminants in removed material except potential elevated levels of contaminant vapors (i.e., benzene), so training will consist of site-specific instruction for all personnel and oversight of inexperienced personnel for one working day. The crane operator will be trained and certified. The following sections describe the general training requirements for work at this site.

9.1 Project Specific Training – Construction Monitoring Activities

All field personnel must read this CHASP and be familiar with its contents before beginning work. They shall acknowledge reading the CHASP by signing the field team CHASP review form contained in Attachment B-1. The form will be kept in the project files.

The SSO or a designee will provide and document project-specific training during the project kickoff meeting and whenever new crew arrives for field work. Field personnel will not be allowed to begin work until project-specific training is completed and documented by the SSO. Training will address the CHASP and all health and safety issues and procedures pertinent to field operations. Training will include, but will not be limited to, the following topics:

- Activities with the potential for chemical exposure
- Activities that pose physical hazards and actions to control the hazards
- Vessel access control and procedures
- Use and limitations of PPE
- Decontamination procedures
- Emergency procedures
- Use and hazards of sampling equipment
- Location of emergency equipment on the vessel
- Vessel safety practices

In addition, since field activities are occurring within the Portland Harbor Superfund Site, all workers must have 40-hour Hazardous Waste Operations and Emergency Response

(HAZWOPER) training in accordance with OSHA, and an updated 8-hour refresher training certification, if applicable.

9.2 Project Specific Training – Construction Implementation

The crane operator and commercial dive crew will be trained and certified.

9.3 Site Specific Safety and Hazard Awareness Briefing

Site specific safety and hazard awareness briefing shall be required for all workers, divers, and other people entering the site. Briefings will inform these individuals of the chemical hazards of the sediment, construction hazards, and define appropriate protections to minimize potential exposure to risks. A written record of the date(s) and time(s) of such training and of the attendees is required.

9.4 Regular Safety Briefings

The SSO or a designee will present safety briefings before the start of each day's activities. These safety briefings will outline the activities expected for the day, update work practices and hazards, address any specific concerns associated with the work location, and review emergency procedures and routes. The safety briefings will be documented in the logbook.

10 RECORDING AND RECORD KEEPING

The SSO or a designee will record health- and safety-related details of the project in the field logbook. The logbook must be bound and the pages must be numbered consecutively. Entries will be made with indelible ink. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all personnel
- Level of PPE worn and any other specifics regarding PPE
- Weather conditions
- Type of field work being performed

The person maintaining the entries will initial and date the bottom of each completed page. Blank space at the bottom of an incompletely filled page will be lined out. Each day's entries will begin on the first blank page after the previous work day's entries.

As necessary, other documentation will be obtained or initiated by the SSO. Other documentation may include field change requests, medical and training records, exposure records, accident/incident report forms, OSHA Form 200s, and material safety data sheets.

11 EMERGENCY RESPONSE PLAN

As a result of the health and safety hazards associated with the field sampling and sample handling activities, the potential exists for an emergency situation to occur. Emergencies may include personal injury, exposure to hazardous substances, fire, explosion, or release of toxic or non-toxic substances (spills). OSHA regulations require that an emergency response plan be available for use onboard to guide actions in emergency situations.

Onshore organizations will be relied upon to provide response in emergency situations. The local fire department and ambulance service can provide timely response. Construction contractor personnel will be responsible for identifying an emergency situation, providing first aid if applicable, notifying the appropriate personnel or agency, and evacuating any hazardous area. Shipboard personnel will attempt to control only very minor hazards that could present an emergency situation, such as a small fire, and will otherwise rely on outside emergency response resources.

The following sections address pre-emergency preparation, identify individual(s) who should be notified in case of emergency, provide a list of emergency telephone numbers, offer guidance for particular types of emergencies, and provide directions and a map for getting from any sampling location to a hospital.

11.1 Pre-Emergency Preparation

Before the start of field activities, the SSO will ensure that preparation has been made in anticipation of emergencies. Preparatory actions include the following:

- Meeting with the captain, equipment handlers, and divers concerning the emergency procedures in the event that a person is injured. Appropriate actions for specific scenarios will be reviewed. These scenarios will be discussed and responses determined before the sampling event commences.
- A training session given by the captain(s) informing all field personnel of emergency procedures, locations of emergency equipment and their use, and proper evacuation procedures.
- A training session given by senior staff operating field equipment, to apprise field personnel of operating procedures and specific risks associated with that equipment.

- Ensuring that field personnel are aware of the existence of the emergency response plan, its location as Section 11 of the CHASP, and ensuring that a copy of the CHASP accompanies the field team(s).

11.2 Site Emergency Coordinator

The SSO will serve as the Project Emergency Coordinator (PEC) in the event of an emergency. For this project, the PEC is Scott Allaire. The SSO will designate a replacement for times when the PEC is not onboard or is not serving as the PEC. The designation will be noted in the logbook. The PEC will be notified immediately when an emergency is recognized. The PEC will be responsible for evaluating the emergency situation, notifying the appropriate emergency response units, coordinating access with those units, and directing interim actions onboard before the arrival of emergency response units. The PEC will notify the HSM and the PM as soon as possible after initiating an emergency response action.

11.3 Emergency Response Contacts

All personnel must know who to notify in the event of an emergency situation, even though the SSO has primary responsibility for notification. Table B-5 lists the names and phone numbers for emergency response services and individuals.

11.4 Recognition of Emergency Situations

Emergency situations will generally be recognizable by observation. An injury or illness will be considered an emergency if it requires treatment by a medical professional and cannot be treated with simple first-aid techniques.

11.5 Decontamination

In the case of evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. If an injured individual is also heavily contaminated and must be transported by emergency vehicle, the emergency response team will be told of the type of contamination. To the extent possible, contaminated PPE will be removed, but only if doing so does not exacerbate the injury.

Plastic sheeting will be used to reduce the potential for spreading contamination to the inside of the emergency vehicle.

11.6 Fire

Shipboard personnel will attempt to control only small fires, should they occur. If an explosion appears likely, personnel will follow evacuation procedures specified by the captain in the training session. If a fire cannot be controlled with a fire extinguisher on board that is part of the required safety equipment, personnel will either withdraw from the vicinity of the fire or use additional fire fighting equipment, or evacuate the boat as specified by the captain in the training session.

11.7 Falling Overboard

In the event that a field crew member falls overboard, the captain of the vessel will be immediately notified and at least one member of the crew will maintain visible contact with the person overboard. The captain will maneuver the boat heading against the wind to a position close enough so that a crew member can throw a life ring near the person overboard. If the person overboard is unconscious, the captain will maneuver close enough so that the crew can physically recover the person. The crew members will then follow the procedures laid out in Section 11.8. All crew members will wear a Coast Guard-approved PFD while working on the vessels to minimize the chances of drowning.

11.8 Personal Injury

In the event of serious personal injury, including unconsciousness, possibility of broken bones, severe bleeding or blood loss, burns, shock, or trauma, the first responder will immediately do the following:

- Administer first aid, if qualified
- If not qualified, seek out an individual who is qualified to administer first aid, if time and conditions permit
- Notify the PEC of the incident, the name of the individual, the location, and the nature of the injury

The PEC will immediately do the following:

- Notify the captain and the appropriate emergency response organization

- Assist the injured individual
- Follow the emergency procedures for retrieving or disposing equipment reviewed in the training session, and leave the site en route to the predetermined land-based emergency pick-up
- Designate someone to accompany the injured individual to the hospital
- If an emergency situation (i.e., broken bones or injury where death is imminent without immediate treatment) occurs, the SSO or captain will call 911 and arrange to meet the response unit at the nearest accessible dock
- Notify the HSM and the PM

If the PEC determines that emergency response is not necessary, he may direct someone to decontaminate and transport the individual by vehicle to the nearest hospital. Directions and a map showing the route to the hospital are in Section 11.10.

If a worker leaves the ship to seek medical attention, another worker should accompany him or her to the hospital. When in doubt about the severity of an injury or exposure, always seek medical attention as a conservative approach and notify the PEC.

The PEC will have responsibility for completing all accident/incident field reports, OSHA Form 200s, and other required follow-up forms.

11.9 Overt Personal Exposure or Injury

If an overt exposure to toxic materials occurs, the first responder to the victim will initiate actions to address the situation. The following actions should be taken, depending on the type of exposure:

Skin Contact

- Wash/rinse the affected area thoroughly with copious amounts of soap and water
- If eye contact has occurred, eyes should be rinsed for at least 15 minutes using the eyewash that is part of the emergency equipment onboard and in the lab
- After initial response actions have been taken, seek appropriate medical attention

Inhalation

- Move victim to fresh air
- Seek appropriate medial attention

Ingestion

- Seek appropriate medical attention

Puncture Wound or Laceration

- Seek appropriate medical attention

11.10 Spills and Spill Containment

Sources of bulk chemicals are not expected to be used during this project. Accordingly, a spill containment procedure is not required for this project.

11.11 Emergency Route to the Hospital

The name, address, and telephone number of the hospital that will be used to provide medical care is as follows:

Legacy Good Samaritan Hospital and Medical Center
1015 NW 22nd Avenue
Portland, Oregon 97210
(503) 413-7711

Figure B-2 is a map of the route from the project site (7900 NW St. Helens Road, Portland, Oregon, 97210) to the Legacy Good Samaritan Hospital and Medical Center. Directions are as follows (travel time is approximately 11 minutes):

1. Start out going Southeast on NW ST HELENS RD/LOWER COLUMBIA RIVER HWY/US-30 toward NW BRIDGE AVE/US-30 BYP W/ST JOHN BRIDGE. Continue to follow NW ST HELENS RD/US-30.
2. Turn SLIGHT RIGHT onto NW ST HELENS RD/COLUMBIA RIVER HWY/US-30. Continue to follow COLUMBIA RIVER HWY/US-30.
3. Turn SLIGHT RIGHT onto NW WARDWAY ST. Turn LEFT on MARIONA ST.
4. NW WARDWAY ST becomes NW VAUGHN ST. Turn LEFT onto JAMES ST.
5. Turn RIGHT onto NW 23RD AVE.

6. Turn LEFT onto NW NORTHRUP ST.
7. Turn RIGHT onto NW 22nd Ave.
8. End at 1015 NW 22nd Ave.

12 HEALTH AND SAFETY PLAN APPROVAL RECORD

By their signature, the undersigned certify that this CHASP is approved and that it will be used to govern health and safety aspects of fieldwork conducted by Anchor personnel to investigate areas associated at the Site.

Project Health and Safety Manager (HSM)	Date
Site Safety Operator (SSO)	Date
Field Operation Lead (FOL)	Date
Field Operation Lead (FOL)	Date
Field Operation Lead (FOL)	Date
Field Operation Lead (FOL)	Date

13 REFERENCES

Anchor Environmental, L.L.C., 2001. "Northwest Natural 'Gasco' Site Ecological and Human Health Risk Assessment – Level II Screening Report." Prepared for Oregon Department of Environmental Quality, February 2001.

U.S. Environmental Protection Agency (EPA), 2004. Administrative Order on Consent for Removal Action between NW Natural and the U.S. Environmental Protection Agency. April 28, 2004.

TABLES

Table B-1
Activity Hazard Analysis

Activity	Hazard	Control
Water-based dredging activities	Falling overboard	Avoid working near the edge of the vessel, if possible. Stay away from edge of barge deck and always wear coast guard-approved PFD.
	Back or muscle strain	Use appropriate lifting technique when handling equipment. Enlist help if necessary.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
	Dredge operations	Only trained, authorized personnel; chains, cables and rigging inspected weekly; crane inspected daily.
	Slipping/tripping on slick or uneven deck or on shoreline rocks	Wear steel-toed boots with gripping tread. Be aware of obstacles and wet patches on deck and select a path to avoid them. Use caution when walking along the shoreline.
Baseline surface sediment sample collection	Falling overboard	Avoid working near the edge of the vessel, if possible. Stay away from edge of barge deck and always wear coast guard-approved PFD.
	Cuts, amputations	Never place body parts within moving parts or the bite of the surface sampler while the sampler is armed.
	Back or muscle strain	Use appropriate lifting technique when handling sediment core tubes or any other pieces of potentially heavy equipment. Enlist help if necessary.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
	Slipping/tripping on slick or uneven deck or on shoreline rocks	Wear steel-toed boots with gripping tread. Be aware of obstacles and wet patches on deck and select a path to avoid them. Use caution when walking along the shoreline.
	Injury from equipment falling or swinging	Wear a hard hat and steel-toed boots at all times; be in the appropriate position on deck when equipment is in operation.
	Fire	Avoid fueling operations near hot engines. Mop up any spilled flammable liquids and dispose of absorbent. No smoking or flame sources on the vessel. Evacuate the vessel according to procedures outlined in the training session given by the captain.
	Injury from winch line snapping	Ensure that winch line is not frayed.
Sediment trap monitoring activities	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection, when handling the sediment trap collection cylinders containing collected material.

Table B-1
Activity Hazard Analysis

Activity	Hazard	Control
	Slipping/tripping on slick or uneven deck or on shoreline rocks	Be aware of obstacles and wet patches on deck and select a path to avoid them. Divers use caution when entering and exiting the water.
Diver-related activities	Communications put together incorrectly	Test and retest dive station communications and life support equipment to ensure that they are properly working and in good order.
	Slips, Trips and Falls, Sprains	Lift with the back and bend knees; wear appropriate personal protection, such as lifejackets (when necessary) hard hat, steel toe boots, leather gloves and eyewear.
	Overhead Cranes	Watch for cranes, DO NOT STAND UNDER LOAD, use a tag line
	Water Entry and Exit (Both Diver and Stand by Diver)	The diver shall enter the water feet first and from any height greater than three feet. There shall be a safe means on entering and exiting the diving platform, such as a ladder, with at least three rungs in the water, or a stage/man basket or other appropriate device. Additionally, the means of entering and exiting the water shall be adequate to facilitate rescue of personnel.
	Umbilical Fouling	Tenders shall maintain tension on divers' umbilical and shall slack only when necessary. Diver shall know where his/her umbilical is at all times. Precautions shall be taken to avoid entanglement especially prior to the end of the dive to avoid and extended and unnecessary bottom time.
	Diver Entrapment	Stand by diver shall be dressed and ready to assist should-need be. The diver shall always be aware of his/her location at all times.
	Differential Pressures	The diver shall be aware of and away from any differential pressures as mush as possible not to entrap the diver. This includes underwater discharges, intakes, pipes, dredges, pumps sluice valves or culverts, etc. Proper procedures shall be followed to lock and tag out any potential differential hazards.
	Decompression (sickness)	All dives will be conducted using the US Navy dive tables and or Nitrox EAD tables. All planned dives, unless otherwise noted shall be no decompression dives. Should decompression be needed in-water decompression shall be utilized before surface chamber decompression. A decompression chamber shall be on site and ready to use for all dives over 33 feet. A CHT will be onsite and ready to treat and decompression illness.
	Hypothermia	Divers shall wear dry suits with appropriate thermal undergarments suitable for the water temperature. Divers shall also wear gloves.

Table B-1
Activity Hazard Analysis

Activity	Hazard	Control
	Electrical hazards	All hand held electrical tools shall be de-energized at the surface prior to being placed or retrieved from the water. All tools shall have a three prong plug with an operational GFI. Cords shall have NO frays or exposed wires. No electrical works shall be done except by a registered and qualified licensed electrician. The diver when welding or burning shall wear insulated gloves.
	Crane Movement – gantry ops	Crane work in relationship to the divers work shall be directed by the topside diving supervisor, a designated person or directly by the diver to the crane operator. At no time shall anyone be under a suspended load.
	Vessel traffic	An ALPHA and a DIVER DOWN flag shall be flown when diving in navigational waterways. No dive operations shall be conducted within 100 feet of operational vessels. Radio contact shall be on VHF channel 11 or 14.
	Equipment malfunction	All equipment shall be inspected prior to the commencement of each dive. Should equipment malfunction occur all diving operations shall be terminated until the equipment can be fixed and operated safely.
	Current	Diving operations shall not be conducted in current greater than three knots.
	Limited Visibility	Provide adequate lighting device. Keep a strain on diver. Diver should be aware of his/her position at all times.
	Communications Breakdown	Immediately go to line pull signals, curtail dive until communications have been properly fixed. Check communications during set.
	Loss of Breathing Media	Immediately activate back up reserve breathing media (bail out or alternate topside breathing source) Curtail diving operations. Perform predive checks, make sure compressors are full of fuel and or HP air is full before start of dive.
	Drowning	Perform predive checks on equipment; make sure is in good and working order prior to dive.
	Lifting materials	NEVER lift load over diver. Always maintain constant communication with the crane operator. If communication is lost ALL diving operations shall cease until comms are established. Rigging to be used in lifting steel shall be rated for the weight of the pick. It is the dive supervisors responsibility to check all rigging prior to its use. Use a tag line at all times to prevent load from swinging.

Table B-1
Activity Hazard Analysis

Activity	Hazard	Control
	Burning	Proper techniques shall be used. The diver shall use rubber gloves when burning. The diver shall wear appropriate eye protection. A vent hole shall be cut into the top of any enclosed structure prior to burning.
	Contamination of Diver	Proper techniques shall be used. In areas of contamination the diver shall wear a vulcanized rubber dry suit with locking gloves, a positive pressure surface supplied diving helmet with minimum double exhaust (triple recommended) and locking neck ring or yoke. On exit from the water the diver shall be deconned with fresh water before removing his gear. All divers and tenders shall be 40 hour hazmat workers with current 8 hour refreshers.
Processing, packaging, and shipping samples, if applicable	Skin or eye contact with potentially contaminated solids, liquids, or sediments	Wear Level D or modified Level D PPE, including eye protection.
	Back strain	Use appropriate lifting technique when handling filled sample coolers, or seek help.
	Inhalation of vapors	Use an OVM, and benzene sample tubes as necessary, to determine if VOC levels remain below identified thresholds.
Water quality monitoring	Falling overboard	Avoid working near the edge of the vessel, if possible. Stay away from edge of barge deck and always wear coast guard-approved PFD.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
	Slipping/tripping on slick or uneven deck or on shoreline rocks	Wear steel-toed boots with gripping tread. Be aware of obstacles and wet patches on deck and select a path to avoid them. Use caution when walking along the shoreline.
Sediment sampling and sediment trap and water quality monitoring equipment decontamination	Inhalation of, or eye contact with, airborne mists or vapors	Wear safety glasses. Perform decontamination activities outdoors or in a well-ventilated area. Stay upwind when spray-rinsing equipment.
	Skin contact with potentially contaminated materials	Wear modified Level D PPE.
	Ingestion of contaminated materials	Decontaminate clothing and skin prior to eating, drinking, smoking, or other hand-to-mouth activities. Follow the decontamination procedure for personal decontamination.

Table B-2
Real Time Air Monitoring Action Levels

Air Monitoring Instrument	Monitoring Location	Action Level	Site Action	Reason
PID	Breathing Zone	0 to 5 ppm	No respiratory protection required	Below action level.
		5-50 ppm (>15 minutes)	Upgrade to Level C PPE and determine Benzene concentrations	May meet action level of some hydrocarbons.
		> 50 ppm	Cease activities; proceed to rally point in clean area, contact PM and PSM for further instructions	Conservative action level to prevent exposure.
Detector tubes for benzene	Breathing Zone	< 0.5 ppm	Continue work	No respiratory protection required.
		> 0.5 to 10 ppm benzene	Level C	PEL for benzene is 1 ppm. Maximum allowable concentration for respirator, without quantitative fit test is 10 ppm.
		>10 ppm benzene	Cease activities; proceed to rally point in clean area, contact PM and HSM for further instructions.	
Dust Meter	Breathing Zone	< 500 ug/m^3	Continue work	No respiratory protection required.
		500 – 5000 ug/m^3 (>15 minutes)	Upgrade to Level C	Implement dust control. Approaching occupational exposure level for respirable particulate.
		> 500 ug/m^3	Cease activity, implement dust control.	
Hydrogen sulfide monitor	Breathing Zone	0-20 ppm	Continue work	Below action level for worker exposure.
		>20 ppm	Cease work; proceed to rally area; contact PM and HSM for further instructions.	

Table B-3
Real Time Air Monitoring Action Levels (Environmental)

Air Monitoring Instrument	Monitoring Location	Action Level	Site Action
PID	Upwind and downwind of Active Work Area. Readings taken every 2 hours.	5 ppm above background for a sustained (15 minute) period	Institute vapor control methods, i.e., slowing pace of work, covering dredged and stabilized sediments; slower addition of stabilizing agent.
Dust Meter	Upwind and downwind of Active Work Area. Readings every 2 hours.	>150 ug/m^3 above background for a sustained (15 minute) period	Institute dust control, i.e., addition of water, covering dredged and stabilized sediment.
Hydrogen sulfide monitor	Upwind and downwind of Active Work Area. Readings taken every 2 hours.	.10 ppm background for a sustained (15 minute) period	Institute gas control methods, i.e., slowing pace of work, covering dredged and stabilized sediments; slower addition of stabilizing agent.

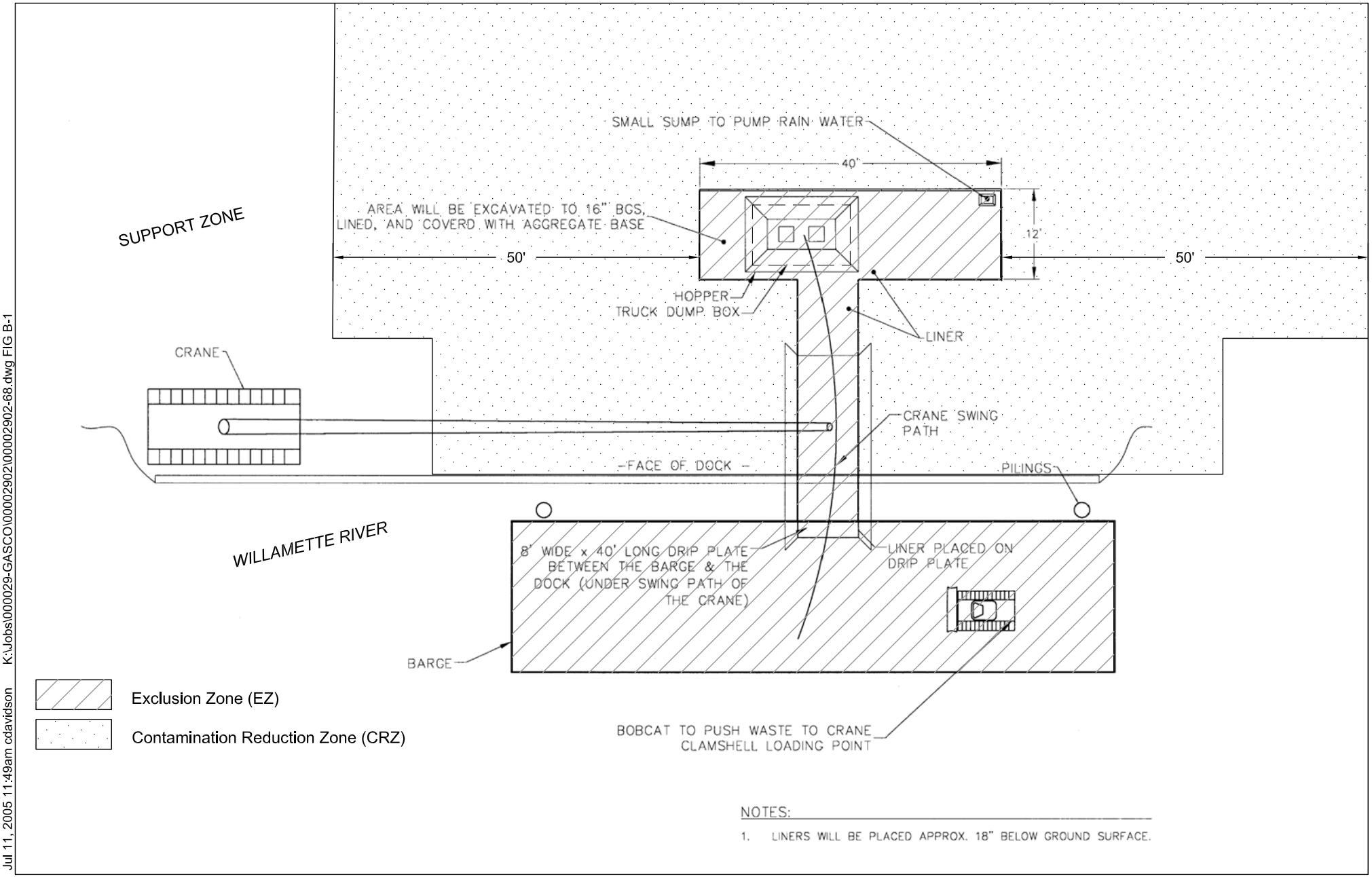
Table B-4
Frequency and Location of Air Monitoring

Activity	Air Monitoring Instrument	Frequency and Location
Mobilization and site preparation	PID/Dust Meter	Twice per day (AM and PM) upwind and downwind of work area.
Dredging	PID/Dust Meter	Readings shall be taken in the breathing zone every 15 minutes and upwind and downwind of work area every 2 hours.
Sediment Drying	PID/Dust Meter	Readings shall be collected from the breathing zone during these activities. At a minimum, readings shall be data logged at least every 15 minutes. Also upwind and downwind of work area every 2 hours.
Off loading of dredged sediments	PID/Dust Meter	Readings shall be taken in the breathing zone every 15 minutes and upwind and downwind of work area every 2 hours.

Table B-5
Emergency Response Contacts

Contact	Telephone Number
Emergency Numbers	
Ambulance	911
Police	911
Fire	911
Legacy Good Samaritan Hospital and Medical Center	(503) 413-7711
Emergency Responders	
U.S. Coast Guard Willamette River Station General information	(503) 240-9311 (503) 247-4018
National Response Center	(800) 424-8802
Emergency Contacts	
Construction Contractor Health and Safety Manager (HSM)	
Paul J. Hitcho, PhD, CIH	(716) 284-0431 (716) 998-9797
Construction Contractor Site Safety Officer (SSO)	
Scott Allaire	XXXXXXX (office) XXXXXXX (cell)
Anchor Project Manager	
TBD	XXXXXXX (office) XXXXXXX (cell)
Field Operation Leads	
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
Water Quality Monitoring Vessel	
TBD	( ) (office) ( ) (cell)
TBD	( ) (office) ( ) (cell)
Upland Surveyor	
	( ) (office) ( ) (cell)
In-Water Bathymetry	
	( ) (office) ( ) (cell)

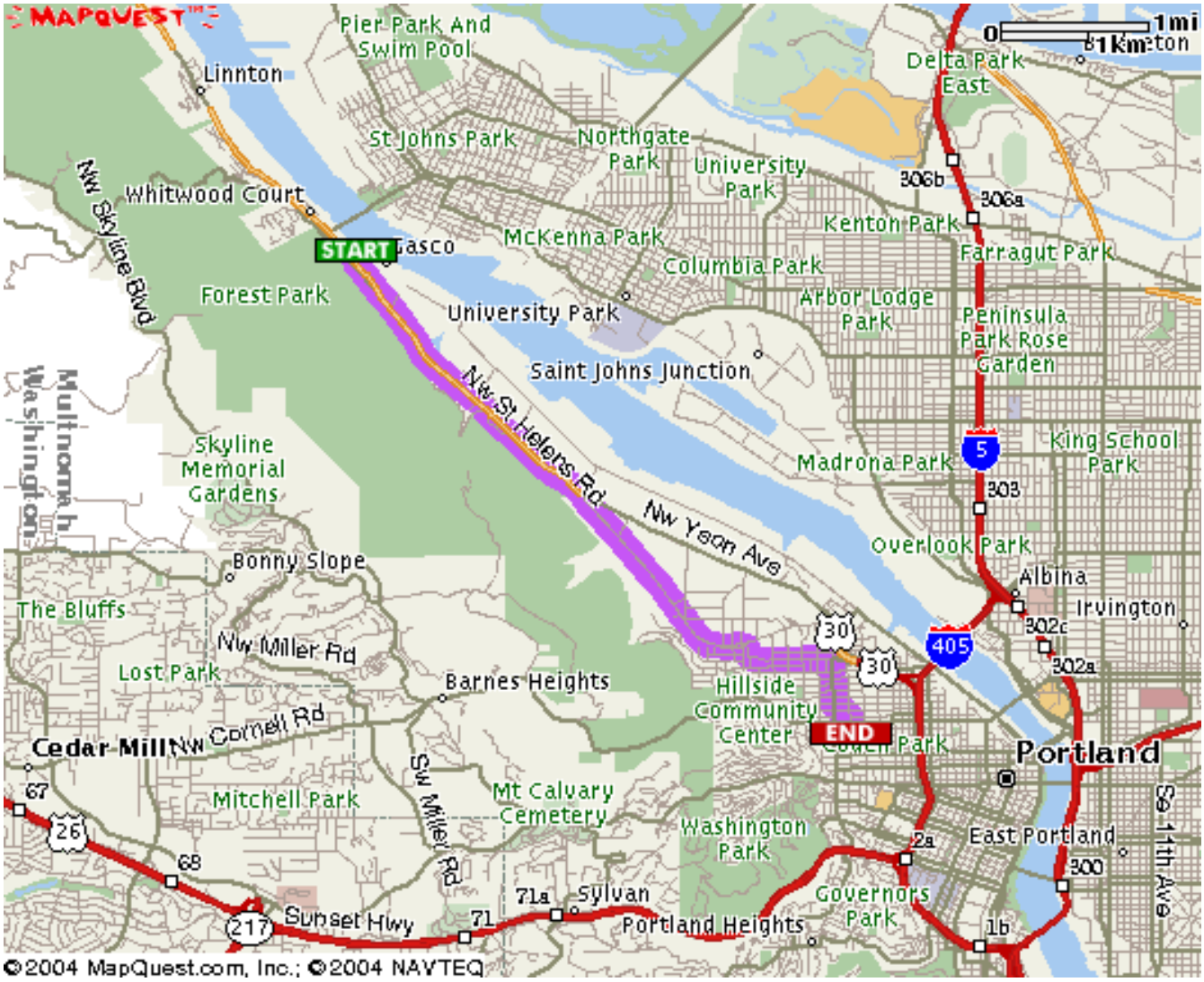
FIGURES



Jul 11, 2005 11:49am cdavidson K:\Jobs\000029-GASCO\00002902\00002902-68.dwg FIG B-1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure B-1
Offloading Facility - Work Zones Delineation
NW Natural "Gasco" Site



ANCHOR ENVIRONMENTAL, L.L.C.

Figure B-2
Hospital Map
NW Natural "Gasco" Site

ATTACHMENT B-1

SAFETY RECORD FORMS

FIELD TEAM HEALTH AND SAFETY PLAN REVIEW
SEVENSON ENVIRONMENTAL SERVICES, INC.

I have read a copy of the CHASP, which covers field activities that will be conducted to investigate specified areas at the Site, Portland, Oregon. I understand the health and safety requirements of the project, which are detailed in this CHASP.

Signature Date

Signature Date

Signature Date

Signature Date

Signature Date

APPENDIX C

CONSTRUCTION QUALITY ASSURANCE PLAN

APPENDIX C

CONSTRUCTION QUALITY ASSURANCE PLAN
FINAL DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.

6650 SW Redwood Lane, Suite 110

Portland, Oregon 97724

On behalf of

NW Natural

220 NW Second Avenue

Portland, Oregon 97209

July 2005

Table of Contents

1 INTRODUCTION 1

2 PROJECT ORGANIZATION AND RESPONSIBILITIES 2
2.1 U.S. Environmental Protection Agency 2
2.2 NW Natural 2
2.3 Removal Action Construction Contractor 2
2.4 Subcontractors 3
2.5 Consultants 3

3 QUALIFICATIONS OF PERSONNEL WITH QA RESPONSIBILITIES 5
3.1 Construction Contractor and Subcontractors 5
3.2 Construction Quality Assurance Officer (Anchor) 5

4 IMPLEMENTATION OF THE REMOVAL ACTION 6
4.1 Removal of the Tar Body 7
4.1.1 Description 7
4.1.2 Verification Activities 7
4.1.2.1 Verification of Dredging Locations 7
4.1.2.2 Verification of Compliance with Specified Dredging Limits 8
4.1.3 Water Quality Monitoring 8
4.1.4 Sediment Trap Monitoring 9
4.1.5 Post Removal Sediment Characterization 9
4.2 Sediment Drying 10
4.3 Transport and Disposal of Dredge Material 10
4.4 Placement of Cover/Pilot Cap 11
4.4.1 Description 11
4.4.2 Verification Activities 11
4.4.2.1 Borrow Source and Materials Acceptability Criteria 12
4.4.2.2 Placement Acceptability Criteria 12
4.4.3 Water Quality Monitoring 12
4.5 Corrective Action Procedures 13

5 DOCUMENTATION AND REPORTING 15
5.1 Contractor's Daily Log 15
5.2 Construction Quality Assurance Officer's Daily Field Log 16
5.3 Weekly Summary Reports 16

6 REFERENCES 18

List of Figures

Figure C-1 – Organization Chart

1 INTRODUCTION

This Draft Final Construction Quality Assurance Plan (CQAP) is an appendix to the Draft Final Remedial Action Project Plan (RAPP) and one of the draft final design documents submitted to U.S. Environmental Protection Agency (EPA) for the removal action at the "Gasco" Site (Site). This document addresses the requirement of the Statement of Work (SOW, Appendix B of the Order) to submit a site-specific CQAP. The purpose of this CQAP is to identify the responsibilities of the construction contractor and Anchor Environmental, L.L.C. (Anchor) for performing the removal action and monitoring the performance of the removal action in accordance with the final design. This CQAP identifies the quality assurance (QA) measures to be used in construction management, including monitoring actions, reporting mechanisms, and documentation formats. In addition, this CQAP defines quality assurance methods and protocols to ensure that project personnel have a complete understanding of monitoring, feedback, and adjustment mechanisms.

As noted above, the CQAP is an appendix to the RAPP, which provides an overview of the removal action design. Other appendices to the RAPP provide specific details of the removal action that are pertinent to the CQAP. These other documents, which are cited in the CQAP, include:

- Transportation and Disposal Plan (TDP, Appendix A to the RAPP)
- Construction Health and Safety Plan (CHASP, Appendix B to the RAPP)
- Construction Water and Sediment Monitoring Plan (WSMP, Appendix D to the RAPP)
- Removal Action Environmental Protection Plan (RAEPP, Appendix E to the RAPP)

The remaining sections of this CQAP discuss the following project elements:

- **Section 2.** The responsibilities and authorities of key project personnel, contractors, and all organizations involved in the construction or oversight of the removal action, including EPA and other agencies.
- **Section 3.** The qualifications of necessary personnel, the contractor, and subcontractors.
- **Section 4.** Removal action construction elements, including potential issues, monitoring requirements, and corrective actions.
- **Section 5.** Documentation requirements for construction QA activities, including daily summary reports, inspection data sheets, and filing system organization, as well as post-construction documentation.

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

In accordance with the requirements of the SOW, the roles and responsibilities of the parties involved in the removal action are identified in this section. An organization chart representing specific project responsibilities, including project administration, management, and oversight is shown on Figure C-1

2.1 U.S. Environmental Protection Agency

EPA is the regulatory authority and responsible agency for overseeing and authorizing the removal action. In this capacity, EPA will approve this CQAP and all other removal action submittals as defined in the SOW. EPA has designated Sean Sheldrake as On-Scene Coordinator (OSC) and Project Coordinator for the Gasco removal action. The OSC has the responsibility to monitor that the removal action is performed in accordance with Title 40, Part 300 of the *Code of Federal Regulations* (the National Contingency Plan) and that the removal action addresses the removal action objectives identified in the SOW. EPA and NW Natural will act in coordination to resolve any unforeseen problems that could change project components or the manner in which the construction is executed.

2.2 NW Natural

NW Natural is responsible for implementing the removal action in compliance with the Order. NW Natural has designated Robert Wyatt as the Project Coordinator.

2.3 Removal Action Construction Contractor

The removal action construction contractor is Sevenson Environmental Services.
The construction contractor is required to perform the following construction activities: dredging; disposal, stabilization, and transportation of dredged sediments; and application of a submerged sand cover or pilot cap. These activities are to be performed in accordance with the project design, as approved by EPA. The construction contractor will prepare a separate quality control plan, which will propose specific measurements and methods to confirm that removal objectives are being achieved during the course of the removal action. The contractor CQAP will be provided by the contractor at least 15 days prior to the start of work. The designated project manager for Sevenson is Mike Crystal.

2.4 Subcontractors

The construction contractor has employed Hickey Marine as a subcontractor to provide dredging and hauling equipment and support personnel. The construction contractor has also employed Tidewater Marine as a subcontractor to provide services for offloading of the material from the Port of Morrow facility and placement of the material into transport trucks. NW Natural has employed Envirocon and Trucking, Inc. to be the trucking transport contractor. Each of these subcontractors is responsible to Sevenson for the quality of their work and for the health and safety of their project personnel in accordance with this CQAP and CHASP. The subcontractors will designate their job site superintendents prior to start of work. Those persons will ensure that work is conducted in accordance with the contract requirements.

2.5 Consultants

NW Natural has selected Anchor as the supervising consultant for the removal action. Anchor is providing personnel to perform the Project Coordinator, Project Engineer, and Construction Quality Assurance Officer (CQAO) roles shown in Figure C-1. Anchor's Project Coordinator is Carl Stivers with Rick Schwarz serving as the Project Engineer. A Construction Quality Assurance Officer (CQAO) will be selected 15 days prior to the start of work.

The Project Coordinator is responsible for Anchor's overall performance on the project, including achieving project objectives, schedule, and budget. The Project Coordinator is Anchor's primary point of contact for communication with NW Natural's Project Manager and EPA's OSC.

The Project Engineer is responsible for preparing the design of the removal action such that successful implementation of the design will result in achieving the removal action objectives identified in the SOW. During implementation of the removal action, the CQAO will refer potentially noncompliant construction to the Project Engineer. The Project Engineer is responsible for determining whether the allegedly noncompliant construction is acceptable within the design, unacceptable, or acceptable with a design modification. EPA will have final authority to approve design modifications proposed by the Project Engineer.

The CQAO is responsible for monitoring compliance with the design during implementation of the removal action. The CQAO will review documentation submitted by and work completed by the construction contractor for adherence to design requirements. The CQAO will also collect data and documentation required for weekly progress reports and the Removal Action Completion Report (RACR), and direct the collection of samples for water quality monitoring as described in the WSMP (Appendix D of the RAPP).

3 QUALIFICATIONS OF PERSONNEL WITH QA RESPONSIBILITIES

3.1 Construction Contractor and Subcontractors

The construction contractor maintains, as part of its permanent organization, high-caliber, knowledgeable, and experienced key personnel. These individuals have experience in the type of work being contracted. The journeyman operators, surveyors, and other construction contractor personnel performing key jobs have demonstrated the ability and skills to satisfactorily perform those assignments. The contractor's superintendent is Mike Crystal, who has over 10 years of experience in the type of work being contracted. In addition, the contractor has the documented qualifications and experience for performing the independent checks on the contractor's operations that are necessary to determine compliance with the contract provisions.

Subcontractors on the project include Hickey Marine. Hickey Marine has demonstrated to the satisfaction of NW Natural and Anchor that it is qualified and has satisfactorily performed the type of work for which it will be engaged. The contractor is responsible for the performance of its subcontractors. All contractors and subcontractors have all health and safety training required by the CHASP. The contractor's qualifications will be submitted to EPA before the contractor begins work, as required by paragraph 11 of the Order.

3.2 Construction Quality Assurance Officer (Anchor)

The CQAO will be determined prior to start of work. It will be someone who has an engineering degree and at least 5 years of experience managing construction projects with similar QA requirements. The CQAO will be sufficiently familiar with the final design and the construction operations to recognize deviations from that design. The CQAO will also have the ability to manage and maintain the integrity of the data generated during the Project.

4 IMPLEMENTATION OF THE REMOVAL ACTION

NW Natural will implement the removal action, as detailed in the final design, to achieve the objectives of the Order. The major components of the removal action and the required notifications and reports are described in the RAPP, including:

- Major design components
  - Removal of the tar body
  - Transportation and disposal of removed material
  - Cover/cap placement
  - Environmental controls
- Notifications, meetings, and reports
  - Preconstruction notification
  - Preconstruction meeting
  - Weekly progress meeting
  - Weekly progress reports
  - Removal action completion notification
  - Removal action completion inspection/meeting
  - Removal Action Completion Report

Both preconstruction and weekly progress meetings will be coordinated with EPA and its partner agencies including pre-notification of time and place of meetings. Conference call access will be provided as needed and requested by those agencies. During the removal action, the construction contractor will implement quality control measures to determine that construction activities comply with the final design. The contractor will submit a quality control plan at least 15 days prior to the start of work. The contractor will provide documentation to Anchor to demonstrate that the final design has been addressed such as bathymetric surveys and soundings. Anchor will monitor the contractor's activities and documentation for compliance with the final design. The inspection and verification activities are described in the following sections.

In addition, the CQAO will be responsible for identifying those field conditions that may warrant deviation from the final design. In such circumstances the CQAO will coordinate with the EPA project coordinator to identify and agree upon any necessary deviations to meet the

overall objectives of the design. Any agreed upon deviations will be documented in the weekly progress reports to EPA.

4.1 Removal of the Tar Body

4.1.1 Description

This construction element includes the removal of the tar body within the dredge prism as depicted in the RAPP. It also includes removal of pilings in the removal action area prior to dredging. As discussed in the RAPP the construction contractor will perform the dredging operations using one or more of the mechanical bucket dredges noted in the RAPP from a floating derrick barge.

4.1.2 Verification Activities

Verification activities associated with the dredging activities include:

- Quality Control (QC) checks on the location (stationing, offset, and elevation) of each dredging activity within the dredge prism.
- Initial verification of compliance with specified dredging elevations within the dredge prism to verify that the target elevation has been reached and that contract dredging may stop.

Each of these activities is described in further detail below.

4.1.2.1 Verification of Dredging Locations

The construction contractor will accurately locate and track the movement of its dredging equipment. The CQAO will work with the contractor's hydrographic survey crew to independently verify the dredge's horizontal position and dredging depth. This may be done by evaluating the contractor's daily QC surveys and/or positioning data, conducting independent surveys, or a combination of both methods. To ensure that the actual dredging depths are accurately determined, the contractor will be required to conduct daily bathymetric surveys. Prior to initiation of dredging, a surveyed tide board or gauge will be installed at the site to permit determination of elevation independent of tidal effects. Sediments will be removed to the full aerial extent as detailed in the final design.

4.1.2.2 Verification of Compliance with Specified Dredging Limits

The effectiveness of sediment removal will be verified by ensuring the construction contractor achieved compliance with the final design elevation(s) identified in the final design documents. Changes in the mudline elevation resulting from the removal action will be documented through hydrographic surveys. Potential hydrographic survey technologies include lead line surveys or surveys using electronic sounding devices (i.e., single beam surveys). Additional coordination with the contractor is required to determine what type of survey will be most applicable for the removal action. The contractor will perform daily surveys (or, if approved by the Project Engineer, less frequent) progress surveys to establish actual excavated depths and extent of dredging. If water depths prohibit surveying of portions of the dredge prism (i.e., along the shoreline), the elevation changes in these areas will be performed using standard terrestrial survey equipment. The dredging and surveying process will occur until the final design elevation is achieved. The final bathymetry will be verified by an independent third-party surveyor. EPA will make the final determination that the dredge prism as described in the RAPP has been removed. If successive side-slope sloughing in a portion of the dredge prism occurs inhibiting the contractor from reaching the final design elevation, the Anchor Project Coordinator will notify the EPA OSC to discuss which further action, if any, may be necessary in that portion of the dredge prism.

4.1.3 Water Quality Monitoring

Anchor will monitor water quality during dredging and the subsequent application of a sand cover or pilot cap in order to provide ongoing assessment of water quality during these activities. The objectives of the monitoring program are to:

- Determine that water quality conditions meet the substantive requirements of the Clean Water Act Sections 401 and 404(b)(1)
- Allow for appropriate adjustment of construction activities in a manner that minimizes impact to the environment
- Document the results of the water quality monitoring.

The construction WSMP (Appendix D of the RAPP) provides specific details on the water quality monitoring parameters and performance criteria, monitoring locations, sampling and analysis methods and equipment, monitoring schedule, QA/QC procedures, and corrective actions. In summary, potential water quality impacts (e.g., turbidity, dissolved oxygen, pH, and chemistry for a subset of PAHs and cyanide) will be monitored. Environmental controls and best management practices (BMPs) in the event that water quality monitoring indicates exceedances of specified trigger levels, are provided in the RAEPP (Appendix E of the RAPP).

4.1.4 Sediment Trap Monitoring

Anchor will install and monitor sediment traps in the vicinity of the removal action. The objective of the monitoring program is to conduct baseline and action specific monitoring to evaluate the effectiveness of the containment system at containing Site related chemicals.

The construction WSMP (Appendix D of the RAPP) provides specific details on the sediment trap monitoring parameters, monitoring locations, sampling and analysis methods and equipment, measurement documentation, and monitoring schedule. The material collected within the sediment traps will be analyzed for a partial list of PAHs, cyanide, total solids, and grain size.

4.1.5 Post Removal Sediment Characterization

Baseline sediment characterization monitoring will be performed immediately following completion of the sediment removal and prior to cap and cover placement. This information will be used to determine the baseline conditions in the area prior to capping and may be useful to for later comparison to longer-term cap monitoring results. It will not be used to determine whether additional dredging is required as a part of this removal action.

The construction WSMP (Appendix D of the RAPP) provides specific details on the sediment characterization parameters, sampling and analysis methods and equipment, measurement documentation, and sampling schedule. In summary the samples will be analyzed for the following parameters:

- Total organic carbon (TOC), total solids (TS), and grain size
- Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), cyanide, and total metals (i.e., arsenic, chromium, copper, nickel, lead, and zinc)

4.2 Sediment Drying

Free liquids are prohibited in the Arlington Chemical Waste Management North West (CWMNW) Subtitle C landfill, so the dredged material will require drying to meet the paint filter test prior to trucking and disposal. In addition, the landfill requires that all wastes satisfy a 1 ton per square foot (tsf) load bearing capacity. Following dredging and placement of the material into a dewater barge, the material will be rehandled via a second derrick into the haul barge for sediment drying. Drying will be conducted by adding a drying reagent (e.g., Portland cement or lime) to the material in the barge using a crane-operated bucket. The reagent and dredged material will be thoroughly mixed using the bucket in the haul barge. Based on the sediment drying bench scale test (discussed in the RAPP), a minimum of 5 percent (by weight) of drying reagent will be added to meet the landfill 1 tsf bearing capacity requirement. Following addition of the reagent the operator will determine whether sufficient reagent has been added to the dredged material by conducting three paint filter tests per barge load of material transferred. Because additional drying will take place over time, the haul barge may be sent to the transfer facility even though one or more paint filter tests fail at the time of testing at the Site. The decision to either send the barge in anticipation of further drying in transit or to add additional drying reagent at the Site will be made in the field based on experience and specific consistency of the material at the time.

4.3 Transport and Disposal of Dredge Material

Following dredging, the construction contractor will transport and dispose of the sediments at the CWMNW Subtitle C landfill. The haul barge will be pushed from the secondary containment system at the Site to the offloading facility. The description of the transport methods; potential issues, concerns, and solutions; environmental monitoring and corrective actions; and, a description of the equipment, monitoring and maintenance is discussed in the TDP (Appendix A of the RAPP).

The verification activities for determining that the material is transported to the disposal facility, per the final design, are described in the TDP. In summary, accurate documentation of transport and disposal will be collected and tracked during the transportation process. The approximate volume/weight of material and sediment drying agent loaded onto the haul barge and the date of the removal operation will be recorded in the field log. Once the truck is cleared to leave the facility following inspection and cleaning (defined in the TDP), if applicable, the load will be documented on a manifest that will be carried by the driver. Copies of all project records, including manifests, bills of lading indicating cargo contents, weight, and date, will be collected for each overland trip transporting waste for disposal and maintained for the project file. The disposal facility will verify receipt of the contents and record the weight and the time that it is received. These records will be tracked during the process and then compiled into a spreadsheet, which will be reflected in the weekly progress reports and summarized in the RACR.

4.4 Placement of Cover/Pilot Cap

4.4.1 Description

Following completion of dredging, pilot cap and fringing cover will be placed over the extents of the dredge prism at the depths and locations specified in the RAPP. As discussed in the RAPP, placement of the material will likely be performed from a barge using mechanical methods (e.g., clamshell bucket). All cover/cap material will be evaluated prior to its placement to ensure compliance with the final design requirements and environmental monitoring will be performed during placement to monitor potential water quality impacts (as described in the WSMP – Appendix D).

4.4.2 Verification Activities

Verification activities associated with the cover/capping activities include:

- Ensuring the cover/cap has the appropriate physical and chemical characteristics as per the RAPP.
- Achieving material placement over the required areas and to the required thickness as per the RAPP.

Each of these activities is described in further detail below.

4.4.2.1 Borrow Source and Materials Acceptability Criteria

The construction contractor shall supply cover/cap materials with physical properties meeting the quality, size, shape, and gradation identified in the final design RAPP. The contractor shall also perform characterization of all imported cover/cap material to ensure that the "cap material to be used for construction of the sediment cap will be imported, clean, granular material free of roots, organic material, contaminants, and all other deleterious and objectionable material" (Ecology and the Environment 2003), as discussed in the RAPP. The contractor will perform the following:

- Document origin of source of cover/cap material
- Document material sampling for physical and chemical characterization

The contractor will provide documentation of a site inspection and of material sampling and characterization (including physical and chemical testing) to ensure that the imported material will uniformly meet the physical specifications of its intended use. The potential sources of material are presented in the RAPP.

4.4.2.2 Placement Acceptability Criteria

To verify that the thickness of cover/cap material applied is in compliance with the final design, a minimum cover/cap thickness will be placed with an over-placement allowance to account for placement inaccuracies. The capping procedure will be monitored using location control for bucket location and observing tonnage placed in a given area. The in situ thickness and extents of the applied cover/cap will be documented by verifying the material thickness visually (if the water levels facilitate visual inspection of the cover depth) or by conducting a post-placement hydrographic survey in cap areas that are submerged. Wherever the material thickness is less than the specified amount, the construction contractor will be required to add a sufficient amount of material to achieve the specified design thickness.

4.4.3 Water Quality Monitoring

The construction contractor will be required to place the cover/cap material following several standard environmental controls and BMPs as described in the RAEPP. Water

quality monitoring during placement activities will be identical to the monitoring to be performed during dredging activities. Additional information on environmental controls during placement of the cover/cap is provided in the WSMP and RAEPP (Appendix D and E of RAPP, respectively).

4.5 Corrective Action Procedures

If any work is found to deviate from the final design (e.g., noncompliance with the final dredge elevation, water quality exceedences during dredging and placement of cover/cap, characteristics of the material), the CQAO will immediately bring the deviation to the attention of the construction contractor for correction. Such deviations that can not be immediately corrected will trigger the corrective action procedures described in this section.

If the construction contractor is unable to comply with the final design or disagrees that the work is out of specification, the CQAO will notify the Anchor Project Coordinator and request an interpretation from the Project Engineer regarding the acceptability of the work in question. The construction contractor, CQAO, and Project Engineer will reach agreement regarding resolution of the work. If the question arose as a result of differing interpretations of the final design or unexpected site conditions, the Project Engineer will issue a clarification or modification of the design. The issue will be brought to the immediate attention of EPA, and prompt EPA approval of the clarification or modification will be requested. The approved clarification or modification will be summarized in the next Weekly Progress Report (described in Section 5) and noted in the RACR.

If the Project Engineer determines that the work questioned by the CQAO clearly deviates from the final design and is not necessitated by unexpected site conditions, the construction contractor will be required to correct any deficiency. The Project Engineer will have the authority to interpret the technical requirements of the design. The NW Natural Project Coordinator, with technical assistance from Anchor, will resolve contractual issues, if any arise, with the construction contractor.

In the particular case of deviation from the requirements for protection of environmental quality as determined by water quality monitoring, corrective actions will be implemented as described in the RAEPP. Upon receiving water quality monitoring results indicating an

exceedence, the CQAO will immediately notify the construction superintendent to take corrective action. The CQAO will also notify the Anchor Project Coordinator and the EPA representative on-site, if one is present, as soon as possible of the water quality monitoring result and corrective actions being implemented.

5 DOCUMENTATION AND REPORTING

The construction contractor will be responsible for quality control during construction and the CQAO will be responsible for quality assurance (i.e., verifying that the required quality control measures have been implemented). The contractor superintendent and the CQAO will work closely on a daily basis during the removal action to complete the project as specified in the final design and to collect the documentation required by the Order. The following sections describe documentation that will be maintained by the contractor superintendent and CQAO.

During construction activities, the construction contractor will be required to provide a variety of documentation to the CQAO, including testing results of materials received, weigh tickets for shipments of materials removed, survey results, and documentation of pay items completed. The contractor will also maintain a daily log of activities, as described in Section 5.1. The CQAO will maintain a field log of daily activity and complete an internal weekly report. The contents of the log and report are described in Sections 5.2 and 5.3 In addition, as noted in Section 4.3 all documentation related to tracking of transferred and disposed material will be documented by the contractor and presented in the RACR.

Weekly progress reports and the RACR, which will be submitted to EPA, are described in the RAPP. The records described in this section will be maintained in the project files. Monitoring data will be provided electronically to EPA in the RACR.

5.1 Contractor's Daily Log

The contractor's daily log will record at a minimum:

- Identification of personnel on-site
- Activities completed
- Any changes to BMPs or environmental controls (including when silt curtains were opened)
- Materials delivered/used
- Materials dredged/shipped off-site
- Surveys completed
- Problems encountered and resolution of problems
- Any EPA authorized deviations from the final design

5.2 Construction Quality Assurance Officer's Daily Field Log

The CQAO will maintain a daily field log to record observations, measurements, inspections completed, data received, communications with other members of the project team or EPA, any water quality exceedances, additional environmental controls that were added, problems encountered, and resolutions. The daily field log will be supported by submittals received from the construction contractor, such as survey results and weigh tickets, chain of custody forms for water quality monitoring samples collected, laboratory data received, inspection reports, and written communication from members of the project team or EPA. Water quality results are also separately recorded and reported as defined in Section 6.2 of the WSMP (Appendix D).

5.3 Weekly Summary Reports

The CQAO, in cooperation with the contractor superintendent, will prepare weekly summaries of progress. These summaries will facilitate the preparation of the Weekly Progress Report to EPA and the RACR. The weekly summary will identify progress organized by activity:

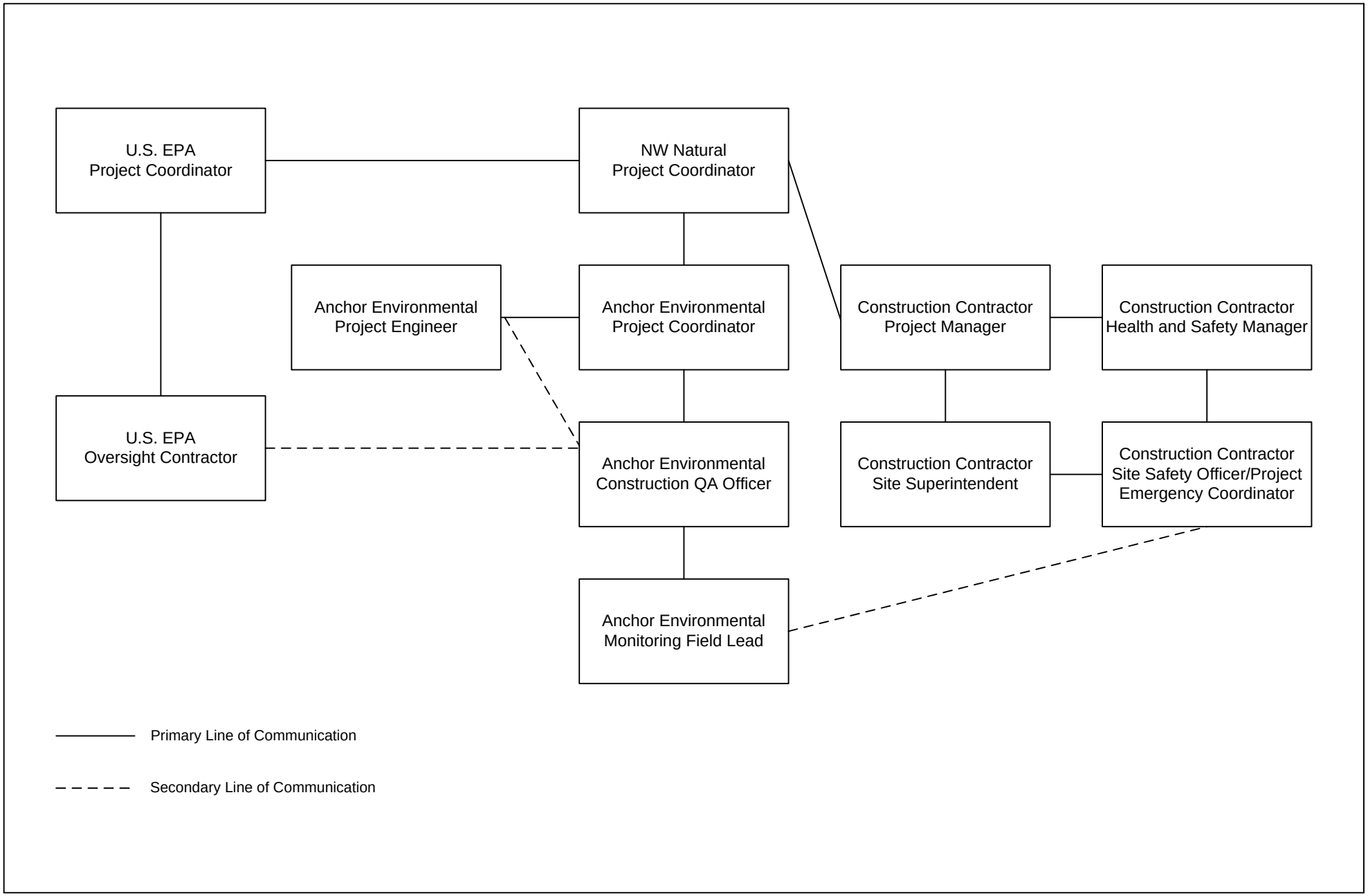
- Removal
  - Area worked (supported by contractor's log)
  - Volume of material removed (supported by contractor's log)
  - Surveys completed (supported by contractor's log)
  - Problems encountered
  - Corrective Actions
- Sediment Drying
  - Weight/volume of sediment drying agent shipped to the Site via barge and used during the drying process
  - Weight/volume of sediment drying reagent received and added at the transfer facility (supported by trip tickets)
  - Problems encountered
  - Corrective actions
- Transportation and Disposal
  - Weight/volume of material shipped off-site (supported by trip tickets)
  - Mode(s) of transportation
  - Disposal confirmations received

  - Weight of cover/cap materials received (supported by trip tickets)
  - Problems encountered
  - Corrective Actions
- Cover/Pilot Cap
  - Area worked (supported by contractor's log)
  - Weight/volume of material placed
  - Problems encountered
  - Corrective Actions
- Environmental Controls
  - Samples collected
  - Summary of analytical results
  - Problems encountered
  - Corrective Actions

6 REFERENCES

Anchor Environmental L.L.C. (Anchor). 2004. Field Sampling Plan – Northwest Natural "Gasco" Site, Removal Action Work Plan. Prepared by Anchor Environmental, June 2004.

FIGURES



ANCHOR ENVIRONMENTAL, L.L.C.

Figure C-1
Organization Chart
NW Natural "Gasco" Site

APPENDIX D

CONSTRUCTION WATER AND SEDIMENT MONITORING PLAN

APPENDIX D

CONSTRUCTION WATER AND SEDIMENT MONITORING PLAN
FINAL DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for Submittal to

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Table of Contents

1 INTRODUCTION 1

2 WATER QUALITY MONITORING 2
2.1 Monitoring Parameters 2
2.2 Monitoring Locations/Depths 2
2.2.1 Field Parameters 3
2.2.2 Laboratory Parameters 4
2.3 Monitoring Frequency/Schedule 4
2.4 Background Survey 5
2.5 Visual Monitoring 6
2.6 Observation/Sampling of Silt Curtain-Mudline Interface 7
2.7 Sampling and Analysis Methods and Equipment 8
2.7.1 Sample Location/Depth Determination 9
2.7.2 Monitoring Equipment Calibration 9
2.7.3 Measurement Documentation 10
2.7.4 Laboratory Parameters Methods 10

3 RIVER VELOCITY MONITORING 11
3.1 Monitoring Locations/Depths 11
3.2 Monitoring Frequency and Schedule 11
3.3 Sampling and Analysis Methods and Equipment 11
3.4 Measurement Documentation 12

4 BASELINE/ACTION SPECIFIC SUSPENDED SEDIMENT MONITORING 13
4.1 Monitoring Parameters 13
4.2 Sampling and Analysis Methods and Equipment 13
4.2.1 Locations and Depths 13
4.2.2 Frequency and Schedule 14
4.2.3 Methods and Equipment 14
4.2.4 Measurement Documentation 14

5 POST REMOVAL SEDIMENT CHARACTERIZATION 16
5.1 Monitoring Parameters 16
5.2 Sampling and Analysis Methods and Equipment 16
5.2.1 Locations and Depths 16
5.2.2 Frequency and Schedule 17
5.2.3 Methods and Equipment 17
5.2.4 Measurement Documentation 17

6 QUALITY CONTROL AND ASSURANCE PROCEDURES 19
6.1.1 Reporting Limits 19
6.1.2 Precision/Accuracy 19
6.2 Health and Safety Procedures 20

7 NOTIFICATION AND REPORTING 21
7.1 Notification Requirements 21
7.2 Reporting Requirements 21

8 MONITORING PERSONNEL AND KEY CONTACTS 23

9 REFERENCES 24

List of Tables

Table D-1 Sediment Trap Monitoring Station Geographical Coordinates

List of Figures

Figure D-1 Schematic Showing Water Quality Monitoring Depths

Figure D-2 Schematic Showing Water Quality Monitoring Locations for Field Measurements

Figure D-3 Sediment Trap Monitoring Station Locations

Figure D-4 Sediment Trap Construction Schematic

List of Attachments

Attachment D-1 Water Quality Monitoring Form

Attachment D-2 Surface Sediment Field Sample Record Form

1 INTRODUCTION

This document presents the Construction Water and Sediment Monitoring Plan (WSMP) for the "Gasco" Site (Site) Removal Action (Project) being conducted by NW Natural. It is one part of the Draft Final Design Submittal for the Project. The objective of water quality monitoring will be to determine whether potential water quality impacts occur near removal operations. The Removal Action Environmental Protection Plan (RAEPP) – Appendix E of the Draft Final Design Submittal will be used in conjunction with the WSMP. The RAEPP (Appendix E) defines the water quality measurements and levels that will be used to determine water quality impacts and trigger additional protective measures, if necessary, based on the sampling performed per the WSMP. This WSMP presents the types, locations, frequency, equipment, and methods of measurements as well as data reporting that will be used in these RAEPP (Appendix E) determinations.

Construction operations covered by this WSMP include dredging (and related activities such as piling removal and monitoring of the silt curtain), addition of the sediment drying reagent, transfer of dredged materials to upland transport, and placement of cover/cap material at the Site after dredging is complete. Water quality monitoring is proposed during each of these activities. This WSMP fulfills the substantive requirements of Clean Water Act Section 401 and 404(b)(1) in terms of monitoring for compliance with these regulations. Determinations of compliance with the Clean Water Act and decisions regarding potential additional protective measures are presented in the RAEPP (Appendix E).

2 WATER QUALITY MONITORING

Monitoring methods (including parameters, locations/depths, frequency/schedule, background surveys, visual monitoring, and equipment) are consistent with the substantive requirements of a Section 401 Water Quality Certification in the State of Oregon. Appropriate methods were determined by reviewing recent Oregon water quality certificates for similar projects involving in-water work such as dredging and remediation of contaminated sediments in the Columbia and Lower Willamette Rivers. These included the water quality certificates for the McCormick and Baxter site in-water work and the Columbia River channel deepening project. Additional project-specific monitoring requirements were developed through discussions with EPA.

2.1 Monitoring Parameters

Consistent with recent water quality certificates for contaminated and potentially uncontaminated sites in the area (as described above), the following parameters will be monitored near removal operations:

- Field Parameters
  - Turbidity (in nephalometric turbidity units [NTU])
  - Temperature (in degrees Celsius)
  - Dissolved oxygen (in mg/L)
  - pH (in standard units)
  - Visual monitoring for sheens
- Laboratory Parameters
  - PAHs (anthracene, benzo(b)anthracene, benzo(a)pyrene, dibenzofuran, fluoranthene, fluorene, naphthalene, and phenanthrene) (in μg/L)
  - Cyanide (in mg/L)

2.2 Monitoring Locations/Depths

Monitoring will take place near each of the following operations:

- Dredging/Piling Removal or Placement
- Transfer of dredged material to upland transport
- Placement of cover/cap

Sampling depths for both the field and laboratory parameters will be located at the approximate top, middle, and bottom of the water column if the water depth permits

collecting samples from three intervals separated by at least 5 feet from each other. This procedures is identical to the one described in the Water Quality Certificate for the McCormick and Baxter site. Top and bottom samples will be taken 1 foot below the surface of the water and above the mudline, respectively. Thus, for water depths less than 7 feet, two samples will be taken and for water depths less than 2 feet, one sample will be taken. This approach is shown in Figure D-1. The same approach will be used during monitoring at the transfer facility.

2.2.1 Field Parameters

For all dredging and offloading operations at the transfer facility, field water quality parameters will monitored in the river 300 feet directly upstream (for background conditions) and 150 feet directly downstream of the operation, as measured from the primary (silt curtain) containment barrier by a high accuracy laser range finder. Three downstream stations will be monitored in an arc as shown in the example in Figure D-2. (This figure only shows an example for the dredging activities.) A similar approach will be used at the transfer facility monitoring with the monitoring locations measured upstream (300 feet) and downstream (150 feet) from the location of the transfer barge when it is docked at the transfer facility.

Although the Willamette River is tidally influenced at the Site, it infrequently undergoes flow reversals due to tidal changes. If flow reversal is observed to occur at the Site or at the transfer facility during construction, then the sampling will be conducted down current and up current (for background conditions) as appropriate. For dredging operations, the monitoring locations will be 300 feet upstream and no more than 150 feet downstream of the edge of the primary containment barrier. The primary containment barrier for the inner removal area discussed in the RAPP will be the full length silt curtain. The primary containment barrier for the outer removal area will be the partial length (i.e., extending to within 2 feet from the bottom) silt curtain. Depending on results of initial monitoring near other operations, additional environmental controls may be implemented to reduce observed potential water quality impacts per the RAEPP (Appendix E).

For capping operations, cap placement will be performed within the containment configuration used for the outer removal area and therefore the water quality locations will be identical to the example shown in Figure D-2.

2.2.2 Laboratory Parameters

Grab water samples will be taken for the subset of PAHs (as noted above in Section 2.1) and cyanide at one station immediately downstream of the dredging operation at a distance of no more than 150 feet from the edge of the primary containment barrier. Grab samples will not be analyzed for laboratory parameters during monitoring at the transfer facility. For the first sampling event prior to start of construction (see Section 2.4), the following background samples will be taken and analyzed for the above laboratory parameters:

- An upstream grab water sample (1 foot above the mudline) at 300 feet from the primary containment
- Two grab water samples immediately over the dredge prism (one 1 foot above the mudline and the other 1 foot below the water surface).

2.3 Monitoring Frequency/Schedule

Field parameters will be measured at the start of each operation (i.e., dredging or offloading at the transfer facility) at least once every hour during active in-water work (defined as the operations noted above). On any day active in-water work occurs, the first sample will be taken 1 hour after the initiation of the activity, and once at each 1-hour interval thereafter. This frequency of monitoring for field parameters will continue until four consecutive hourly events indicate no exceedance of any trigger levels described in RAEPP. If no exceedance is identified following four consecutive hourly events the sampling frequency will be reduced to once every 4 hours. If results exceed the triggers presented in the RAEPP (Appendix E), then these same parameters will be measured again within 30 minutes of determination of the exceedance. If the exceedance continues, procedures discussed in the RAEPP (Appendix E) will be followed.

Laboratory parameters will be measured once a day for three consecutive days at the start of the dredging activities at the Site. These parameters will be measured once per week

thereafter. If substantial exceedances (as defined in the RAEPP, Appendix E) occur, additional monitoring events may be conducted as determined in consultation with EPA.

Visual monitoring will be continuously conducted during the in-water dredging, capping and offloading activities. Visual observations of the mudline elevation (see Section 2.6) both within and outside of silt curtain(s) via remote cameras or divers will be conducted if topside visual monitoring and/or water quality monitoring indicates the silt curtain is not functioning to contain suspended materials within the containment system. Collection of water samples with the van Dorn or similar sampler (see Section 2.6) from the bottom depth adjacent to the silt curtain will be conducted daily coincident with water quality monitoring for the field parameters. Monitoring of suspended sediment deposition in the vicinity of the Site before and following completion of the in-water construction through the use of sediment traps (see Section 4).

2.4 Background Survey

For field parameters, initial background conditions for the Site will be established prior to the start of any active in-water work. A minimum of seven independent measurements (at all applicable water depths) will be made 300 feet (as measured by a high accuracy laser range finder) upstream of the expected location of containment barriers around the removal action area and at the transfer facility over the course of a two-day period just prior to construction initiation. For each parameter, the 95th percentile upper confidence limit on the mean will be determined and used to represent initial background conditions. Sampling event-specific background conditions will be determined from the upstream monitoring that takes place for each event (with an event defined as each sample collection described above). The use of initial and sampling-event-specific background in evaluating triggers for protective procedures is presented in the RAEPP (Appendix E).

Background sampling for laboratory parameters will only occur at the Site. Sampling will consist of one upstream event of one sample taken 1 foot above the mudline 300 feet from the expected location of the primary containment during the first sampling event. In addition, two grab water samples will be taken immediately over the dredge prism (one 1 foot above the mudline and the other 1 foot below the water surface) during the first

sampling event. All three of these background water samples will be analyzed for the laboratory parameters noted above.

2.5 Visual Monitoring

Visual monitoring is equally important to the monitoring regime as the above quantitative measurements. Exceedances of visual monitoring triggers will result in contingency monitoring actions as summarized below and in the RAEPP (Appendix E).

Visual monitoring will take place whenever construction is actively underway. Dredging operations will not be performed after dark, so the visual monitoring will be limited to the daylight hours. It will be conducted by the Water Quality Monitoring Field Leader when present on-site and by the Construction Quality Assurance Officer (CQAO) at all other times (see Section 7 for personnel descriptions). Observations will be made as to the presence of any of the following occurring outside containment barriers (where present):

- High turbidity that might reasonably result in exceedance of triggers in the RAEPP (Appendix E)
- Sheens or other visible contamination in the water
- Distressed or dying fish or birds
- Other visual indicators of potential adverse water quality impacts

If such conditions are observed, monitoring for field and laboratory parameters following the above procedures will be conducted and procedures for protective measures as described in the RAEPP (Appendix E) will be followed.

Sheens or related materials will be characterized as to their relative magnitude and quality. At a minimum the following will be noted:

- Oil drops – presence, size, whether on or below the water surface
- Sheens – thickness, continuous or discontinuous, approximate size, rate of dissipation
- Floating product – thickness, approximate size, color, odor
- Underwater product – same attributes as for floating product
- Tar particles – size, color, sinking, floating, approximate size where present, creation of sheen

For distressed or dying fish or birds the following, at a minimum, will be noted:

- Condition of fish or birds (dead, dying, decaying, erratic or unusual behavior)
- Number, species, and size of fish or birds in each condition
- Location of fish or birds relative to operations
- Presence of any normal fish or birds in the area at the same time
- Whether the species is a listed species

Contingencies for distressed or dying fish or birds for both listed and non-listed species are described in the RAEPP.

2.6 Observation/Sampling of Silt Curtain-Mudline Interface

EPA has expressed a concern that where silt curtains are used, materials related to the removal could escape through the relatively small gap at the mudline interface of the full length curtains used for the inner removal area and beneath the bedload baffle used for the outer removal area. These materials could then migrate downstream along the bottom depth. Field parameter sampling at 1 foot above the mudline elevation as discussed in Section 2.2, will be one means to monitor this potential migration pathway of materials upstream and downstream (100 feet) from the in-water activities within both the inner and outer removal areas. In addition, the following two methods will be used to monitor this migration pathway in the direct vicinity of the in-water work:

- Collection of water samples with the van Dorn or similar sampler from the bottom depth adjacent to the silt curtain.
- Monitoring of suspended sediment deposition in the vicinity of the Site before and following completion of the in-water construction through the use of sediment traps (further discussed in Section 4).
- If monitoring via collection of near bottom water samples (as described in first bullet) indicates the silt curtain is not functioning to contain suspended materials within the containment system, then visual observations of the mudline elevation both within and outside the silt curtain(s) via remote cameras or diver will be made. In addition, if any topside visual monitoring indicates a potential problem (e.g., observations of possible anchor dragging or sailing of curtains or baffles that might

indicate a potential rip or connection failure), visual monitoring of underwater conditions will be made.

Visual observations will record the presence of any materials such as product, oil, tar fragments, loose sediments, which appear to be migrating beneath the curtain. Pictures of the silt curtain–mudline interface will be taken as visibility allows. The water samples will be collected by deploying the van Dorn sampler to the bottom. The sampler will be rested on the bottom and then a sample will be taken. This sample will be pulled to the surface and decanted into a large clear jar or other clear container. Pictures will be taken of the contents of the container. Use of these data for contingency decisions is described in the RAEPP (Appendix E).

2.7 Sampling and Analysis Methods and Equipment

Sampling will be collected in accordance with *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (EPA 2001). In addition, the horizontal positioning and vertical control, station identification, equipment decontamination, analysis methods, targeted reported limits, sampling handling and storage, waste disposal, data quality objectives and criteria, documentation and records process, and data verification and validation methods will be consistent with the EPA-approved Field Sampling Plan (FSP), which is Appendix A of the Removal Action Work Plan (RAWP) (Anchor 2004). Additional sampling and analysis methods not described in the FSP are described in detail in the following sections.

Samples will be collected from a self propelled vessel equipped with a differential global positioning system (DGPS) with a handheld global positioning system (GPS) unit as backup if necessary. Field parameters will be measured with a calibrated field probe. Laboratory parameter grab samples will be collected using a decontaminated van Dorn bottle or similar device. Recovered water from the appropriate depth will be transferred immediately to appropriate laboratory-provided pre-labeled, pre-cleaned sample containers (see below).

Turbidity measurements will follow Standard Method 2130 (AWWA 1998). Dissolved oxygen, temperature, and pH will be measured using a calibrated field probe deployed to the appropriate depth where both dissolved oxygen and temperature will be recorded. For

water depths that exceed 25 feet (the standard meter cord length) dissolved oxygen measurements will follow Standard Method 4500-O (AWWA 1998). Measurement of pH will follow Standard Method 4500-H^+.

2.7.1 Sample Location/Depth Determination

Distances from operations will be verified by a high accuracy (+/- 3 feet accuracy) laser rangefinder. Two readings will be taken during each verification to ensure the laser is measuring the appropriate distance.

Depth to the bottom will be determined using the van Dorn bottle or lead line. From this, the appropriate sampling depths will be determined. Both the depth to the bottom and the sampling depths will be recorded at each location sampled.

2.7.2 Monitoring Equipment Calibration

Monitoring equipment will be calibrated prior to its use in the monitoring program following manufacturers' instructions. The calibration will be conducted once at the beginning of each sampling day for all equipment. Where not covered by manufacturers' instructions, calibration procedures will follow Standard Methods 2130-b (turbidity), 4500-O (dissolved oxygen), 2550 (temperature), and 4500-H^+ (pH) (AWWA 1998).

For the nephalometer, at the end of each day of monitoring a post-calibration procedure will be performed by measuring one of the calibration standards (preferably the standard whose value is closest to the river turbidity during that day). In addition, standards may be measured to check the calibration throughout the day, especially if higher or lower than expected turbidity values occur.

All calibration information will be recorded in the field notebook. Equipment that does not properly calibrate will not be used.

2.7.3 Measurement Documentation

The water quality monitoring data (e.g., station coordinates, water depths sampled, date, time, parameter results, and other observations) will be recorded on the Water Quality Monitoring Form (Attachment D-3).

2.7.4 Laboratory Parameters Methods

Grab samples collected for PAH and cyanide analyses will be submitted to a qualified laboratory for a 72-hour turnaround time analysis (from time of receipt of samples at the laboratory). It should be noted that EPA has indicated in the event of multiple chemical exceedances of the triggers in Appendix E, quicker turnaround times may be requested. The laboratory will have some limit on how fast samples can be processed, and this limit will need to be determined at the time that EPA makes any such requests. The laboratory analyses (EPA Method 8270C-SIM for PAHs and EPA 335.2 for cyanide) will be conducted in accordance with the protocols described in the EPA-approved Removal Action Work Plan (RAWP) Field Sampling Plan (FSP) (Anchor 2004). The quality control/quality assurance (QA/AC) procedures are described in Section 5.

3 RIVER VELOCITY MONITORING

River water velocity measurements will be collected during all in-water removal activities to ensure the velocities do not exceed the threshold for use of the containment barriers (i.e., silt curtains) discussed in the RAEPP (Appendix E). The measurements will be made from a moored vessel in accordance with the procedures described below.

3.1 Monitoring Locations/Depths

River velocity measurements will be taken at an upstream location near a piling or other structure that the boat can be moored to. The measurements will be made within the top third of the water column depth to ensure the measurement is not affected by the presence of the sampling vessel or bottom effects. Care will be taken to keep the meter away from the any nearby structures so that the measurement is not affected.

3.2 Monitoring Frequency and Schedule

River velocity measurements will be conducted concurrently with the water quality monitoring activities discussed above (Section 2).

3.3 Sampling and Analysis Methods and Equipment

The velocity measurement will be made using telescoping velocity meter with capabilities of measuring velocities in the anticipated velocity range (0.1 to 1 fps). To avoid potential error in measurements at the longest extended telescoping length (e.g., due to "whipping" of the meter in eddies), the meter will be extended to a maximum depth of 15 feet below the water surface. The meter will be operated in accordance with the manufacturer's instructions.

The horizontal positioning of the monitoring location will be determined using the methods described in the EPA-approved Field Sampling Plan (FSP), which is Appendix A of the Removal Action Work Plan (RAWP) (Anchor 2004). Equipment will be calibrated and maintained per manufacturers' instructions. All results will be immediately recorded in the field log book. Measurements will be recorded to the one-hundredths decimal place.

3.4 Measurement Documentation

The river velocity monitoring data (e.g., station coordinates, water depths sampled, date, time, velocity, and other observations) will be recorded on the Water Quality Monitoring Form (Attachment D-1).

4 BASELINE/ACTION SPECIFIC SUSPENDED SEDIMENT MONITORING

The EPA Action Memorandum (2005) requires that NW Natural perform baseline and action specific monitoring for Site related contaminants suspending and settling in the vicinity of the removal action area, using equipments such as sediment traps. In accordance with EPA's direction, sediment traps will be deployed at the Site.

4.1 Monitoring Parameters

The characterization will include the following physical and chemical parameters:

- Total organic carbon (TOC), total solids (TS), and grain size
- PAHs (anthracene, benzo(b)anthracene, benzo(a)pyrene, dibenzofuran, fluoranthene, fluorene, naphthalene, and phenanthrene) and cyanide,

These parameters were monitored during the design characterization sampling (see Appendix A of the RAWP; Anchor 2004) and include any likely chemicals of potential concern at the site. If insufficient volume is collected in the individual sediment traps, the analyses will be conducted in this priority pending sample volume availability: PAHs, cyanide, TOC, TS, and grain size.

4.2 Sampling and Analysis Methods and Equipment

Sampling will be collected in accordance with *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (EPA 2001). In addition, the horizontal positioning and vertical control, equipment decontamination, analysis methods, targeted reported limits, sampling handling and storage, waste disposal, data quality objectives and criteria, documentation and records process, and data verification and validation methods will be consistent with the EPA-approved Field Sampling Plan (FSP), which is Appendix A of the Removal Action Work Plan (RAWP) (Anchor 2004). Additional sampling and analysis methods not described in the FSP are described in detail in the following sections.

4.2.1 Locations and Depths

Three sediment traps will be deployed in the vicinity of the Site. The locations of the traps (RAA-ST-1, RAA-ST-2, and RAA-ST-3) are depicted in Figure D-3 and the geographical coordinates are provided in Table D-1. The sediment traps will be

deployed to measure sedimentation upstream, directly downstream, and further downstream of the removal action to monitor background and near-field and far-field sediments, respectively. The sediment traps will be placed at approximately the same elevation at each monitoring station (i.e., 32 feet NAVD 88).

4.2.2 Frequency and Schedule

For the baseline monitoring period, the sediment traps will be installed in mid-July 2005 and removed prior to initiating any in-water construction activities (approximately 30 day duration). The sediment trap collection cylinders will be reinstalled following placement of the inner removal area containment described in the RAPP. The sediment traps will be maintained in place until completion of the dredging and capping activities and removal of the outer removal area containment barriers.

4.2.3 Methods and Equipment

A schematic showing the construction details of the sediment traps is shown in Figure D-4. The sediment traps will be installed and retrieved by commercial divers. The rebar support bar (see Figure D-4) will be driven into the sediment a sufficient distance to ensure the bar will be maintained in place. In addition, the rebar used to support the sediment traps will be tied to pilings or other physical structure with a lead line (line on the bottom) to assist in finding the sediment trap locations for re-sampling during the project. Once in place the collection cylinder and surrounding PVC sleeve will be affixed to the rebar so that the height of the cylinder ranges from 2 to 3 feet above the mudline elevation. The collected sediment will be placed in a decontaminated stainless-steel mixing container, homogenized using a decontaminated stainless steel spoon until uniform color and texture is achieved and placed in the appropriate laboratory provided pre-labeled sample containers (certified, pre-cleaned). The height of sediment within the collection cylinder will be measured following collection and settling of visual particulates within the cylinder.

4.2.4 Measurement Documentation

The sediment trap monitoring data will be recorded in the field logbook. The information summarized in the logbook will include but not be limited to the following:

- Date and time

- Sampling personnel
- Weather
- Sampling location
- Water depth
- Height of sedimentation within the cylinder
- Characteristics or other observations of sediment sample (i.e., sheen, presence of tar, etc.)
- Other comments

The field logbook will include clear information concerning any modifications to the details and procedures identified in the FSP (Anchor 2004).

5 POST REMOVAL SEDIMENT CHARACTERIZATION

Baseline sediment characterization monitoring will be performed immediately following completion of the sediment removal and prior to cap and cover placement. This information will be used to determine the baseline conditions in the area prior to capping and may be useful to for later comparison to longer-term cap monitoring results. It will not be used to determine whether additional dredging is required.

5.1 Monitoring Parameters

The characterization will include the following physical and chemical parameters:

- Total organic carbon (TOC), total solids (TS), and grain size
- Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), cyanide, and total metals (i.e., arsenic, chromium, copper, nickel, lead, and zinc)

These are the parameters that were monitored in the design characterization sampling (see Appendix A of the RAWP; Anchor 2004), and include any likely chemicals of potential concern at the site.

5.2 Sampling and Analysis Methods and Equipment

Sampling will be collected in accordance with *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (EPA 2001). In addition, the horizontal positioning and vertical control, station identification, equipment decontamination, analysis methods, targeted reported limits, sampling handling and storage, waste disposal, data quality objectives and criteria, documentation and records process, and data verification and validation methods will be consistent with the EPA-approved Field Sampling Plan (FSP), which is Appendix A of the Removal Action Work Plan (RAWP) (Anchor 2004). Additional sampling and analysis methods not described in the FSP are described in detail in the following sections.

5.2.1 Locations and Depths

Surface (0 to 10 cm) sediment sampling will be conducted within the capping and cover areas of the project. Surface sediment samples will be collected in a grid formation from 15 locations within the cap and fringing cover areas. This sampling design will provide

a valid representation of the surface sediment concentrations remaining following the removal. The target sampling locations will be determined following evaluation of the leadline/bathymetry results to ensure a range of elevations is sampled. The target sampling locations will be reviewed by EPA before sampling. Concurrence with EPA on the sampling locations will be received prior to sampling.

5.2.2 Frequency and Schedule

Baseline sediment sampling in the capping and fringing cover areas will occur a single time immediately following EPA approval that the removal has been completed to the designed elevations and prior to placement of the capping and cover material.

5.2.3 Methods and Equipment

Surface sediment samples will be collected for physical and chemical testing using a 0.1 m^2 modified van Veen or similar type grab sampler in accordance with EPA protocols (EPA 2001). The sampler has been modified to improve sediment penetration and recovery in dense substrates. Samples will be collected from a vessel equipped with a differential global positioning system (DGPS) with a handheld global positioning system (GPS) unit as backup if necessary. Samples will be collected and evaluated against the EPA acceptability criteria (EPA 2001). If acceptable, the overlying water will be siphoned off and a decontaminated stainless-steel trowel or similar device will be used to collect sediments from the 0 to 10 cm zone from inside the sampler, taking care not to collect sediment in contact with the sides or surface of the sampler. The collected sediment will be placed in a decontaminated stainless-steel mixing container, homogenized using a decontaminated stainless steel spoon until uniform color and texture is achieved and placed in the appropriate laboratory-provided pre-labeled sample containers (certified, pre-cleaned).

5.2.4 Measurement Documentation

The post removal surface sediment characterization data (e.g., station coordinates, water depths sampled, date, time, physical characteristics, and other observations) will be recorded on the Surface Sediment Sampling Form (Attachment D-2). The information summarized on this form will include but not be limited to the following:

- Date and time

- Sampling personnel
- Weather
- Sampling location
- Water depth
- Sample depth
- Characteristics or other observations of sediment sample
- Penetration depth
- Other comments

The field logbook will include clear information concerning any modifications to the details and procedures identified in the FSP (Anchor 2004). Surface sediment collection log sheets (Attachment D-2) will be completed for each sediment grab. In addition to standard entries of personnel, date, and time, the log sheet will also include information regarding station coordinates and physical characteristics of the sediment such as texture, color, odor, stratification, and sheens.

6 QUALITY CONTROL AND ASSURANCE PROCEDURES

General quality control and assurance procedures will follow the overall project Quality Assurance Project Plan (QAPP), which is Attachment A of the FSP (Anchor 2004) and the amendments included in the procedures described in Sections 2, 3 and 4 of this WSMP. In addition, this section describes quality control and assurance procedures specific to this WSMP.

The following general quality control information will be collected:

- Names and affiliations of technical and support staff performing the water quality monitoring and post removal sediment characterization (recorded on Monitoring Form, Attachment D-1 and D-2, respectively)
- Locations and times for all samples (Field Forms, Attachment D-1 and D-2)
- Daily calibration information for field probes and velocity meter (field notebook)

Calibration of equipment used for measuring the field parameters will follow procedures noted above in Section 2.6.2. The field probes will be allowed to equilibrate before in situ measurements are collected to minimize measurement variability. For all measurements, unusual or questionable readings will be noted and duplicate readings made.

6.1.1 Reporting Limits

For turbidity measurements, reporting limits will follow Section 5 of the SM 2130 (AWWA 1998). For dissolved oxygen measurements, reporting will be to plus or minus 0.1 mg/L. Temperature and pH will be reported to plus or minus 0.1° C and 0.01 standard units, respectively. The velocity measurements will be reported to plus or minus 0.01 feet/sec. The reporting limits and analytical methods for all sediment and water laboratory analyses will be in accordance with those provided in the EPA-approved QAPP (Attachment A of the FSP; Anchor 2004).

6.1.2 Precision/Accuracy

Precision for the water quality and velocity monitoring will be estimated through duplicate measurements of 1 in 20 field measurements by nephalometer, pH and dissolved oxygen probe and the velocity meter, respectively. The water quality and velocity meters will be retrieved to the boat and then immediately redeployed to the same depth for a second measurement. Duplicate measurements will provide an

indication of field variability. Accuracy of the water quality monitoring measurements will be checked through calibration by measurement against known standards for turbidity, dissolved oxygen, and pH consistent with Standard Methods (AWWA 1998) as noted above. The accuracy of the velocity meter will be based on the manufacturer's specifications. The meter will be serviced frequently according to the manufacturer's operating guidelines and will be maintained in good working condition to ensure the stated accuracy.

The precision and accuracy of the field and laboratory water quality parameter data and surface sediment chemistry data will be maintained by following the procedures defined in the EPA-approved QAPP (Attachment A to the FSP; Anchor 2004).

6.2 Health and Safety Procedures

The health and safety procedures detailed in the Construction Health and Safety Plan (CHASP) – Appendix B of the RAPP, will be followed at all times by all personnel during monitoring activities. Appropriate health and safety procedures are described in detail in the CHASP.

7 NOTIFICATION AND REPORTING

7.1 Notification Requirements

The primary purpose of water quality monitoring during construction is to determine when water quality impacts may be occurring so that additional protection procedures and measures can be implemented, if necessary, as described in the RAEPP. Consequently, immediate notification of water quality measurements that exceed triggers in the RAEPP is necessary. Upon obtaining results that exceed any RAEPP trigger, the Water Quality Monitoring Field Leader will notify the Construction Quality Assurance Officer (CQAO) as quickly as possible. The CQAO will notify the Anchor Project Coordinator, who in turn will immediately notify the EPA Project Coordinator or designated oversight contractor contact person by telephone if one is not on-site. Daily reporting to EPA's designated contact is described in the next section. In addition, implementation of RAEPP procedures due to water quality notifications may require additional contacts and discussions with EPA representatives, and these requirements are described in the RAEPP.

The primary purpose of the river velocity monitoring is to determine if the river velocity may adversely affect the containment barriers in use. Upon obtaining results that exceed the velocity trigger defined in the RAEPP, the Water Quality Monitoring Field Leader will notify the CQAO as quickly as possible. The CQAO will take the appropriate actions as defined in the RAEPP and notify the Anchor Project Coordinator and the EPA field representative, if present on-site. In addition, implementation of RAEPP procedures due to velocity notifications may require additional contacts and discussions with EPA representatives, and these requirements are described in the RAEPP.

7.2 Reporting Requirements

Data will be collected and recorded in the field on the Water Quality Monitoring and Surface Sediment Sampling Forms (Attachment D-1 and D-2, respectively) as described in Section 2 and 4, respectively. These data will be reported to EPA in the following steps:

- Daily Reporting – Any water quality or velocity exceedances of triggers specified in the RAEPP will be reported verbally to EPA on a daily basis.
- Weekly Reporting – Results from each week's Water Quality Monitoring Forms will be compiled into a summary table with a comparison to RAEPP triggers and provided to EPA with the Weekly Progress Report described in the RAPP.

- Project Reporting – Once all construction is complete, results for the entire construction period will be compiled and reported to EPA along with supporting documentation in the Removal Action Completion Report (RACR).

Daily and weekly reporting will be conducted by the Water Quality Monitoring Field Leader. All reporting will include both regularly schedule monitoring and any additional monitoring results that may have been required due to any trigger exceedances and resulting procedures described in the RAEPP.

After all construction is complete, the results of water quality and river velocity monitoring, and post removal sediment characterization will be provided to EPA in the draft RACR. The RACR will be revised to address EPA comments, if applicable, and submitted as a final report. The results section of the RACR will include:

- Any deviations from this WSMP and reasons for deviations
- Tabular summaries of all water quality and river velocity monitoring data with comparisons to RAEPP triggers
- Tabular summaries of all post removal sediment characterization results
- Narrative text on results of water quality monitoring related to each operation (e.g., dredging [and related activities such as pile pulling or placement], upland transfer, and cover/pilot cap placement).
- Discussion of water quality trigger exceedances and any additional monitoring that may have resulted
- Data validation results based on calibration and precision/accuracy information including any data qualifications and reasons for those qualifications
- An appendix containing all completed water quality monitoring and surface sediment sample forms
- An appendix containing all calibration information

8 MONITORING PERSONNEL AND KEY CONTACTS

Personnel to fulfill the following roles will be designated at least one week prior to start of the first monitoring events:

- Water Quality Monitoring Field Leader
- Monitoring personnel
- Sediment collection
- CQAO
- EPA Project Coordinator – Sean Sheldrake (for receipt of reports)

All monitoring personnel noted are experienced in the collection and measurement of water quality parameters.

As noted in previous sections, the Water Quality Monitoring Field Leader is responsible for:

- Visual water inspections
- Oversight of all water monitoring and sediment sampling
- Verification that results are properly recorded and forms completely filled out
- Verification that appropriate calibration and quality control and assurance procedures are conducted
- Notification to CQAO in the event of water quality or velocity triggers are exceeded
- Daily and weekly reporting of water quality results to EPA's designated contact

Monitoring and sediment collection personnel are responsible for conducting the field activities, necessary calibrations, quality assurance and quality control procedures, and recording of results as directed by the Water Quality Monitoring Field Leader.

The CQAO is responsible for acting upon water quality and velocity information as provided by the Water Quality Monitoring Field Leader as necessary to comply with the RAEPP.

9 REFERENCES

American Water Works Association (AWWA) 20th ed., 1998. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Water Pollution Control Federation, Washington, DC. U.S.

Anchor Environmental, L.L.C., 2004. NW Natural "Gasco" Site Removal Action Work Plan. Prepared for U.S. Environmental Protection Agency on behalf of NW Natural, August 2004.

U.S. Environmental Protection Agency, 2001. Methods for Collection, Storage and Manipulation of Sediment for Chemical and Toxicological Analyses: Technical Manual. U.S. Environmental Protection Agency Office of Water, EPA-823-B-01-002, October 2001.

U.S. Environmental Protection Agency, 2005. Action Memorandum – Action Memorandum for a Non-time critical Removal Action at the GASCO site within the Portland Harbor Superfund Site, Portland, Multnomah County, Oregon; Site ID: BW, June 17, 2005.

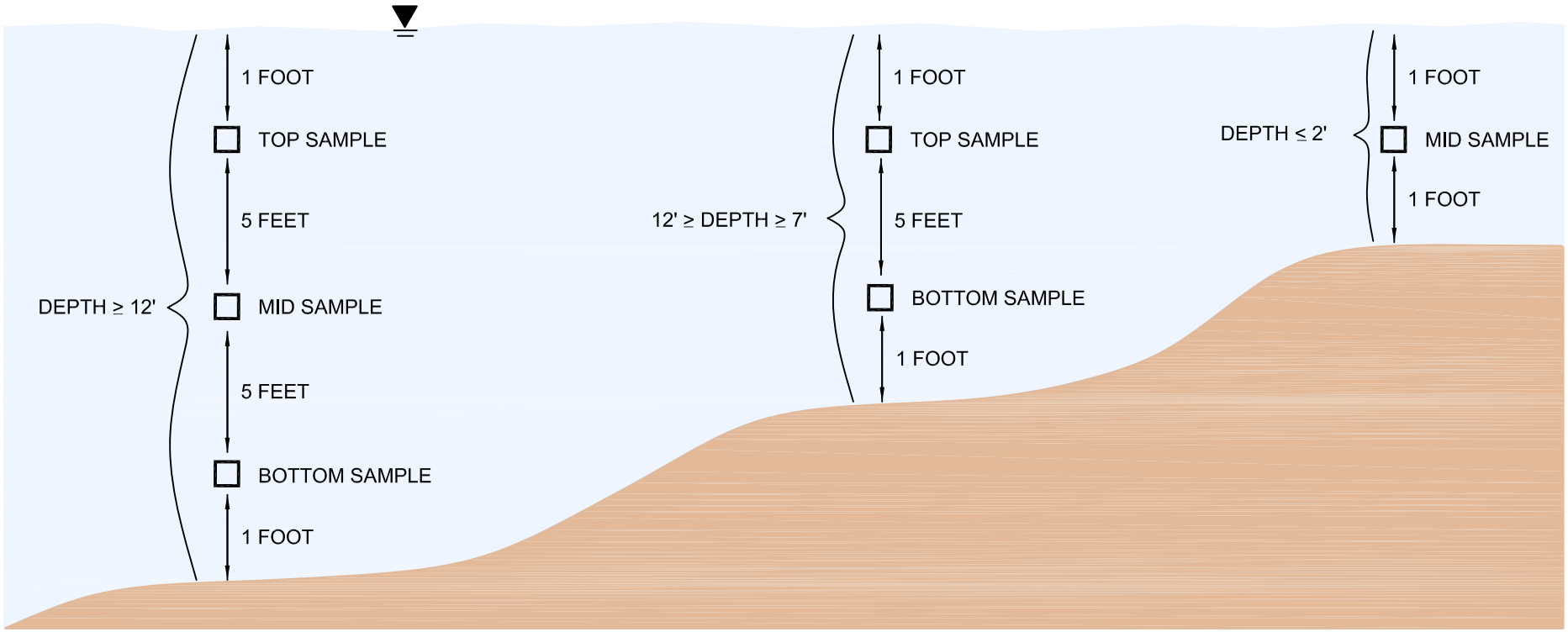
TABLES

Table 1
Sediment Trap Monitoring Station Geographical Coordinates

Station ID	Latitude (Degrees N NAD 83)	Longitude (Degrees W NAD 83)
'RAA-ST-1'	122.7542911	45.57889639
'RAA-ST-2'	122.7588663	45.58056284
'RAA-ST-3'	122.7610736	45.58152637

Notes:
Monitoring stations are proposed and may be revised based on conditions encountered in the field

FIGURES



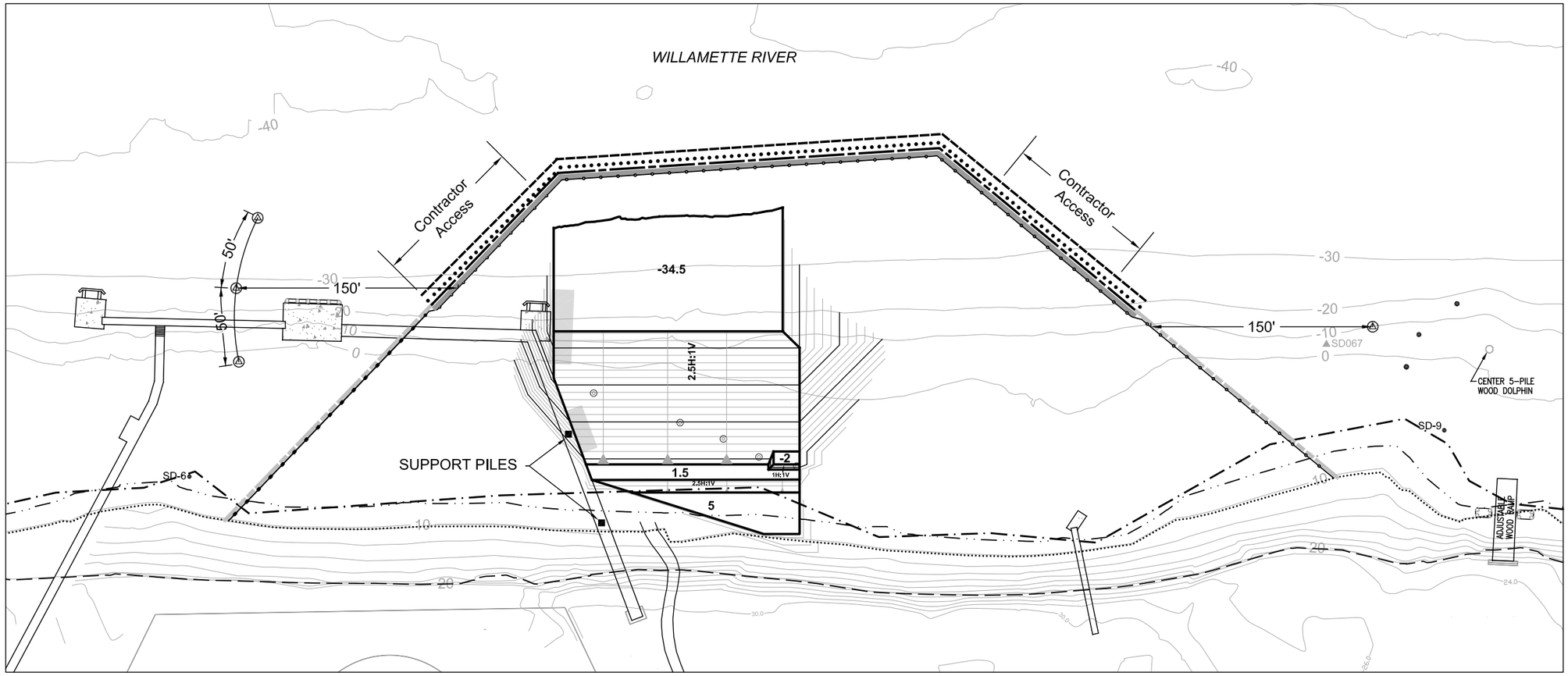
NOTES:

1. MONITORING LOCATIONS WILL BE 100' UPSTREAM AND DOWNSTREAM FROM EDGE OF CONTAINMENT BARRIER.
2. MONITORING METHODS CONSISTENT WITH SIMILAR PROJECTS IN REGION WITH OREGON WATER QUALITY CERTIFICATES (DEQ 2000)

Jan 19, 2005 7:54am cdavidson K:\Jobs\000029-GASCO\00002902\00002902-55.dwg FIG D-1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure D-1
Schematic Showing Water Quality Monitoring Depths
NW Natural "Gasco" Site



LEGEND:

- 1.5 — Dredge Prism And Dredge Elevation
- Property Line
- OHWw = 20.41 Ft NAVD 88
- OLW = 7.91 Ft NAVD 88
- 50% River Stage Elevation = 10.23 Ft NAVD 88
- Oil Absorbent Boom (mobile)
- Full Length Silt Curtain (anchored)
- Oil Containment Boom With Skirt (2 Ft) (mobile)
- Partial Length Silt Curtain (anchored)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (to Be Removed Before Dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles
- Water Quality Location

0 80
Scale in Feet

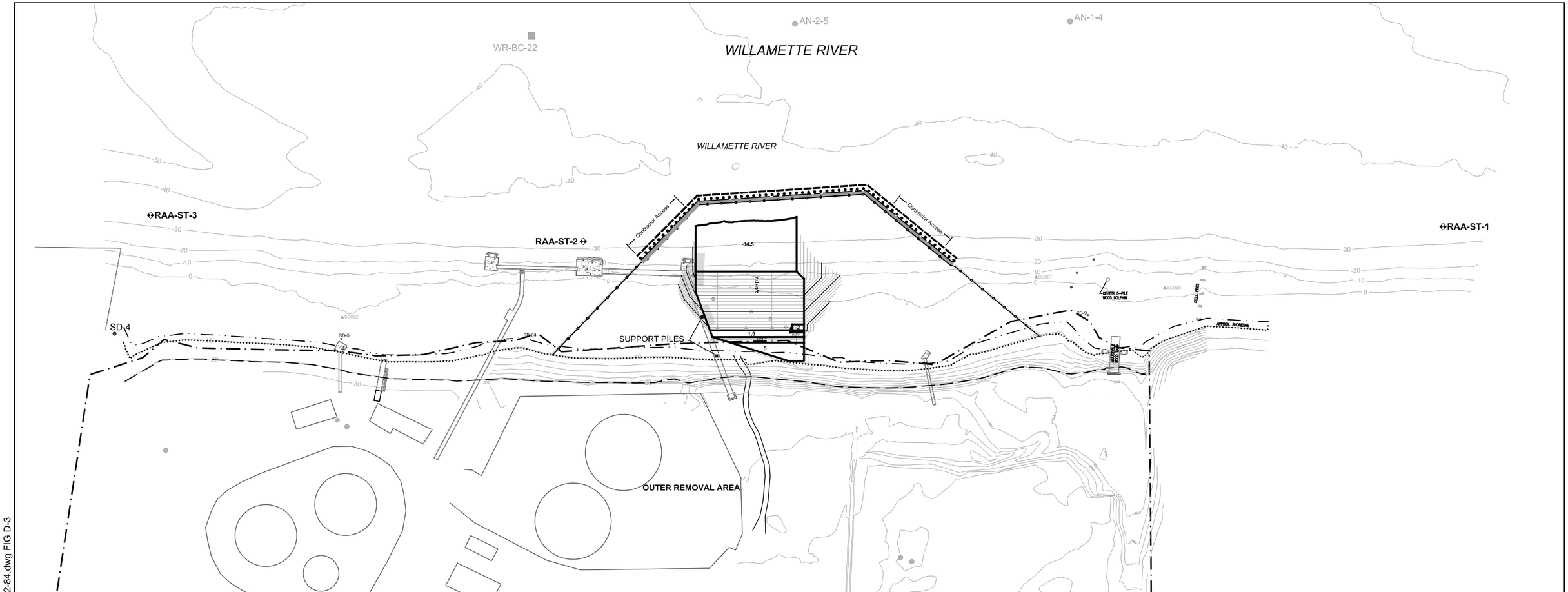
Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site Study (2003).
2. Upland topography directed by anchor environmental as part of upland investigation (2002)
3. Horizontal datum: Oregon State Plane North NAD 83 (ft).
4. Vertical datum: NAVD 88 (feet).
5. Former drainage ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.

Jul 26, 2005 4:12pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-86.dwg FIG D-2

ANCHOR ENVIRONMENTAL, L.L.C.

Figure D-2
Typical Water Quality Monitoring Locations for Field Measurements
NW Natural "Gasco" Site



LEGEND:

- 1.5 — Dredge Prism And Dredge Elevation
- Property Line
- OHWw = 20.41 Ft NAVD88
- OLW = 7.91 Ft NAVD 88
- 50% River Stage Elevation = 10.23 Ft NAVD 88
- Oil Absorbent Boom (mobile)
- Full Length Silt Curtain (anchored)
- Oil Containment Boom With Skirt (2 Ft) (mobile)
- Partial Length Silt Curtain (anchored)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (to Be Removed Before Dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles
- RAA-ST-1 — Sediment Trap Location and Number

0 150
Scale in Feet

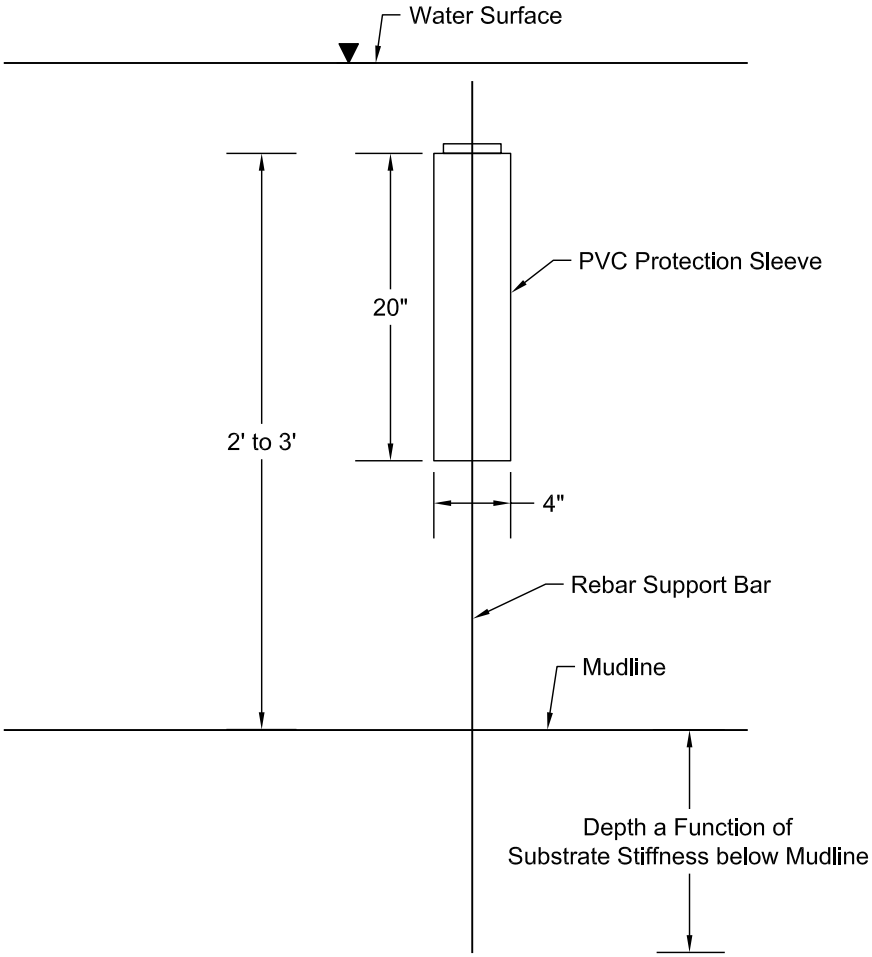
Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site Study (2003).
2. Upland topography directed by anchor environmental as part of upland investigation (2002)
3. Horizontal datum: Oregon State Plane North NAD 83 (ft).
4. Vertical datum: NAVD 88 (feet).
5. Former drainage ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.

Jul 26, 2005 4:07pm dholmer K:\Jobs\000029-GASCO\0000290\0000290\0002902-84.dwg FIG D-3

ANCHOR ENVIRONMENTAL, L.L.C.

Figure D-3
Sediment Trap Monitoring Station Locations
NW Natural "Gasco" Site



Jun 30, 2005 1:27pm cdavidson K:\Jobs\000029-GASCO\00002902\00002902-89.dwg FIG D-4

ANCHOR ENVIRONMENTAL, L.L.C.

Figure D-4
Sediment Trap Construction Schematic
NW Natural "GASCO" Site

ATTACHMENT D-1

WATER QUALITY MONITORING FORM

ANCHOR ENVIRONMENTAL, L.L.C.

1423 3rd Ave., Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287-9131
www.anchorenv.com

Water Quality Monitoring Form

Station ID:		**Date:**	**Time:**
Project Name:		**Project Number:**	
Coordinates Datum:			
Lat/Northing:		Long/Easting:	
Weather/River Stage/Flow Observations: Status/Description of Operation at Time of Sampling:			
Depth to Bottom: _____ (m)			
	Dissolved Oxygen (mg/L)	Temperature (C)	Turbidity (NTU)
Depth 1: ____ (m)			
Depth 2: ____ (m)			
Depth 3: ____ (m)			
Other:			
Evidence of floating or suspended materials:			
Evidence of oil/hydrocarbon sheen: (Thickness, contiguous?, size, rate of dissipation)			
Discoloration and Turbidity:			
Velocity at stated depth:			
Color:			
Odor:			
Other Observations:			
Comments:			
Recorded by:		Other Monitoring Personnel:	

ATTACHMENT D-2

SURFACE SEDIMENT FIELD SAMPLE RECORD FORM

ANCHOR ENVIRONMENTAL, L.L.C.

Surface Sediment Field Sample Record

Collection Date:
Shipping Date:

Project Number:

Project Name: Gasco - Post Removal Sediment Characterization **Station ID:**

Sampling Crew: _____

Sampling Vessel: _____ Sampling Method: _____

Subcontractor(s): _____

Station Coordinates: N / Lat. _____ Weather: _____

E / W / Long. _____

Datum: NAD 83 / WGS 84 Zone:

Sample Number: _____

Analysis: Metals / BNAs / VOCs / PCBs / Pest / Herb / TBTs / Diox-Furans
TS / Grain Size / TOC / TVS / Ammonia / Sulfides
(Circle Appropriate Analyses)

Field Test Results Comments: _____

Salinity: _____ ppt

Ammonia: _____ mg/L

Grain Size: ml Coarse: _____ ml Fines: _____

Grab Number: _____ Water Depth:_____ Penetration/Sampled Depth: _____ Time: _____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Grab Number: _____ Water Depth:_____ Penetration/Sampled Depth: _____ Time: _____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Grab Number: _____ Water Depth:_____ Penetration/Sampled Depth: _____ Time: _____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Grab Number: _____ Water Depth:_____ Penetration/Sampled Depth: _____ Time: _____

Bioassay / Chemistry (circle) AVS/SEM; Total Sulfides; VOC Sample (circle)

Sediment Type:	Sediment Color:	Sediment Odor:		Comments:
cobble	D.O.	none	H2S	
gravel	gray	slight	Petroleum	
sand C M F	black	moderate	other:	
silt clay	brown	strong		
organic matter	brown surface	overwhelming		

Recorded by:_____

APPENDIX E

REMOVAL ACTION ENVIRONMENTAL PROTECTION PLAN

APPENDIX E

REMOVAL ACTION ENVIRONMENTAL PROTECTION PLAN
FINAL DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for Submittal to

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.

6650 SW Redwood Lane, Suite 110

Portland, Oregon 97224

On behalf of

NW Natural

220 NW Second Avenue

Portland, Oregon 97209

July 2005

1 INTRODUCTION 1

2 ACTION TRIGGERS AND ENVIRONMENTAL CONTROLS REFINEMENT PROCESS 2
2.1 Action Triggers 3
2.2 Notification Requirements 5

3 ENVIRONMENTAL CONTROLS AND BEST MANAGEMENT PRACTICES 6
3.1 Sheen and Spill Prevention and Response 6
3.2 Dredging 9
3.2.1 Containment Barriers 9
3.2.2 Operational Controls 13
3.2.3 Dredging Equipment 15
3.2.4 Piling Related Controls (Standard Controls) 15
3.2.5 Fish Protection Measures 16
3.3 Barge Loading 17
3.4 Barge and Dredge Decontamination 19
3.5 Sediment Drying Agent Addition and Mixing 20
3.6 Material Transferal at the Transfer Facility 22
3.7 Fringe Cover and Pilot Cap Placement 25

4 OTHER PROTECTIVE MEASURES 27
4.1 Protection of Land Resources 27
4.2 Disposal 27
4.3 Protection of Fish and Wildlife 27
4.4 Dust Control 28

5 WATER QUALITY ANALYSIS 29
5.1 Physical and Chemical Characteristics 30
5.2 Biological Characteristics 30
5.3 Special Aquatic Sites 30
5.4 Human Use Characteristics 30

6 REFERENCES 31

List of Tables

Table E-1 Water Quality Triggers for Additional Environmental Controls

List of Figures

Figure E-1 Inner Removal Area – Non-Rigid Containment Configuration

Figure E-2 Outer Removal Area – Non-Rigid Containment Configuration

Figure E-3 Construction Detail of Silt Curtain

Figure E-4 Inner and Outer Removal Area Anchoring Schematic

Figure E-5 Outer Removal Area – Partial Depth Curtain and Bedload Baffle Curtain

Figure E-6 Construction Detail of Bedload Baffle

List of Attachments

Attachment E-1 – Quantitative Water Quality Analysis

Attachment E-2 – Notification Process Flow Chart

1 INTRODUCTION

This document presents the Draft Final Removal Action Environmental Protection Plan (RAEPP) for the "Gasco" Site (Site) Removal Action (Project) being conducted by NW Natural. It is one part of the Draft Final Removal Action Project Plan (RAPP) for the Project. The objective of this RAEPP is to minimize potential short-term impacts to the environment during construction. The RAEPP identifies the environmental controls and Best Management Practices (BMPs) that will be implemented (as well as contingency measures and additional controls that may be implemented should specific circumstances arise) to minimize adverse short-term impacts of the removal action. The RAEPP also defines the water quality measurements and action levels that will be used to assess water quality impacts and trigger additional contingency measures, if necessary. The Construction Water and Sediment Monitoring Plan (WSMP)—Appendix D of the Final RAPP will be used in conjunction with the RAEPP. The WSMP describes the water quality measurements, monitoring methods, and data collected that will be used in the assessment process described in this RAEPP.

Construction operations covered by this RAEPP include dredging (and related activities such as piling removal and silt curtain monitoring), barge loading, sediment drying procedures, transfer of dredged materials to upland transport, upland transport, and placement of fringe cover and pilot cap at the Site after dredging is complete. Henceforth, these construction phases will be referred to as dredging, sediment drying, barging, transferring, upland transport, and cover/cap placement. These construction operations are described in detail in the RAPP and Transportation and Disposal Plan (TDP) (Appendix A of the RAPP).

2 ACTION TRIGGERS AND ENVIRONMENTAL CONTROLS REFINEMENT PROCESS

Section 3 of this RAEPP describes environmental controls and BMPs (hereafter referred to together as controls) that will be employed during construction to minimize short-term environmental impacts. There are two general types of controls considered, which are defined as:

- Standard – controls that are typically employed during contaminated sediment removal projects and will be employed at all times during the applicable operation regardless of any water quality measurements or other observations regarding environmental impacts. These controls are intended to minimize those potential impacts that might otherwise be expected without such controls.
- Project Specific – controls that have been selected specifically for the conditions of this project based on EPA and partner agency comments regarding concerns about potential water quality and other impacts. These controls will be employed at all times during the applicable operation regardless of any water quality measurements or other observations regarding environmental impacts.
- Additional – controls that will be employed as contingency measures if and when certain specific conditions are measured (e.g., water quality results per the WSMP) or observed. These additional controls are intended to minimize any potential impacts if they occur despite the use of standard and project specific controls. Generally, additional controls are implemented in a step-wise and issue-specific fashion as may be needed to reduce any potential impacts that may be measured or observed.

The primary method of determining the need for additional controls is through results evaluation of the water quality measurements and observations described in the WSMP. The determination of the need for additional controls as described in this section is consistent with the substantive requirements of Clean Water Act, Section 401 Water Quality Certification in the State of Oregon. The evaluation methods and triggers for additional controls have been developed through review of recent water quality certificates issued for dredging and contaminated sediment remediation projects in the Columbia and Lower Willamette Rivers (see Section 5 for details) as well as specific comments from EPA and partner agencies.

2.1 Action Triggers

The water quality results that will trigger the implementation of additional environmental controls and other contingency actions are shown in Table E-1. Should the results of the monitoring indicate an exceedance of any of the water quality triggers, the WSMP describes the additional monitoring, notification, and reporting requirements. The additional controls and other contingency actions that are summarized in Table E-1 and discussed in Section 3 will be implemented in a stepwise and issue-specific fashion until the exceedance is no longer observed.

In addition, when an exceedance is observed and additional controls are applied, monitoring will be conducted (field or laboratory parameters, whichever were exceeded) after the full resumption of the operation with the new additional controls in place. If exceedances continue to occur, the same process will be repeated after the implementation of another round of additional controls. This monitoring will be in addition to the standard monitoring frequency described in the WSMP.

Section 3 describes the additional controls that can be implemented to reduce potential water quality impacts that may be indicated by trigger exceedances.

In addition, the WSMP calls for visual monitoring of the project area during all operations. If any of the following are observed, this will also constitute a trigger for additional controls:

- Observations of high turbidity that might reasonably result in exceedance of triggers in Table E-1. (In this case, these visual observations will be first verified through additional monitoring and compared to the quantitative levels in Table E-1.)
- Distressed or dying fish or birds inside or outside containment barriers (see Section 3.2.5 for additional controls specific to this situation).

Use of these action triggers allows, on a temporary basis (during construction), exceedances of the water quality levels described above within containment barriers and/or 150 feet outside the primary (silt curtain) barriers for field and laboratory chemistry parameters. In addition, as noted in Table E-1, additional controls will be implemented if a second exceedance of a field parameter is observed 30 minutes after the first exceedance. This

procedure allows temporary exceedances of field parameters more than 150 feet from primary barriers, but only for durations of 30 minutes or less.

A water velocity trigger of 1.0 feet per second (fps) will be used to determine the need for ceasing operations at the removal area due to potential loss of silt curtain effectiveness. Exceedance of the water velocity trigger does not indicate potential water quality impacts, which are instead measured through the other parameters noted above. Rather, water velocity of 1.0 fps is a trigger to ensure that silt curtains are operating effectively while removal actions are taking place and should ensure that potential water quality impacts are avoided.

Laboratory chemistry parameters have triggers for both chronic and acute guidelines. The procedures for exceeding these two values differ. If chronic guidelines are exceeded, then the proper implementation of standard controls will be checked, confirmed, and/or reestablished, as necessary. In addition, the monitoring frequency for laboratory chemistry parameters will increase to once per day until the exceedances are no longer observed. If exceedances of the chronic guidelines persist for more than four days, then additional controls will be implemented. If acute guidelines are exceeded, then additional controls will be implemented where the activities associated with the exceedance are still being conducted in a similar manner. Laboratory analysis will be conducted on a rush turnaround schedule (i.e., results will be available in 3 days).

The WSMP includes monitoring at the base of the silt curtains during the in-water construction activities to determine whether materials are escaping beneath the silt curtain and migrating along the mudline. If substantial presence of tar particles or dense oils is found through visual observations or monitoring, then additional controls noted in Section 3 will be implemented. In addition, the WSMP includes monitoring of sedimentation in the vicinity of the Site before and after the in-water construction activities to monitor the effectiveness of the silt curtain containment system. This type of monitoring is meant to evaluate project-wide changes in sedimentation and therefore will not be used as a real-time method for implementing contingency actions.

2.2 Notification Requirements

The overall notification information flow is shown in Attachment E-2 for any water quality exceedances, issues with environmental controls, and/or construction issues that potentially impact the effective and environmentally protective performance of the project. EPA will be notified in the event of any water quality exceedances as specified in the WSMP. This includes both immediate verbal notifications where the EPA field representative is on-site and daily as well as weekly written notifications to EPA. Also, the Project Coordinator will notify EPA of any additional controls and monitoring that were triggered and employed to minimize potential for water quality impacts. Notification will take place on the same day that such additional controls or monitoring were conducted as a part of the daily report.

3 ENVIRONMENTAL CONTROLS AND BEST MANAGEMENT PRACTICES

All operations will be conducted employing standard environmental controls and best management practices (controls) that minimize the potential for water quality impacts. Additional controls (contingency measures) will be implemented where the water quality triggers defined in Section 2 have been exceeded. The standard, project specific, and additional controls for each of the major operations for this removal action construction are discussed below. Under each operation, each potential control is identified as either a standard, project specific, or additional control.

As noted in Section 2, the approach to employing additional controls is a stepwise procedure. Where a water quality exceedance occurs, every potential additional control is not employed simultaneously. Rather, the approach is to examine the current operations and identify the most likely causes of the water quality exceedances measured. Thus, it may be possible to link exceedances to specific practices or issues associated with one aspect of the operation. In this case, a single additional control targeted to address the specific issue may eliminate the water quality problem. Where the implemented additional controls fail to improve water quality (as measured by additional monitoring events as noted in Section 2), then more broad scale or active control measures may be indicated.

3.1 Sheen and Spill Prevention and Response

For all operations, a spill response team will be notified and on standby over the course of the operations. The spill response team will have available for use at the site an oil skimming boat, additional absorbent booms, and absorbent pads.

Curtain Opening Procedures (Project Specific Control) – Several levels of containment barriers will be present during the inner and outer removal operations and are described in the next section. These barriers will provide complete containment of the removal area. Occasionally it may be necessary to open the access "door" within the primary containment barrier to allow the passage of equipment and/or personnel. In these situations, all dredge work within the primary silt curtain containment will be stopped before the access door is opened and will not recommence until the door is closed. In addition, the area inside the containment barrier(s) will be observed. If sheen is present inside the outer skirt and boom, oil absorbent booms and pads will be used to remove the sheen before this outer barrier is

opened to prevent release of sheen or floating material. Similarly, if substantial turbidity exists within the silt curtain, operations will stop to allow larger solids to settle before opening the silt curtain. The goal in this case is not to achieve water clarity, but rather allow a brief period of time for settling to occur and decrease turbidity.

Dredge Derrick Spill Prevention Inspection (Standard Control) – Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., shall be checked regularly for drips or leaks, and shall be maintained in order to prevent spills into river water.

Transfer Facility Spill Prevention (Standard Control) – A spill apron will be constructed at the transfer facility to prevent spilling of drying reagent or material into the river water. In addition, material will be transferred from the barge to an upland hopper at the transfer facility to minimize spilling that may occur via direct transfer to trucks.

Sheen Contingency Response (Additional Control) – Deployment of additional booms and absorbent materials will be triggered if any project related sheen is observed outside the outer standard perimeter controls (per the triggers in Section 2). In addition, if substantial sheen is observed operations will cease until sheen outside containment barriers can be removed and any further loss of material beyond the containment barriers can be stopped. Booms and absorbent materials will be kept on derricks or barges in a clean dry location and be present at the site at all times for ready deployment. As these materials are used, they will be replaced immediately and stored in similar locations. If the amount of padding or booming needed is too large to store completely on derricks or barges, some of these supplies may be stored in a clean, dry location nearby on the shoreline.

Spill Response (Additional Control) – If substantial oily releases or free product is observed, the spill response boat will be deployed and standby in the event that this material cannot be contained and removed inside the perimeter controls. The Oregon Department of Environmental Quality (DEQ) Spill Response Team (Northwest Region/Portland: (503) 229-5614) will also be notified. If a barge accidentally spills (e.g., turns over, breaks, collides with something) the following will immediately occur:

- Once equipment is under control and safety of personnel is ensured, the tug operator will note the exact area of the spill by recording GPS coordinates and visual notes

(e.g., 300 yards upstream of such and such). The operator will also note to the best of his or her ability the approximate quantity of material lost (e.g., 25 percent of barge load).

- If substantial oily releases or free product is present on the water the tug operator will notify the Construction QA officer and/or the spill response team immediately via radio or cell phone. The Oregon Emergency Response System (OERS) will be contacted at 1-800-452-0311. The National Response Center will be notified if the release exceeds a reportable quantity.
- As notified, the spill response team will deploy booms, absorbent materials, etc and operate oil skimming boats as necessary to contain the sheen/floating oil to the extent practicable. Cleanup will be completed as soon as possible and take precedence over normal site related activities.
- The CQAO will notify EPA and arrange for a site meeting and determination of further actions.
- In consultation with appropriate agencies, further actions may include conducting bathymetry or other testing in the spill area to determine location of spilled material, dredging up spilled material for reloading onto another barge, or subsequent monitoring of the site after dredging. Depending on the quantity or nature of the spill some of these actions may not be necessary or other actions may be warranted.

If a truck accidentally spills (e.g., collision during transport, turns over) the following will immediately occur:

- Once safety of personnel is ensured, the truck driver will estimate to the best of his or her ability the approximate quantity of material lost (e.g., 25 percent of barge load).
- The driver will notify the Oregon Department of Environmental Quality, the National Response Center (if the release exceeds a reportable quantity), the Construction QA officer and/or the spill response team immediately via radio or cell phone.
- The spill response team will deploy booms, absorbent materials, etc. as necessary to contain the material to the extent practicable. Cleanup will be completed as soon as possible and take precedence over normal site related activities.

- The CQAO will notify EPA and arrange for a site meeting and determination of further actions.
- In consultation with appropriate agencies, further actions may include conducting testing in the spill area to determine the extent of the spilled material (if not on paved surfaces) and removing all affected materials. Depending on the quantity or nature of the spill, some of these actions may not be necessary or other actions may be warranted.

3.2 Dredging

A bucket dredge will be used to remove the tar body using a water-based derrick. Dredged material will be placed in a barge for subsequent transport. Dredging methods are described in detail in the RAPP.

Dredging controls are separated into three main categories: containment barriers, operational controls, and types of dredging equipment. The efficacy of each of these controls is related to site-specific variables (e.g., sediment physical properties and water currents). Each of the types of controls is discussed more in the following sections. In addition, removal of remnant pilings will be necessary before dredging operations. Controls for piling operations are discussed in Section 3.2.4.

3.2.1 Containment Barriers

Inner and Outer Area Containment Systems (Project Specific Controls) – As described in the RAPP, the area of removal has been subdivided into two areas (the inner removal area and outer removal area) based on the feasibility of installing the containment barriers (see Figures E-1 and E-2). A construction detail for the silt curtain, a schematic of the anchoring system for the inner and outer removal areas, and a schematic of the outer removal area are shown in Figure E-3, E-4, and E-5, respectively. In addition, a schematic of the bedload baffle construction is provided in Figure E-6.

The primary standard and project specific controls for the inner removal area (presented in order from shoreline outward) include:

- Inner mobile floating oil absorbent boom to capture buoyant substances (project specific)

- Middle silt curtain extending down to the mudline to capture suspended sediments and related materials and prevent bedload movement (project specific). A construction access door will be located along the portion of the silt curtain parallel to shore (an example location is shown in Figure E-1). Barges will be loaded across the middle silt curtain barrier with spill plates in place as detailed below under "holding and movement of barges."
- Outer bedload baffle extending from the mudline upward 12 feet into the water column around the foot print of the dredge prism in the channel to help further contain any particulates within the dredge area (project specific).
- An outer bubble curtain extending outward around all transfer and haul barges, which is expected to deter movement of fish into the area as well as help reduce turbidity (if present) moving out of the area (project specific).
- An outer oil containment boom with a skirt extending 2 feet below the water surface to capture any floatables (project specific).

The primary standard and project specific controls for the outer removal area (presented in order from shoreline outward) include:

- Inner mobile floating oil absorbent boom (project specific).
- Inner bedload baffle extending from mudline upward 12 feet into the water column (project specific).
- Middle silt curtain anchored flush to the mudline along portions of the upstream and downstream areas with the remaining upstream, downstream and channel ward portions of the curtain extending to within approximately 2 feet from the mudline (project specific). Construction access doors will be located on the upstream and downstream legs of the silt curtain (as shown in Figure E-2). Barges will be loaded inside all containment devices as detailed below under "holding and movement of barges."
- An outer bubble curtain which is expected to deter movement of fish into the area as well as help reduce turbidity (if present) moving out of the area (project specific).
- An outer oil containment boom with a skirt extending 2 feet below the water surface to capture any floatables (project specific).

The silt curtain design for the inner removal area (Figure E-1) will be fabricated with permeable fabric on the upstream and downstream side to minimize the direct impact of currents, and impermeable fabric on the channel ward side. The anchoring system was designed to be robust and maintain the curtains in place during expected summer/fall water velocities, which should be well below the design limit of 1 fps (see Figure E-4). A bedload baffle will be placed around the outer extent of the dredge prism, while the inner removal is taking place, to ensure that any loose material generated is confined to the dredge area when the inner silt curtain is removed in preparation for dredging in the outer removal area. This bedload baffle will be the last portion of the inner containment to be moved in preparation for removal in the outer area.

The silt curtain design for the outer removal area (Figure E-2) was modified due to the high water depths and high water velocity forces. The silt curtain subcontractor that will be used on this project has substantial experience at other sites and estimates that current forces would be too great in these depths of water for silt curtains feasibly to contact the bottom. The risks of attempting to deploy such a system include dragging and loss of the curtain and/or ripping of the curtain. Therefore, following completion of the removal within the inner area, the channel ward portion of the inner area full length curtain will be removed to allow the containment area to be enlarged further into the channel using partial length curtains extending to approximately 2 feet above the mudline. Partial length curtains will be anchored to the upstream and downstream channel ward extents of the permeable full length silt curtain used during the inner area removal. The upstream and downstream partial length curtains will be permeable to minimize the direct impact of currents, and impermeable fabric will be used on the channel ward side. A bedload baffle will also be used in the outer removal area and will extend 12 feet above the mudline creating a minimum vertical overlap of approximately 10 feet between the baffle and the adjacent partial length curtain (see Figure E-2). Due to the anchoring methods for the silt curtains and proper separation placement between silt curtains and bedload baffle, there appears to be little potential for interference between the top of the bedload baffle and the bottom of the silt curtain during movement caused by river currents.

Placement of containment barriers around the outer removal area will limit the access of fuel barges to the dock. NW Natural will limit the use of the dock to large vessels during the late August to early October time frame to limit potential conflicts with use of the dock during the removal activities. For the inner area dredging, barge docking will be controlled with additional tugs as needed to avoid propwash affecting the full length silt curtain. In addition, the outer floating skirt, which is easily moved as compared to the silt curtain, will be moved aside at docking times.

Cease/Modify Operations in High Currents/Waves (Additional Control) – Currents will be monitored regularly as described in the WSMP (Appendix D). If currents exceed 1.0 fps, operations will stop until currents are again below this velocity. In addition, visual monitoring of wave conditions and action will be conducted throughout the removal. Any wave conditions that visibly compromise floating skirts and/or booms will also trigger limiting or stopping operations until either wave conditions calm or controls can be deployed in an effective manner under those conditions.

Containment Monitoring and Correction (Standard Control) – In addition to the monitoring described above, at all times the curtains and other containment features will be observed for proper deployment, effectiveness, signs of unacceptable sailing or dragging, and if the containment features are not properly deployed, work will be stopped until they can be corrected. The same divers who installed the silt curtains will conduct weekly underwater inspections of the silt curtains and other underwater containment systems. The frequency of regular diver inspections may be increased or decreased in consultation with EPA. If topside monitoring of the containment identifies a significant maintenance issue or if water quality monitoring identifies a plume of unclear origin, divers will be mobilized to inspect the curtains and other containment features and make any necessary repairs.

Curtain Opening Procedures (Project Specific Control) – Occasionally it may be necessary to open the access "door" within the primary containment barrier to allow the passage of equipment and/or personnel. In these situations, all dredge work within the primary silt curtain containment will be stopped before the access door is opened and will not recommence until the door is closed. In addition, the access door will not be

opened if substantial turbidity or sheen (assessed visually) is present within the primary silt curtain containment, and in this case, the operation will pause with the door closed for a sufficient period to allow larger solids materials to settle before the door is opened.

3.2.2 Operational Controls

Operational controls are methods of using and deploying dredging equipment that can minimize the resuspension and loss of materials to the water column. Types of dredging operational controls are discussed below.

No Multiple Bites (Standard Control) – When the clamshell bucket takes multiple bites, the bucket loses sediment as it is reopened for subsequent bites. Sediment is also released higher in the water column, as the bucket is raised, opened, and lowered. Multiple bite techniques will not be allowed on the project.

No Bottom Stockpiling (Standard Control) – Bottom stockpiling is when material is dredged and then temporarily placed on the bottom prior to final removal to the barge. This increases the handling of the sediment with each step potentially causing more material loss to the water column. Bottom stockpiling will not be allowed on the project.

No Dragging of the Dredge Bucket (Project Specific Control) – In some maintenance dredging projects the bucket can be dragged along the bottom in order to determine the "high spots" in the dredge prism. This practice will not be employed at this site because it may cause additional material resuspension.

No Lateral Movement of the Dredge Bucket Under Water (Project Specific Control – The bucket will be lifted straight up and down through the water column and not move extensively laterally through the water column, which can increase material resupsension.

Pausing before Opening Silt Curtains (Project Specific Control) – The silt curtain may need to be opened during transition of removal activities conducted within the inner and outer removal areas (see Figures E-1 and E-2, respectively) to facilitate equipment exchange and/or personnel entry. Before silt curtains are opened or moved, all dredge

work will cease to allow some resettling of suspended sediments within the silt curtain area. No work will be conducted while the silt curtain door is open. The appropriate settling period will vary depending on the silt content and other properties of the sediment and will be judged through visual observations or turbidity measurements, if necessary. The intention of this control is not to achieve pristine or clear water within the silt curtain area, which may take hours or even days. Rather, it is intended to simply allow some gross settling of larger grain size materials. Work will not recommence until the door is closed.

Spill Apron (Project Specific Control) – Spill plates and aprons will cover the area below the path of the bucket to prevent dropping any dredge material or drying reagent into the water when the dredge bucket swings over water between the containment area and the transfer barge or from the transfer barge to the haul barge with either dredge material or drying reagent. The spill plates and aprons will drain into one of the barges at the removal Site. No water will be allowed to enter the river. The barges are water tight and scuppers will be sealed when the barge is in transit between the removal site and the offloading facility. While dredged material is being loaded into the transfer barge, return water will be directed only into the fully contained removal area and solids will be retained in the barge as described in Section 3.3.

Increased Cycle Time (Additional Control) – Cycle time refers to the time it takes for the bucket to be deployed, recovered, moved to and from the haul barge, and returned to the sediment bed. Longer cycle time is achieved by reducing the velocity of either the ascending loaded bucket or descending empty bucket through the water column. Limiting ascension velocity can reduce the potential for washing of sediment from the bucket. In addition, pausing at the surface of the water before movement through the air and to the barge can also reduce the amount of water laden sediment that washes from the bucket. Limiting the descending velocity reduces the impact of the bucket on the bottom, which can cause resuspension. However, limiting the velocity of the descending bucket reduces the volume of sediment that is picked up with each bite and requires more total bites to remove the same material, which can cause more overall resuspension. Consequently, if needed, descending velocity should only be limited to the extent that relatively full buckets can be obtained for each bite. Sediment

resuspension can also be reduced by pausing the bucket at bottom after impact and before digging.

Reduce or Stop Dredging during Peak Currents (Additional Control) – Because of the short construction window, dredging will initially proceed at all daylight hours. However, high flows or tidal exchange periods can result in higher currents that carry any resuspended material further downstream. If it is found that water quality exceedances occur during periods of higher currents, an additional control may be to reduce the amount or rate of dredging or completely stop dredging until current velocities decrease.

Dredging During Night Time Hours – Dredging operations will be confined to daylight hours.

3.2.3 Dredging Equipment

Closed Dredge Bucket (Project Specific Controls) – A closed cable arm bucket will initially be used for dredging at the project. However, as noted in the RAPP, there is some doubt whether this technology will be able to dredge this material efficiently and may actually increase the rates of suspension depending on the stiffness of the material encountered. The closed bucket will be used until such time it is determined that it cannot dredge the material efficiently and or unacceptable or exacerbated resuspension appears to be occurring. If such conditions persist, a standard clamshell bucket will be used instead. Also, if bucket efficiency appears to be the source of any water quality exceedances, a larger capacity bucket may be employed. Throughout the project, the most effective bucket will be selected for the particular materials encountered throughout the dredge prism.

3.2.4 Piling Related Controls (Standard Controls)

Standard controls for piling removal will include:

- Pulling rather than digging out pilings
- All piling removal inside all containment barriers noted above.

Digging for piling stubs will be avoided, if possible. Any woody debris that is lost to the water will be captured and removed from the water.

3.2.5 Fish and Bird Protection Measures

Fish and bird protection measures apply to threatened and endangered species, non-listed fish species, and other species of interest to particular parties such as lamprey and sturgeon.

Measures to Protect Fish from Entrapment (Project Specific Control) – When the silt curtain is closed, entrapment of fish could occur within the curtain, but is not expected to be likely. Seining will be use to remove fish from within the containment barrier before it is closed and dredging begins. Several beach seine nets will be deployed to remove fish from the shallow water, and a research-size purse seine will be deployed from the dock to remove fish from deeper water. Additional nets may be deployed periodically when the silt curtain is opened to allow occasional passage of any equipment during the project. In addition, an outer bubble curtain will be deployed and operated whenever dredging is underway or curtain access doors are temporarily opened. This will also deter fish from entering the general project area or any temporarily opened contained areas. These measures should ensure that fish have not entered the contained area during operations. Any captured fish will be contained in an aerated tank and released outside of the action area.

Cease Operations If Distressed or Dying Fish or Birds Observed and Methods for Recommencing Work (Additional Control) – In the event that distressed or dying fish or birds are observed, all work will stop and the fish or birds will be collected and examined. If such species are endangered or threatened initial notification will be made to the NOAA Fisheries Law Enforcement Office located at Vancouver Field Office, 600 Maritime, Suite 130, Vancouver, Washington 98661; telephone: (360) 418-4246 and U.S. Fish and Wildlife.

Care will be taken in handling sick or injured specimens to ensure effective treatment. Handling of dead specimens will take care to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or

injured endangered and threatened species or preservation of biological materials from a dead animal, the CQAO will carry out instructions provided by NOAA Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

Work will not recommence until informal discussions with the Services can be held to determine appropriate actions. If non-listed species are found, then sonar and/or diver surveys (or visual surveys for birds) may be conducted of the area to determine whether fish are present, and if so where. Seining as described above will be employed to remove any living fish from the area before work recommences.

Measures to Protect Birds (Project Specific Control) **–** The presence of birds in the area will be routinely monitored. Birds persistently present within the containment or near the contained area will be hazed with sound or by physically approaching the birds so that they leave the area. Procedures when distressed or dying birds are found are noted above.

3.3 Barge Loading

No Release of Water Outside Silt Curtains (Project Specific Control) – The haul barges and transfer barges are watertight. While dredged material is being loaded into the transfer barge, return water will be directed only into the fully contained removal area. The haul barge will be sealed so there is no release of water from the barge in transit.

Barge Spill Control (Project Specific Control) **–** Spill plates and aprons will be employed to prevent material dripping (of either dredged material or drying reagent) from the swinging bucket from entering water outside the silt curtain. This includes plates and aprons between all barges including the transfer barge, drying reagent storage barge, and the haul barge. During removal within the inner removal area, all barges will be maintained within the secondary set of containment elements discussed in Section 3.2.1 and shown in Figure E-1. During outer removal, the transfer barge will be inside primary containment and all other equipment within the secondary set of containment elements as shown in Figure E-2.

Fill Barge to Only 85-90 percent Capacity/Rain Control (Project Specific Control) – In some types of dredging operations, the barge is overfilled with sediment so that additional water (and some associated sediments) are lost. This increases the sediment load in the barge. This practice will not be allowed for this project. To prevent any possible spillage, barges will be filled to only 85 to 90 percent capacity. In addition, this practice allows for rain to fall in the barge without causing a spill. Monthly average rainfall in Portland in September and October is 1.75 and 2.67 inches, respectively. One inch of rain (which might be expected under extreme conditions during the few days before a barge is unloaded) on the "CHETCO" haul barge (which has a 2,000 cy capacity, for example) would result in an approximate additional 1.6 percent volume of water in the barge. Consequently, filling barges to only 85 to 90 percent will allow more than enough volume to accommodate extreme rain events with no spillage. In these cases, additional drying agent would be added to address the extra free water.

Barge Inspection Before Hauling (Project Specific Control) – Once a haul barge is appropriately loaded and before it leaves the secondary containment the barge outsides will be inspected for any dredge or drying reagent material. If present, this material will be swept into the interior of the haul barge before leaving the secondary containment to ensure that no material could be spilled into the water in transit to the transfer facility. The material will be removed by sweeping as necessary either with our without additional water (e.g., river water from buckets or hoses) so that all material is forced into the haul barge. No wash water or swept material will be allowed to escape to the river

Alteration of Dredge Water Release Methods within Primary Containment (Additional Control) – If exceedances of water quality criteria are detected at the monitoring compliance points and it is determined that release of the dredge water back into the primary containment is a contributing significant factor to the observed exceedances, then one or more of the following additional controls will be applied:

- Reduce the rate of dredge water released from the transfer barge back into the primary containment
- Change the method of releasing water from the transfer barge back into the primary containment (e.g., using different collection points or methods, using overflow scupper(s) instead of pumping, etc.)

- Filtering water through filter fabric, hay bales, and/or similar devices before releasing water back into the primary containment.

If these measures are not successful in reducing water quality exceedances, then additional measures may be determined in consultation with EPA.

Limit Operations to Appropriate Weather (Additional Control) – If high river flows, wind, or storm events occur, operations should be limited to the extent necessary to prevent loss of materials. This may include ceasing operations where river waves or currents prevent the thorough control and precise movement of equipment and BMPs. In addition, the dredged material will be relatively heavy and moist, and not subject to wind loss even once drying reagent has been added. However, in the event that high wind conditions occur that could result in the movement of materials off the barges, work will be stopped and the barges will either be covered or dredge material rearranged on the barge such that wind loss of material is prevented. As noted above, the free capacity of the barges (all barges will be loaded to only 85 to 90 percent) will allow extra rainwater to enter the barge without any threat of overflow spillage (even in extreme storm events).

3.4 Barge and Dredge Decontamination

Decontamination Procedures (Project Specific Control) - Decontamination of the holding barges will be done at the completion of the removal activities. The transfer barge, used at the dredge site, will be swept and pressure washed and the remaining material and water will be loaded/pumped into the last haul barge going to the disposal transfer facility. On the last trip that each haul barge makes to the disposal transfer facility, the dredged material will be unloaded and the haul barge will be swept of all loose material, which will be placed in trucks and hauled to the disposal site. The barges will then be pressure washed and the collected water pumped to a baker holding tank (or similar type storage vessel) onshore for eventual trucking and disposal at either the local sanitary district (if permits can be obtained), a liquid contaminated waste disposal facility, or the 500 gallon above ground storage tank for DNAPL extraction system at the Gasco site. The contractor will perform a visual inspection of each barge before it leaves the transfer site to determine if all visible material has been removed. Given that the swing path of the transfer bucket is across the sediment drying storage barge there exists some potential for spillage to occur in the storage

barge. Any drying agent that is contaminated with dredge spillage will be removed to the final haul barge, prior to that haul barge leaving the site for the transfer facility. Following completion of the dredging and sediment drying addition, if substantial drying reagent remains in the barge, the sediment drying barge will be hauled to Hickey Marine, and the drying reagent will be recycled for future use. If minor amounts of drying reagent remain, they will be placed in the last haul barge going to the transfer facility.

Decontamination of the dredging, mixing, and upland transfer buckets will be done at the completion of the removal activities. In between barge loads, the buckets will not be decontaminated because their use will be dedicated to transfer of the Site material. At the completion of the removal, the dredging and mixing buckets will be pressure washed over the last haul barge prior to going to the offloading facility. The contractor will perform a visual inspection, if any residual material remains on the buckets, the buckets will be pressure washed repeatedly until the visible material has been removed. A similar procedure will be used on the upland transfer bucket at the time of pressure washing of the last haul barge at the transfer facility, as described above. Wastewater from this process will be handled as described above for the pressure washing of the haul barges at the transfer facility

3.5 Sediment Drying Agent Addition and Mixing

The following controls will be employed during the drying process.

Sediment Spill Protection (Standard Control) –

A spill apron will be constructed along the swing pathway of the bucket to prevent material from entering the water. In addition, the sediment drying barge will be placed within the swing path of the bucket such that it effectively acts as spill protection during rehandling of the material from the transfer barge into the haul barge. The bucket will not load across open water. Mixing will be performed entirely within the haul barge by a dredge bucket. Mixing will be conducted such that no material is piled beyond the height of the barge to avoid the potential for material to overtop into the river. Mixing will be conducted continuously during filling of the haul barge so that the sediment drying reagent is mixed throughout the entire volume of removed material. Following confirmation that the material consistently passes the paint filter test (or determination that it will likely pass after

transit time to the transfer facility), the contractor personnel will conduct a walk around to ensure that no material or drying reagent has settled on the barge deck with a potential to enter the river while in transit to the transfer facility. Any such material found will be swept into the interior of the haul barge.

Containment of Additives (Project Specific Control) – A drying reagent will be used to eliminate free liquids in the dredged material. The reagent will be delivered to the site via a covered dry reagent storage barge. The covering will prevent any wind blown loss of drying reagent and contact with rain water. Covers will be lifted only as needed to access the drying reagent and will be closed when active retrieval of drying reagent is not underway.

Mixing of Additives and Dredged Material (Standard Control) – A derrick barge, with a mechanical clamshell bucket, will be used to re-handle the sediment and place it in the haul barge. The bucket loaded with the sediment will be positioned over and lowered as close as possible into the haul barge as not to cause any splashing or allowing sediment to escape out of the barge. A minimum of 5 percent reagent will be added into the material to facilitate passing of the 1 tsf bearing capacity requirement. As the desired quantity of reagent is added (up to 5 percent as determined by the sediment drying bench scale test) to the barge, the dredged material and reagent will be mixed by successively pushing wet dredged material into the reagent and partially mixed material. Mixing will continue until there is no apparent free liquid in the barge (including any rain water that may have fallen on the material) and the material appears fit to pass the paint filter test or would be expected to do so in transit to the transfer facility. Smaller quantities of reagent will be added for each mix if dust is raised during mixing. Neither dredged material nor reagent will be allowed to spill or drift (as dust) out of the barge and into the water.

Work Stoppage and Additional Controls in the Event of Multiple Spills (Additional Control) – If multiple spills of drying reagent occur during the loading or mixing process, work will be stopped until additional best management practices (BMPs) or methods of handling and mixing the reagent can be implemented to prevent such future spills.

Limit Operations to Appropriate Weather (Additional Control) **–** If high river flows, wind, or storm events occur, operations should be limited to the extent necessary to prevent loss of drying reagent. This may include ceasing operations where river waves or currents prevent the thorough control and precise movement of equipment and BMPs. In addition, the drying reagent will be covered (as noted above) in all cases where drying reagent is not being actively retrieved, which will prevent wind loss from the barge and contact with rain water during storm events. However, in the event that high wind conditions occur that could result in the movement of drying reagent when the cover is opened for reagent retrieval, work will be stopped until those wind conditions cease. Similarly, if rainfall is sufficiently high to compromise the drying agent when the cover is temporarily open, then operations will be stopped until those rain conditions cease.

3.6 Material Transferal at the Transfer Facility

Once the sediment drying reagent is adequately mixed into the material in the haul barge , it will be transported to the Port of Morrow dock for transfer of the sediment to trucks for transport to the disposal facility. The following controls can be employed during the unloading of barges to trucks.

Sediment Spill Protection (Standard Control) – A spill apron will be constructed along the swing pathway of the bucket to prevent material from entering the water. The material will be loaded directly into an upland hopper that will minimize the potential for spilling during truck loading. Trucks will be loaded directly from the hopper. The upland area within the vicinity of the swing pathway, hopper, and adjacent driveways will also be lined as noted in liner controls below.

Prevent Return Material/Water (Project Specific Control) – The material will be loaded into trucks directly from a hopper to avoid splashing during loading from the crane. The transfer facility is paved and all areas of the spill plate and loading area shown in the TDP will be sumped, bermed, or curbed (or similar containment controls) such that all potentially spilled material, decontamination fluids, and/or rainfall runoff will be contained within this area and at no time will any water or solids be allowed to discharge to the river. Any rainfall runoff will be collected within a sump and pumped to baker tanks, if necessary, for storage and eventual disposal. Disposal options for liquid waste include taking it to the

local sanitary sewer district (if permits can be obtained), a liquid waste disposal facility, or the DNAPL recovery system at the Gasco Site, depending on the quantities and quality of the water. Because the project will be conducted primarily in months when very little rainfall (average less than half an inch per month in Boardman) is expected, preparations for large amounts of rainfall will not be necessary. In the event of unusually heavy rainfall, offloading will be postponed until high intensity rain has subsided. Regardless of the source of water, free water will be removed from the haul barge via application of additional drying reagent prior to initiating offloading into the upland hopper.

Dewater Control (Project Specific Control) – No water will be discharged as a part of the transfer and disposal process. The disposal facility does not accept free water. If free water is observed in the barge while it is at the transfer facility, additional drying reagent will be added until the material is of acceptable consistency. The reagents will be added to the barge and mixed in with the same clamshell bucket that will be used to transfer the material into the hopper. Through these methods, free dewater will be eliminated without discharging water to surface waters.

Upland Transport Lined/Watertight Containers (Standard Control) – Containers or trucks that are loaded will contain water tight beds. In addition, the truck bed and cargo will be covered to keep rainwater from contacting the material and loss of material during transport.

Upland Transport Loading Capacity (Standard Control) – The transfer bucket used to load the hopper with material from the haul barge will be opened the minimum amount required to empty the desired quantity of material into the hopper. In addition, the transfer bucket will be maintained as close as possible to the top opening of the hopper to minimize the potential for spillage.

Upland Area Sweeping (Standard Control) – The transloading facility will be continuously visually monitored and be swept regularly to prevent potential spreading of materials.

Loadout Pad Lining (Project Specific Control) – Prior to loading dredged material into trucks, the trucks will be driven onto a disposable liner on the loadout pad. Before the truck

is cleared to drive off the loadout pad, the truck and the liner will be inspected for spilled material. Any spilled material will be removed from the truck or the liner. If contamination cannot be thoroughly removed from the liner, the contaminated area will be covered to avoid tracking contaminants onto truck tires and out of the loadout area. After the truck is cleared to leave the loadout area, the liner will be inspected for spillage or damage. Contaminated or damaged liners will be discarded (sent to the disposal facility) and replaced before the next truck enters the loadout pad.

Access Area Inspection (Standard Control) – After the truck is cleared to leave the loadout pad and before it is cleared to leave the transfer facility, the paved area just traversed by the truck will be visually inspected for tracking of contaminated material. If contamination is found, the truck will be routed to a decontamination area to be cleaned and re-inspected before it is cleared to leave the transfer facility and travel on public roads. The paved area will be cleaned and absorbents will be used if appropriate to avoid spreading contamination.

Area and Equipment Decontamination (Standard Control) – Decontamination procedures for barges and buckets are noted above. Trucks will be cleaned before leaving the controlled area as noted above. All contaminated sediment and materials will be removed from the outside of aprons and loadout pads once all loading for the project is complete. This will be accomplished using first dry decontamination methods (brushing or sweeping) and placement of these materials in the final truck load leaving the transfer facility. Because the load out pad will be lined, removal of this final liner and placement in the truck should be sufficient for decontamination of this area. However, any visible signs of contamination after dry sweeping and liner removal in the loadout area or spill apron will be removed through pressure washing with all water collected in the sump noted above. This liquid will be pumped out and disposed of as noted above.

Containment of Additives (Standard Control) – Portland cement (the drying reagent), are respiratory irritants and have high pH. Drying reagent will be delivered to the Site via barge and controls noted above will be employed. Drying reagent will be delivered to the transfer facility via truck and unloaded to temporary covered holding containers to prevent contact with rain water and escape of these materials to wider areas.

Limit Operations to Appropriate Weather (Additional Control) **–** If very high river flows or storm events occur, operations should be limited to the extent necessary to prevent loss of materials. This may include ceasing operations where rain events might cause overflow of onshore containment devices such as curbs noted above. Upgrading runoff controls from equipment and transloading facilities will be considered, if appropriate, as an option to limiting operations during rainfall.

3.7 Fringe Cover and Pilot Cap Placement

As described in the RAPP, a fringe cover and pilot cap will be placed over the newly created sediment surface after dredging. The placement method will be via clamshell placement of material from a barge to the bottom. The following controls can be employed during this operation:

Quality of Cover/Cap Material (Standard Control) – The material to be used for construction of the sediment cap shall conform to the Technical Plans and Specifications for the McCormick & Baxter sediment cap, located in the Willamette River in the vicinity of the removal action area (Ecology and the Environment 2003). Specifically, the cap material shall be an imported, clean, granular material free of roots, organic material, contaminants, and all other deleterious and objectionable material.

Placement Methods (Standard Control) – The cover/cap material will be placed on the newly created sediment surface via clamshell bucket. The following operational controls will be used to limit the potential for resuspension and loss of contaminated sediments that may remain in the area:

- The clamshell will be cracked open while swinging over the desired area of placement. This results in "sprinkling" of material over the bottom and avoids impact of a large amount of material with the bottom in one location.
- The entire area will be covered with a 6 inch lift of cover/cap material working from lower to higher elevations. This approach will result in immediate coverage of all potentially contaminated areas and avoids the potential for cross contamination of cover/cap material.

- The entire area will then be covered with additional 6 inch lifts as necessary to achieve the final required cover/cap thickness in the same manner.

Containment Barriers (Project Specific Control) – As described in Section 3.2.1, silt curtains and associated containment barriers will surround the removal area during cover/cap placement.

4 OTHER PROTECTIVE MEASURES

4.1 Protection of Land Resources

The land resources within the project boundaries and outside the limits of work shall be preserved in their present condition or be restored to a condition after construction that will appear to be consistent with previous site uses, and not detract from the appearance of the area. Areas of bare soil exposed at any time shall be held to a minimum. Surface drainage from cuts and fill, whether or not completed shall be held in sedimentation ponds or the areas shall be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures such as partial backfilling, mulching, ditches, dikes, drains, sedimentation basins, or silt fences or curtains shall be provided as needed, and maintained.

4.2 Disposal

Except as described in this RAEPP, disposal of any wastes, effluents, trash, grease, chemicals, or other contaminants in surface waters will not be allowed. If any waste material is accidentally released in unauthorized areas, the material shall be removed and the area restored to a condition approximating the adjacent undisturbed area.

Petroleum products, chemicals, fresh cement, riprap, grout, or other deleterious waste materials will not be allowed to enter waters of the State. All foreign materials, construction debris, refuse, waste, used absorbent materials, and similar items must be removed from the site and placed in an appropriate upland disposal facility.

4.3 Protection of Fish and Wildlife

All work shall be performed and all steps taken to prevent interference or disturbance to fish and wildlife. This includes threatened and endangered species, non-listed species, and other species of interest to particular parties such as lamprey and sturgeon. Unless otherwise authorized, all work shall be performed within in-water work periods established for fish by Oregon Department of Fish & Wildlife, and all work shall comply with a Biological Assessment for the project approved by EPA. EPA will consult with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). Water flows or habitat outside the project boundaries that are critical to fish or wildlife shall not be altered or disturbed. Protective measures as noted in Section 3 will be employed if dead or distressed fish are observed. If a listed species is found to be distressed or dead, EPA may

require additional control measures beyond those discussed in the final design and BA. This situation constitutes an action trigger as noted in Section 2, and will result in the appropriate measures and notifications as described there. A biological assessment has been prepared and submitted to the USFWS and NMFS for review and issuance of a biological opinion, which has not yet been completed by these agencies. If the Biological Opinion requires additional reasonable and prudent measures, the removal work will comply with such measures. Other protective measures may be required by the final Biological Opinion, and these will be reflected as appropriate in the final design RAEPP.

4.4 Dust Control

Dust control shall be performed as the work proceeds, whenever a dust nuisance or hazard occurs.

5 WATER QUALITY ANALYSIS

The process for determining water quality exceedances, trigger levels, and triggering additional controls as described in this RAEPP is consistent with the substantive requirements of a Section 401 Water Quality Certification in the State of Oregon and Section 404(b)(1) of the Clean Water Act. This RAEPP was developed through review of recent water quality certificates issued for dredging and contaminated sediment remediation projects in the Columbia and Lower Willamette Rivers including the Columbia River Deepening Project (DEQ 2003a) and the McCormick and Baxter Superfund Site Remediation (DEQ 2003b). In summary, the conclusion of this analysis is that given all the circumstances at this Site, this limited removal action will not result in any net loss of habitat or aquatic function, as long as mitigation measures included in this RAEPP (BMPs, operational controls, field and water quality monitoring) will be conducted throughout the removal action.

The water quality monitoring requirements and exceedance levels are consistent with these recent water quality certifications. The environmental controls (both standard and additional) meet, and in most cases exceed, the requirements of these recent water quality certificates. Because these recent water quality certificates were issued for compliance with Section 401 and 404(b)(1) in these same waters for similar projects, the removal alternative described in the RAPP complies with the substantive requirements of these regulations.

The 404(b)(1) guidelines require consideration of potential impacts on the following:

- Physical and chemical characteristics of aquatic ecosystem
- Biological characteristics of the aquatic ecosystem
- Special aquatic sites
- Human use characteristics

Each of these items and potential alternatives are discussed below. Based on the evaluation below, short-term adverse impacts are being minimized to the extent practicable while still attaining the goal of removing the tar body from the site. Additional mitigation is not needed beyond the standard and potential additional controls proposed here and the placement of a temporary cover or pilot cap until full scale remediation of all contaminated sediments within the Portland Harbor Superfund Site can take place.

5.1 Physical and Chemical Characteristics

The chemical characteristics of the removal action area will be substantially improved due to the removal action. Cover/cap material applied to the area will be cleaner than any sediments currently existing in the area, and will meet open water disposal requirements (USACE et al. 1998).

The physical characteristics of the removal action area will also be improved over existing conditions. Tar body waste material substrate will be replaced with clean sand or similar material that should pose less substrate impact to aquatic ecosystems. The dredge cut will cause a slight depression in the bank of the river. However, the created elevations are similar to the water depths currently present throughout the adjacent river channel as well as the varied shoreline bathymetry throughout this portion of the river.

5.2 Biological Characteristics

There are likely little if any current benthic or similar biological communities in the area due to the presence of tar. Thus, there will be little if any impact to resident communities during the removal. There may be some unavoidable water quality impacts within containment barriers. Proposed standard and additional controls should be sufficient to limit water quality impacts that might impact fish or water column communities outside the containment barriers in the area. Water quality monitoring will provide a means to verify this and upgrade controls as needed. Also, containment barriers will prevent fish from swimming into the removal area. Overall, the short-term adverse biological impacts associated with the removal are likely outweighed by the long-term benefits to area biological communities by removing this material from the river.

5.3 Special Aquatic Sites

No special aquatic sites will be affected by this removal action.

5.4 Human Use Characteristics

Human uses of this industrial shoreline site are limited to dock unloading activities associated with the upland industries. The removal action will have no substantial impact on these activities. In addition, any potential chemical risks to human health posed by the tar body will be reduced by this removal action.

6 REFERENCES

DEQ 2003a. Letter dated June 23, 2003. To: Colonel Richard W. Hobernicht U.S. Army Corps of Engineers. From: Michael T. Llewelyn Administrator Water Quality Division, DEQ. Regarding: U.S. Army Corps of Engineers' (Corps) requests for water quality certification dated September 4, 2002, November 26, 2002 and March 28, 2003 for The Corps Portland District proposal to deepen the Columbia River Navigation Channel between River Mile (RM) 3.0 and RM 106.5, including the area adjacent to Port of Portland Terminal 6 in the Oregon Slough.

DEQ 2003b. Memorandum dated December 9, 2003. To: Susan Gardner, Project Engineer, Ecology & Environment, Inc. From: Kevin Parrett, Project Manager, Oregon Department of Environmental Quality. Subject: Clean Water Act 401 Water Quality Certification and 404 Evaluation McCormick & Baxter Superfund Site.

Ecology and the Environment. 2003. Technical Plans and Specifications – Sediment Cap McCormick & Baxter Creosoting Company, Portland, Oregon.

USACE, USEPA, Washington Department of Ecology, and DEQ. 1998. Dredge Material Evaluation Framework Lower Columbia River Management Area. Public Review Draft. Portland, Oregon.

Tables

Table E-1
Water Quality Triggers for Additional Environmental Controls

Parameter	Unit	Location	Trigger[a]	Action Triggered
Turbidity	Nephalometric Turbidity Units (NTU)	150 feet downstream of operations[b]	>3 NTU over background (where background <50 NTU)[c] >10% over background (where background >50 NTU)[c] >50 NTU over background[c]	Inspect construction and select an additional control(s) that focus on cause of exceedance If >50 NTU over background, also cease work and select additional controls
Dissolved Oxygen (DO)	mg/L	150 feet downstream of operations[b]	<6.5 modify operations <6.0 cease operations[d]	Inspect construction and select an additional control(s) that focus on cause of exceedance
pH	Standard units	150 feet downstream of operations[b]	<6.5 or >8.5	Inspect construction and select an additional control(s) that focus on cause of exceedance
Oil/Sheen	Visual Observation	Outside of outer containment barrier	(1) Any project related sheen (2) Substantial sheen (3) Large contiguous, heavy, or persistent oily releases	Per Section 3.1: (1) Deploy additional controls and inspect construction (2) Cease work and conduct Step 1 (3) Cease work and deploy spill response team.
Tar Particles/Oil	Visual Observation	Immediately outside base of full length silt curtain or bedload baffle	Substantial particles of tar and/or oil blebs in water samples taken immediately above bottom	Inspect silt curtains and baffles and make adjustments as necessary.
Anthracene	µg/L	150 feet downstream of containment barriers[b]	Chronic – 0.73[e] Acute – 13	For chronic, confirm standard controls and increase monitoring to once per day (see text for exceedances of more than four consecutive days). For acute, inspect construction and select an additional control(s) that focus on cause of exceedance.
Benzo(a)pyrene	µg/L		Chronic – 0.014[e] Acute – 0.24	
Benzo(a)anthracene	µg/L		Chronic – 0.027[e] Acute – 0.49	
Dibenzofuran	µg/L		Chronic – 3.7[e] Acute – 66	
Fluoranthene	µg/L		Chronic – 6.16[e] Acute – 3980	
Fluorene	µg/L		Chronic – 3.9[e] Acute – 70	
Naphthalene	µg/L		Chronic – 12[e] Acute – 190	
Pheneanthrene	µg/L		Chronic – N/AV[e] Acute – N/AV	
Cyanide	µg/L		Chronic – 5.2[e] Acute – 22	
Water Velocity	fps	Upstream and immediately in line with operation	1.0 fps	Stop operations and secure silt curtains and other containment barriers
Distressed or Dead Fish or Birds	Visual Observation	Anywhere in proximity to site.	Any distressed, dying, or dead fish or birds.	Stop all operations, collect fish or birds, determine species, notify Services if listed species present, apply controls required by Biological Opinion and/or additional controls for non-listed species (see Section 3.2.5 for handling of distressed or dead fish)

Table E-1 Notes:

a If field parameter monitoring results exceed trigger, then the same field parameter will be measured within 30 minutes of the determination of the exceedance. If the exceedance continues, the additional controls discussed in Section 3 will be implemented.

b Sampling will occur at the specified distance from the edge of the primary (silt curtain) containment barrier. Although flow reversals due to tidal fluctuations are rare, if such reversals are observed, sampling will be conducted up current (background) and down current for field parameters, as appropriate.

c Trigger is exceeded where downstream conditions exceed the specified amounts relative to both the event-specific background and the preconstruction background survey.

d If DO levels fall below 6.5 mg/L, additional controls discussed in Section 3 will be implemented. If DO levels fall below 6.0 mg/L, operations will cease until DO levels rise above 6.0 mg/L and additional controls discussed in Section 3 will be implemented before resumption of work.

e If chronic levels are exceeded, see text for description of activities. If acute levels are exceeded, operations will be stopped while additional controls will be applied where activities are still consistent with activities at the time the sampling occurred.

Figures

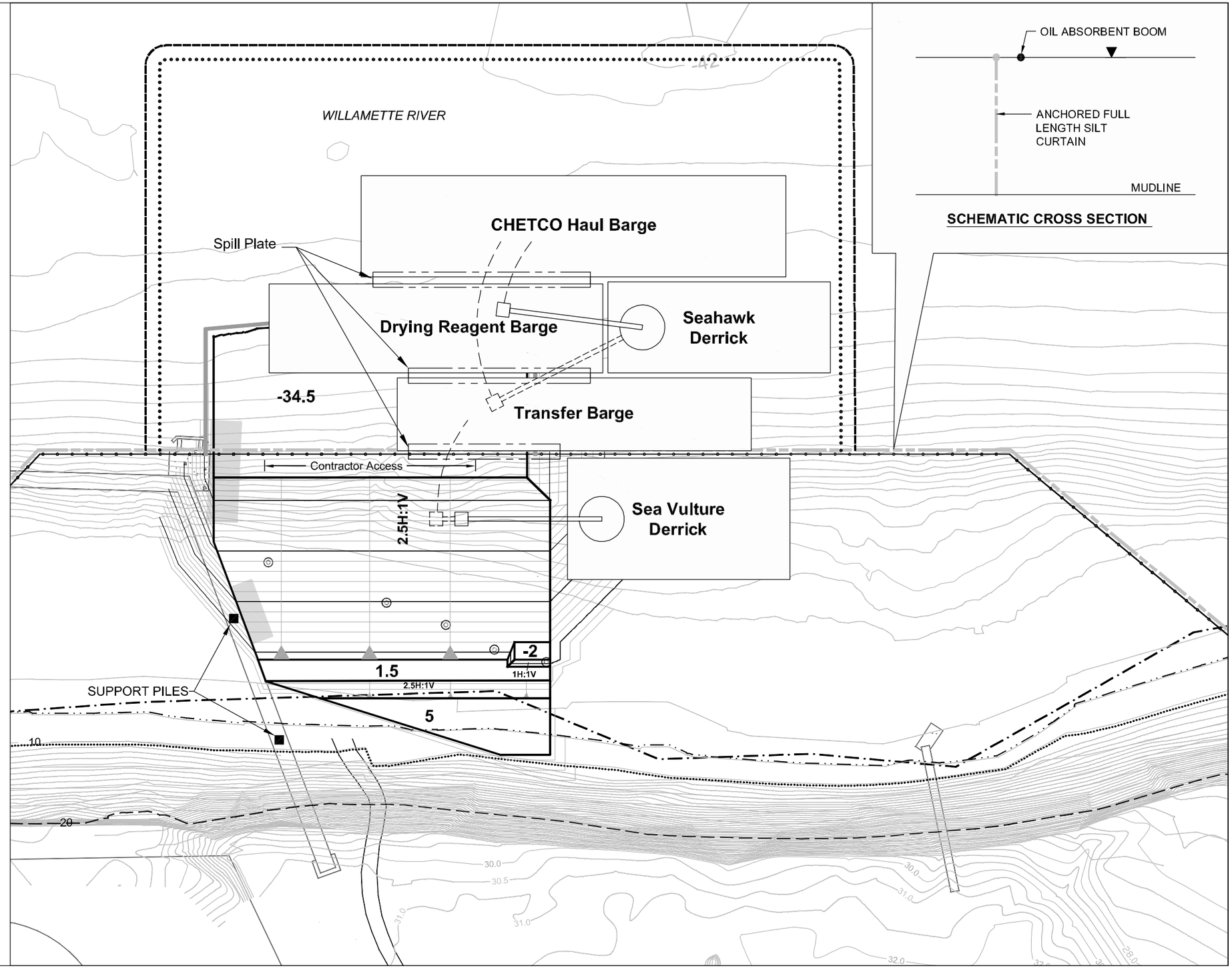
Legend:

- 1.5 — Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Location
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.



Jul 26, 2005 1:41pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-88.dwg FIG E-1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure E-1
Inner Removal Area - Non-Rigid Containment Configuration
NW Natural "Gasco" Site

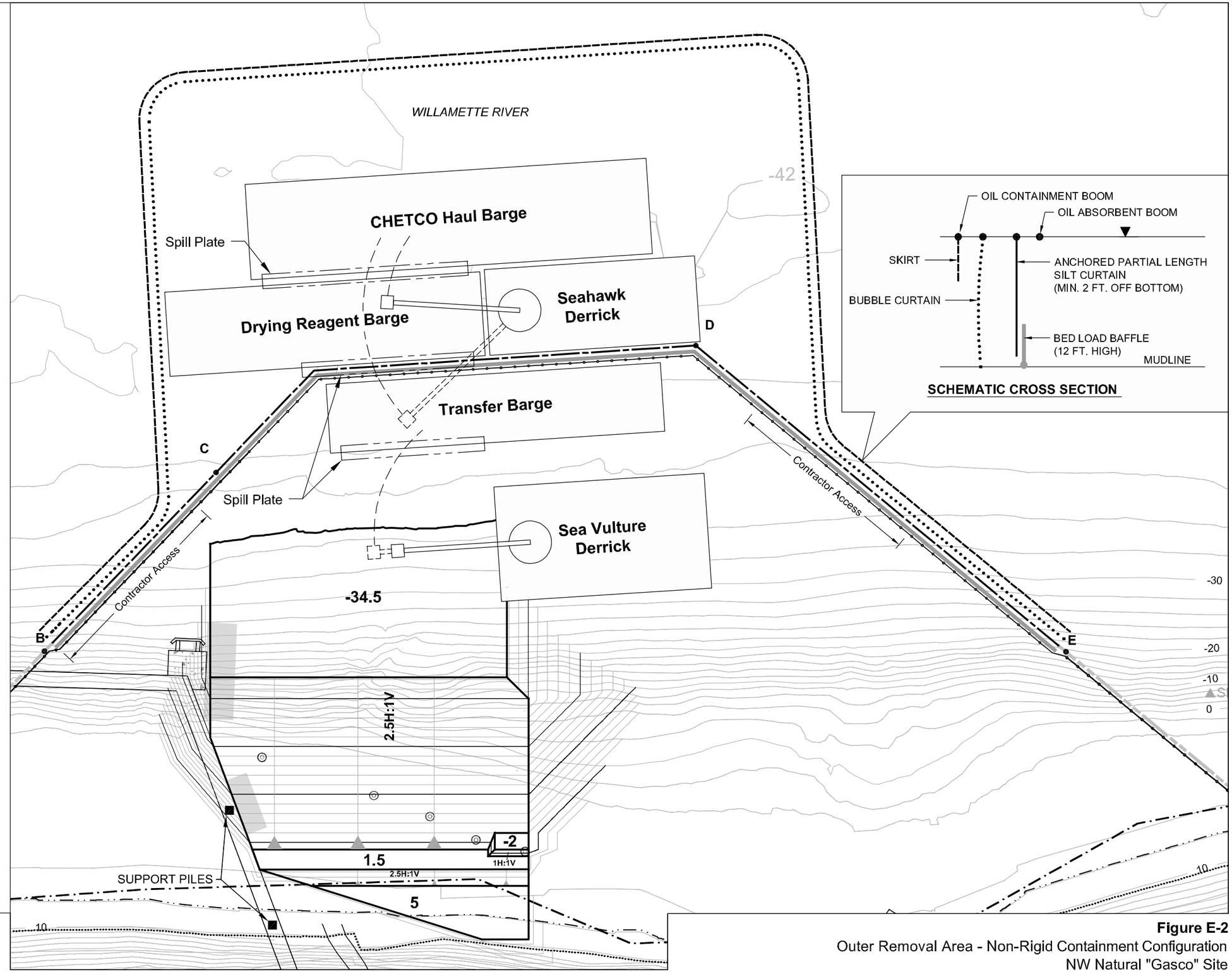
Legend:

- 1.5 Dredge Prism and Dredge Elevation
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88
- Oil Absorbent Boom (Mobile)
- Full Length Silt Curtain (Anchored)
- Oil Containment Boom with Skirt (2 Ft) (Mobile)
- Partial Length Silt Curtain (Anchored)
- Bed Load Baffle
- Bubble Curtain
- Pile Location (To be removed before dredging)
- Support Pile Locations
- 15' Dredging Offset to Protect Piles

0 50
Scale in Feet

Notes:

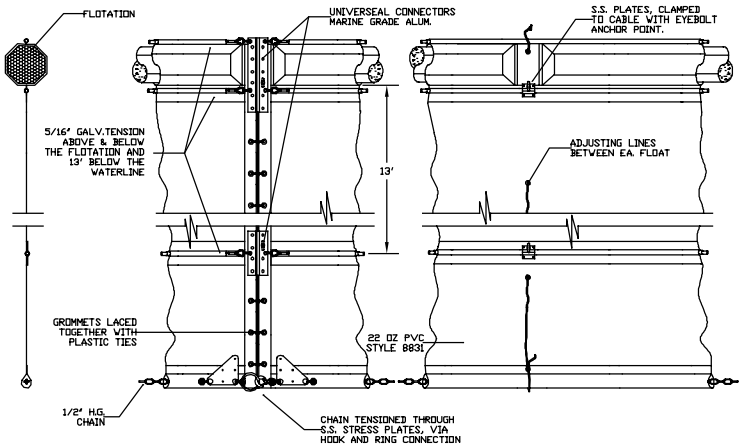
1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD88 (feet).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.



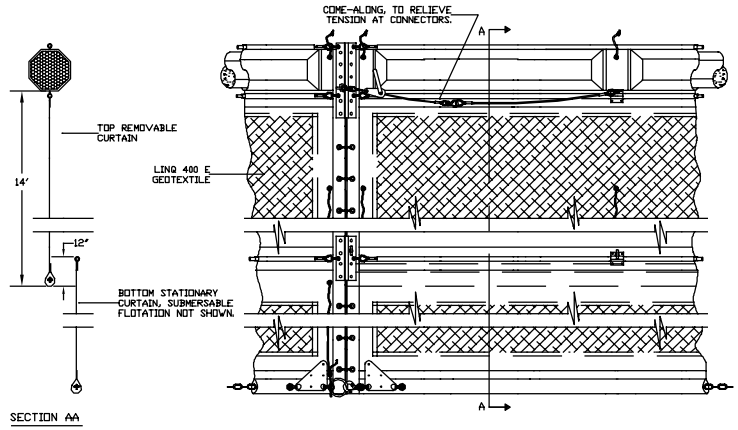
ANCHOR ENVIRONMENTAL, L.L.C.

Figure E-2
Outer Removal Area - Non-Rigid Containment Configuration
NW Natural "Gasco" Site

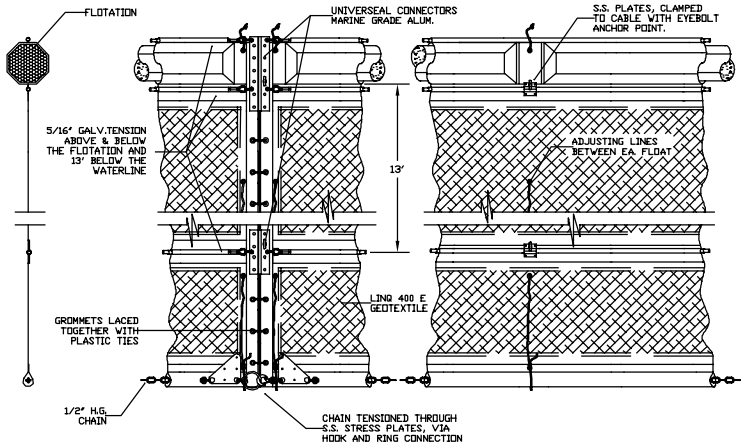
Jul 26, 2005 1:46pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-90.dwg FIG E-2



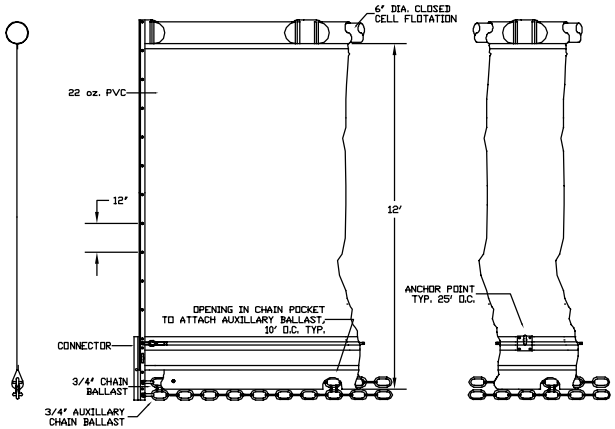
END DETAIL IMPERMEABLE CURTAIN



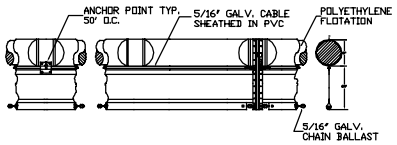
ACCESS GATE SECTION



END DETAIL PEMEABLE CURTAIN



BED LOAD BAFFLE CURTAIN



6'X24' OPTIMAX

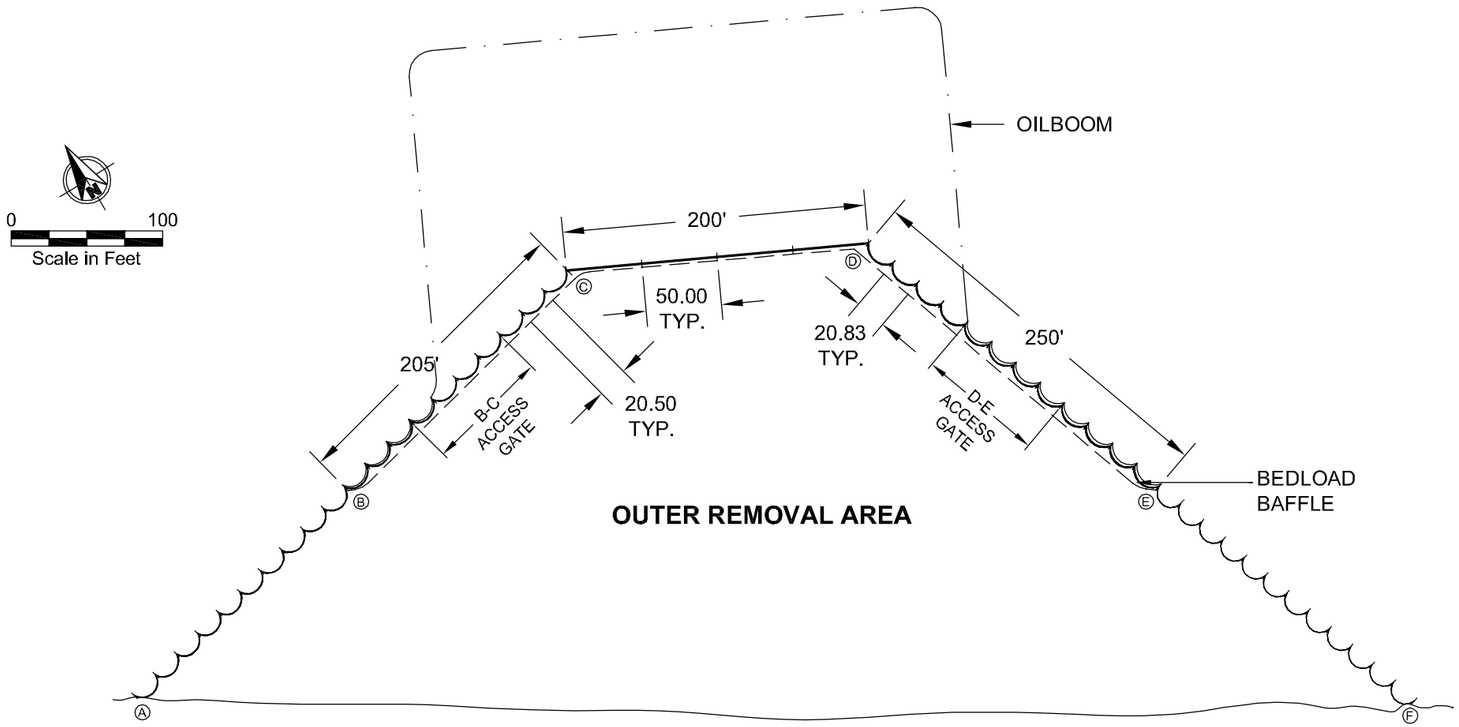
Not to Scale

Jul 28, 2005 11:25am dholmer K:\Jobs\000029-GASCO\00002902\00002902-93.dwg FIG E-3

ANCHOR ENVIRONMENTAL, L.L.C.

Source: Drawing provided by Elastec/American Marine titled "Details" dated July 27, 2005.

Figure E-3
Construction Detail of Silt Curtain
NW Natural "Gasco" Site

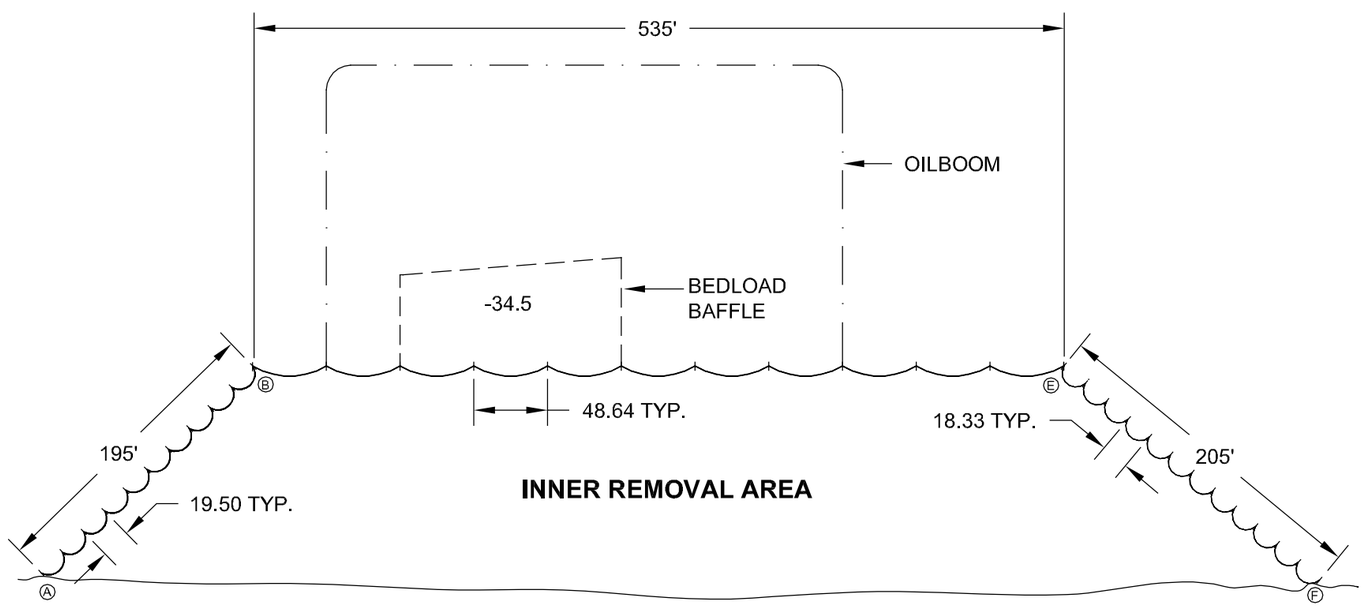


OUTER REMOVAL AREA

BC - 1EA 75' SECTION @ 36' - 39'
1EA 100' GATE SECTION @ 39' - 41' DEEP
1EA 75' SECTION @ 41' - 43'
ADUSTABLE PERMEABLE BARRIER
WITH ANCHOR POINTS 25' O.C.
OILBOOM 100' SECTIONS WITH ANCHOR
POINTS 50' O.C. , LOCATED APPROXIMATELY
AS SHOWN.
BEDLOAD BAFFLE 100' SECTIONS
LOCATED APPROXIMATELY AS SHOWN

CD - 2EA 100' SECTIONS @ 43' DEEP
ADJUSTABLE IMPERMEABLE BARRIER
WITH ANCHOR POINTS 50' O.C.

DE - 1EA 100' SECTION @ 43' - 41' DEEP
1EA 100' GATE SECTION @ 41' - 39" DEEP
1EA 100' SECTION @ 39' - 36' DEEP
ADJUSTABLE PERMEABLE BARRIER
WITH ANCHOR POINTS 25' O.C.
OILBOOM 100' SECTIONS WITH ANCHOR
POINTS 50' O.C. , LOCATED APPROXIMATELY
AS SHOWN.
BEDLOAD BAFFLE 100' SECTIONS
LOCATED APPROXIMATELY AS SHOWN



INNER REMOVAL AREA

AB - 2EA 100' SECTIONS @ 11' DEEP
1EA 50' SECTION @ 11' - 36' DEEP
ADUSTABLE PERMEABLE BARRIER
WITH ANCHOR POINTS 25' O.C.

BE - 5EA 100' SECTIONS @ 36' DEEP
1EA 50' SECTION @ 36' DEEP
ADJUSTABLE IMPERMEABLE BARRIER
WITH ANCHOR POINTS 50' O.C.
OILBOOM 100' SECTIONS WITH ANCHOR
POINTS 50' O.C. , LOCATED APPROXIMATELY
AS SHOWN.
BEDLOAD BAFFLE 100' SECTIONS
LOCATED APPROXIMATELY AS SHOWN

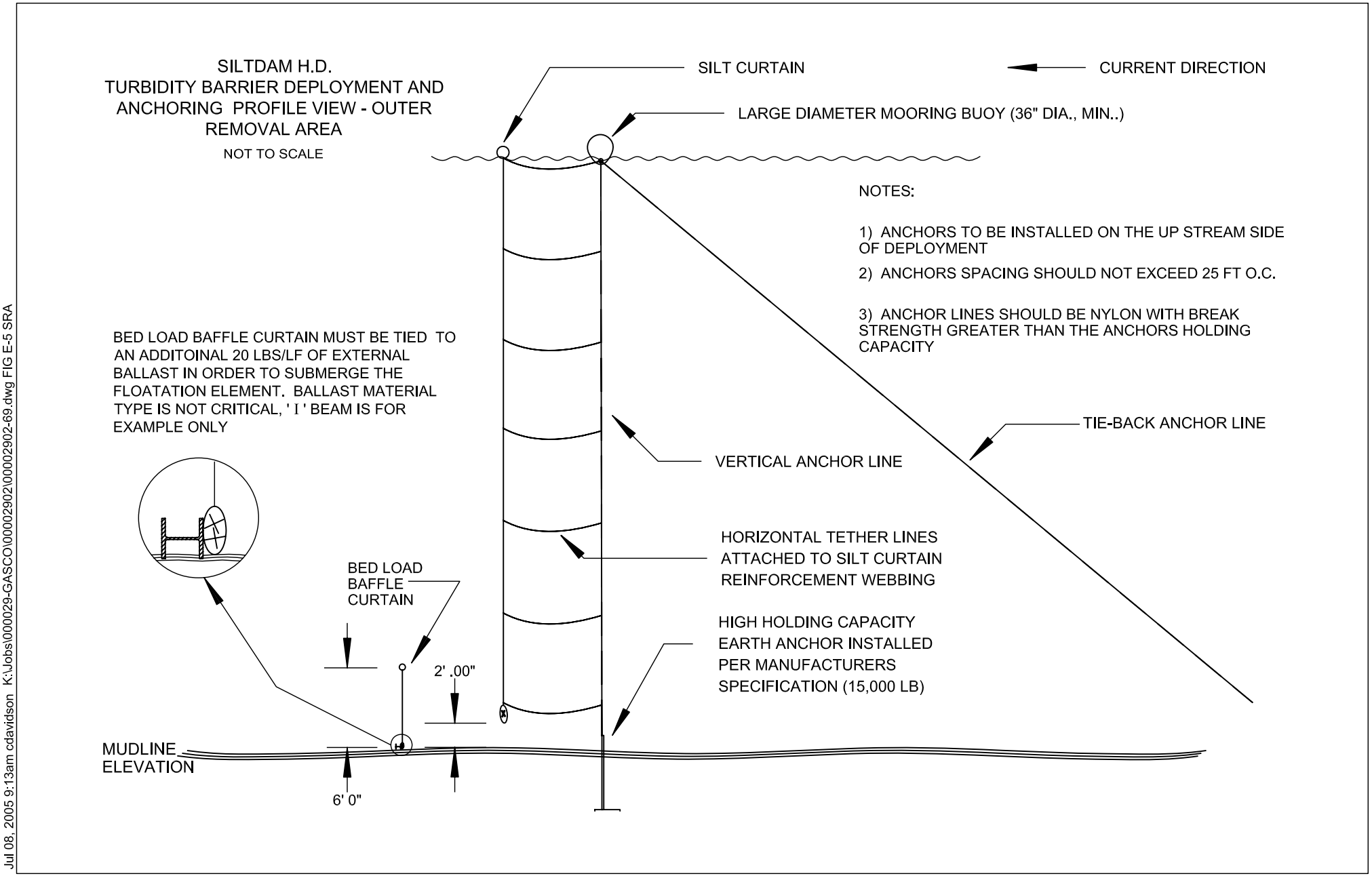
EF - 1EA 100' SECTION @ 36' - 9' DEEP
2EA 100' SECTIONS @ 9' DEEP
ADJUSTABLE PERMEABLE BARRIER
WITH ANCHOR POINTS 25' O.C.

Jul 27, 2005 2:54pm dholmer K:\Jobs\000029-GASCO\00002902\00002902-92.dwg FIG E-4

ANCHOR ENVIRONMENTAL, L.L.C.

Source: Drawing provided by Elastec/American Marine titled "Plan View of Site - Inner and Outer Removal Area" dated July 14, 2005.

Figure E-4
Inner and Outer Removal Area
NW Natural "Gasco" Site



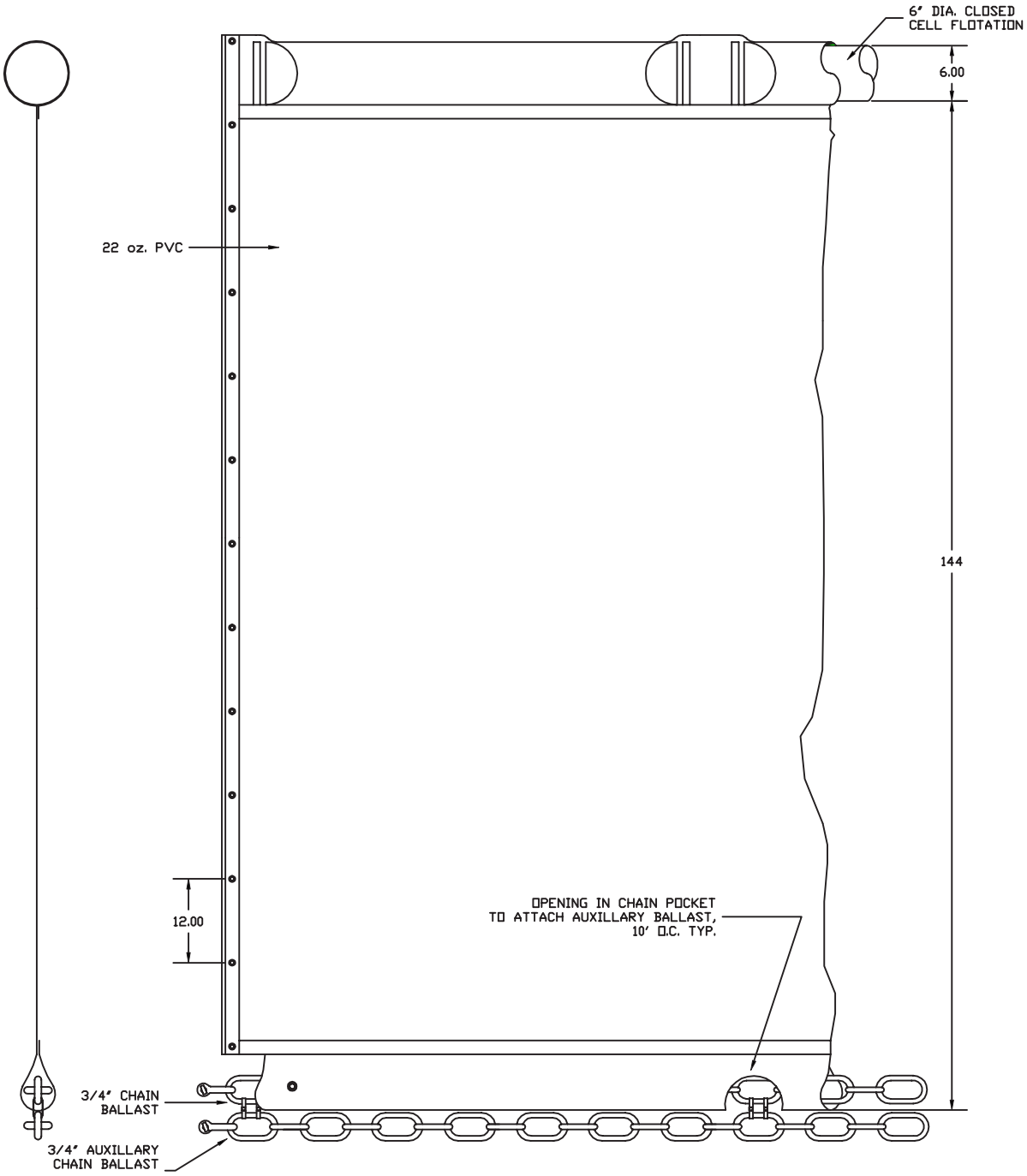
Jul 08, 2005 9:13am cdavidson K:\Jobs\000029-GASCO\00002902\00002902-69.dwg FIG E-5 SRA

ANCHOR ENVIRONMENTAL, L.L.C.

Figure E-5

Outer Removal Area - Partial Depth Curtain with Bed Load Baffle Curtain

NW Natural "Gasco" Site



7/8/05 cvd CAD\Jobs\000029-GASCO\02002902\FIG E-6.cdr

ANCHOR ENVIRONMENTAL, L.L.C.

Figure E-6
Construction Detail of Bedload Baffle
NW Natural "Gasco" Site

ATTACHMENT E-1

QUANTITATIVE WATER QUALITY ANALYSIS

ATTACHMENT E-1
QUANTITATIVE WATER QUALITY ANALYSIS FOR THE GASCO REMOVAL ACTION

1 INTRODUCTION

This attachment describes the quantitative analysis of expected water quality conditions around dredging operations at the Gasco Removal Action. It describes the overall analysis methods and results.

2 DRET SCREENING WITH ACUTE WATER QUALITY GUIDELINES

The purpose of the Dredging Elutriate Test (DRET) test is to understand what, if any, chemicals could be present in appreciable concentrations in the water column during dredging operations (DiGiano et al. 1995). The DRET test simulates water column conditions immediately around the dredge (within a few feet) and without further data analysis, does not provide a direct indication of wider water quality impacts that would be expected from dredging operations. However, direct comparison of DRET test results to water quality guidelines can provide a conservative method to screen out any chemicals that would not be expected to cause water quality impacts, even very close to a dredging operation.

This conservative screening is shown in the Table 1. The DRET analytical results were compared to freshwater acute (short-term) water quality guidelines available through references cited by ODEQ (2001) in their "Guidance for Ecological Risk Assessment Level II Screening Level Values" (SLVs) for freshwater aquatic receptors. This ODEQ guidance document presents only chronic (long-term) water quality guidelines for aquatic organisms from the references cited within the document. Aquatic chronic water quality guidelines are intended for comparison to continuous long-term potential impacts to water bodies. Dredging operations for this project are expected to be discontinuous (e.g., stopping at night and during equipment movement) and of a relatively short duration of approximately two weeks. Consequently, it is most appropriate to compare any expected chemical concentrations near dredging operations to acute values shown in Table 1 rather than the chronic values in ODEQ (2001).

The two sources of water quality guidelines for aquatic life referenced in ODEQ (2001) are Oak Ridge National Laboratory (ORNL) toxicity values contained in "Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota" (ORNL 1996) and Oregon regulations OAR 340-41. In addition, the DRET results were compared against the proposed ODEQ water quality criteria and guidance values (ODEQ 2005). Although these values will not be promulgated until February 2005 they were taken into consideration following direction by EPA. These sources were examined for each chemical analyzed for appropriate acute water quality values that would be consistent with the overall approach used to select guideline values by ODEQ (2001).

As shown in Table 1, only copper, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluorene, naphthalene, ethylbenzene, and toluene exceed one of the acute water quality guidelines. Copper was detected in the visually contaminated samples at levels just above the guidelines. Detections of metals in elutriate tests for even relatively clean sediments are not unusual occurrences, particularly for copper. It is notable that the concentrations of copper in the visually contaminated bulk sediments are quite low, with copper ranging from 14 to 27 mg/kg as compared to Dredge Material Evaluation Framework (DMEF) criteria (USACE et al., 1998) of 390 mg/kg. Consequently, it is unlikely that copper poses any greater short-term risk than that found during dredging of clean sediments that occurs on a regular basis throughout the Columbia/Willamette River system.

3 QUANTITATIVE WATER QUALITY ANALYSIS

The Table 1 results indicate that several chemicals may be present in water very close (within) a few feet of dredging operations. However, this comparison provides no direct information about the concentrations of these chemicals over wider areas around the dredge. An analysis of chemical concentrations over wider areas is described below for each of the chemicals that exceeded the screening as noted above. In addition, EPA requested examination of cyanide, fluoranthene, and benzene in the second step of the analysis discussed below.

3.1 Analysis Methods

To better understand the distribution of chemicals in the water column around dredging operations during this project, a simple analytical model developed by Kuo and Hayes (1991) was employed. This model was develop specifically to estimate the plumes of

suspended sediment that occur around bucket dredging operations, and was calibrated to measurements from four separate dredging operations throughout the country. The model predicts the amount of suspended sediment present in the water column at a specified distance downstream from a dredging operation. This model assumes no silt curtains or similar controls are present. Consequently, it provides a very conservative estimate of water column concentrations around the Gasco removal action dredging, which will employ several types of environmental controls as detailed in main text Appendix E.

The suspended sediment concentration results of the Kuo Hayes model can be used to predict the concentration of chemicals present in the water column around the dredge as well, using a few simple mass balance calculations that rely on the chemical concentrations observed in the bulk sediments and the DRET test. These additional steps are very similar to the mass calculations contained in the Army Corps "DREDGE" model (Hayes and Je 2000), also developed by Donald Hayes. However, unlike the DREDGE model, site specific results of the DRET test can be input into the Kuo Hayes analysis conducted here.

The controlling equation for the Kuo Hayes model is presented in their 1991 paper, which predicts suspended sediment concentrations at the specified distances. The modeled suspended sediment result and the DRET test results were used to calculate the chemical concentration at that same distance as follows:

$$C_w = \left(\frac{TSS}{10^6 \frac{mg}{kg}} \right) * C_s * \frac{C_d}{C_t}$$

where:

C_w = concentration of chemical in water (µg/L)

TSS = concentration of suspended sediments predicted by Kuo Hayes equation (mg/L)

C_s = concentration of chemical in dredge sediments (µg/kg)

C_d = concentration of chemical observed in DRET water at end of test (µg/L)

C_t = concentration of chemical in DRET vessel at start of test (µg/L)

The model was run in a probabilistic mode using @RISK software (Palisade 2001), assuming general ranges of various input parameters. This probabilistic approach provides an

approximation of the likelihood or percent chance of exceeding water quality guidelines given the reasonable variations that might be expected in river currents, sediment type, chemical concentrations in sediments, etc., based on available data. Because insufficient data are available to determine the statistical distributions of various needed input parameters, high, mid-range, and low values were determined for each input parameter based on the ranges of data available. These values were placed in simple triangular distributions (described in Palisade 2001) with the mid-range value defining the peak of the triangular distribution. Essentially, such an approach assumes that the mid-range value is the most likely one to occur on any trial, while values ranging to the high and low ends of the distribution are increasingly unlikely to occur.

The input parameters for the model (including high, mid-range, and low values for parameters with triangular distributions) along with data sources for these values are shown in Table 2.

3.2 Analysis Results

Modeling results are shown in Table 3 as the ratio of the predicted water column concentration over the applicable acute guideline. Ratios greater than 1 indicate a predicted exceedance of the water quality guideline. Results are presented for each of the chemicals exceeding acute guidelines in the DRET test (Table 1) (plus additional chemicals requested by EPA) at distance of 50, 100, 200, 300, and 400 feet downstream of the dredging operation. For each distance, 50th, 90th, and 95th percentile results are also presented. The percentile result can be viewed as a probability of exceedance. For example, given the range of input parameters, there is a 95 percent chance that the predicted results are at or below the value shown in the 95th percentile column.

Modeling results are shown in Table 3 as the ratio of the predicted water column concentration over the applicable acute water quality guideline. Ratios greater than 1 indicate a predicted exceedance of the water quality guideline. Results are presented for each of the chemicals examined at distance of 50, 100, 200, 300, and 400 feet downstream of the dredging operation. For each distance, a 50th, 90th, and 95th percentile results are also presented. The percentile result can be viewed as a probability of exceedance. For example,

given the range of input parameters, there is a 95 percent chance that the predicted results are at or below the value shown in the 95th percentile column.

As shown in Table 10, the 50th percentile results at all distances from the dredge for all chemicals are below their respective criteria (i.e., the ratios are less than 1 in Table 10). Benzo(a)anthracene is predicted to exceed the guideline using the 90th and 95th percentile estimate at 50 feet from the dredge and the 95th percentile estimate at 100 ft from dredge. Benzo(a)pyrene is predicted to exceed the guideline using the 90th and 95th percentile estimate at 50, 100, and 200 feet from the dredge and the 95th percentile estimate at 300 ft from the dredge. .

4 CONCLUSION

This analysis assumes that no environmental controls are present. Even with this assumption, these overall results indicate that exceedances of appropriate water quality guidelines at distances greater than 300 feet from the dredge are unlikely for this removal action. Despite this result, numerous environmental controls have been proposed for this project and are described in the next section. Consequently, with the use of environmental controls detailed in the main text of Appendix E, water quality impacts to the river system are expected to be very unlikely.

5 REFERENCES

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Table 1
Elutrate Testing Analytical Summary

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	Lowest Acute Criterion[1]	RAA-03 RAA-03SD- 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD- 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD- 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD- 7/20/2004 9-11 ft Tar Body
Sheen Visible in Elutriate Test Vessel?			No	Yes	No	Yes
Measurable Non-Aqueous Phase Layer in Test Vessel?			No	No	No	No
Conventionals						
Cyanide	mg/l	0.022	0.01 U	**0.01**	0.01 U	**0.01**
Metals						
Arsenic (dissolved)	µg/l	340	**2.3**	**0.7**	**0.5**	**0.8**
Arsenic (total)	µg/l	340	**3.5**	**0.8**	**0.8**	**1**
Chromium (dissolved)	µg/l	16	**0.31 J**	**0.4**	**0.32 J**	**0.35 J**
Chromium (total)	µg/l	16	**5.39**	**1.08**	**1.09**	**1.53**
Copper (dissolved)	µg/l	13	**13.1**	**1.66**	**2.27**	**1.06**
Copper (total)	µg/l	13	**16.5**	**2.07**	**2.29**	**3.77**
Lead (dissolved)	µg/l	65	**0.12**	**0.06**	**0.12**	**0.09**
Lead (total)	µg/l	65	**7.46**	**0.92**	**3.11**	**2.32**
Nickel (dissolved)	µg/l	470	**0.7**	**1.2**	**1.4**	**1.2**
Nickel (total)	µg/l	470	**4.4**	**1.9**	**2.1**	**2.1**
Zinc (dissolved)	µg/l	120	**2.7**	**1.2**	**1.5**	**2.7**
Zinc (total)	µg/l	120	**16.5**	**3.7**	**4.1**	**7.3**
Total Petroleum Hydrocarbons (TPH)						
TPH - Diesel Range	µg/l	--	**430 Z**	**17000 Z**	**240 J**	**13000 Z**
TPH - Residual Range	µg/l	--	**280 J**	**400 J**	**99 J**	**790 Z**
Semi-Volatile Organic Compounds (SVOC)						
1,2,4-Trichlorobenzene	µg/l	--	0.20 U	3.9 U	0.20 U	20 U
1,2-Dichlorobenzene	µg/l	260	0.20 U	3.9 U	0.20 U	3.9 U
1,3-Dichlorobenzene	µg/l	630	0.20 U	3.9 U	0.20 U	3.9 U
1,4-Dichlorobenzene	µg/l	180	0.20 U	3.9 U	0.20 U	3.9 U
2,4,5-Trichlorophenol	µg/l	--	0.48 U	9.6 U	0.48 U	9.6 U
2,4,6-Trichlorophenol	µg/l	--	0.48 U	9.6 U	0.48 U	9.6 U
2,4-Dichlorophenol	µg/l	2,020	0.48 U	9.6 U	0.48 U	48 U
2,4-Dimethylphenol	µg/l	2,120	2.0 U	**14 J**	2.0 U	200 U
2,4-Dinitrophenol	µg/l		3.9 U	77 U	3.9 U	77 U
2,4-Dinitrotoluene	µg/l	330	0.20 U	3.9 U	0.20 U	3.9 U
2,6-Dinitrotoluene	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
2-Chloronaphthalene	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
2-Chlorophenol	µg/l	4,380	0.48 U	9.6 U	0.48 U	9.6 U
2-Methylnaphthalene	µg/l	--	**0.030 J**	**470**	**0.050 J**	**710**
2-Methylphenol	µg/l	230	0.48 U	**3.3 J**	0.48 U	**1.6 J**
2-Nitroaniline	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
2-Nitrophenol	µg/l	--	0.48 U	9.6 U	0.48 U	48 U
3,3'-Dichlorobenzidine	µg/l	--	2.0 U	39 U	2.0 U	39 U
3-Nitroaniline	µg/l	--	0.96 U	20 U	0.96 U	20 U
4,6-Dinitro-2-methylphenol	µg/l	--	2.0 U	39 U	2.0 U	39 U
4-Bromophenylphenylether	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
4-Chloro-3-methylphenol	µg/l	30	**0.057 J**	9.6 U	**0.076 J**	48 U
4-Chloroaniline	µg/l	--	0.20 U	3.9 U	0.20 U	20 U
4-Chlorophenyl-phenylether	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
4-Methylphenol	µg/l	--	0.48 U	**15**	0.48 U	**12**
4-Nitroaniline	µg/l	--	0.96 U	20 U	0.96 U	20 U
4-Nitrophenol	µg/l	230	2.0 U	39 U	2.0 U	39 U
Acenaphthene	µg/l	1,700	**64**	**150**	**6.7**	**440**
Acenaphthylene	µg/l	--	**1.7**	**390**	**0.48**	**140**
Anthracene	µg/l	13	**0.12 J**	**41**	**1.2**	**58**
Benzo(a)anthracene	µg/l	0.49	**0.78**	**4.8**	**0.76**	**19**
Benzo(a)pyrene	µg/l	0.24	**0.55**	**4.6**	**1**	**24**

Table 1
Elutrate Testing Analytical Summary

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	Lowest Acute Criterion[1]	RAA-03 RAA-03SD- 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD- 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD- 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD- 7/20/2004 9-11 ft Tar Body
Benzo(b)fluoranthene	µg/l	--	**0.61**	**4.5**	**1**	**22**
Benzo(g,h,i)perylene	µg/l	--	**0.39**	**3.8 J**	**1**	**20**
Benzo(k)fluoranthene	µg/l	--	**0.21**	**1.4 J**	**0.39**	**6.9**
Benzoic acid	µg/l	740	**1.9 J**	96 U	**2.1 J**	480 U
Benzyl alcohol	µg/l	150	4.8 U	96 U	4.8 U	96 U
bis(2-Chloroethoxy)methane	µg/l	--	0.20 U	3.9 U	0.20 U	20 U
bis(2-Chloroethyl)ether	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
bis(2-chloroisopropyl)ether	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
bis(2-Ethylhexyl)phthalate	µg/l	27	2.0 U	39 U	2.0 U	39 U
Butylbenzylphthalate	µg/l	--	**0.028 J**	3.9 U	**0.027 J**	3.9 U
Chrysene	µg/l	--	**0.81**	**7.4**	**2.1**	**24**
Dibenzo(a,h)anthracene	µg/l	--	**0.037 J**	3.9 U	**0.086 J**	**1.8 J**
Dibenzofuran	µg/l	66	**0.044 J**	**23**	**0.072 J**	**28**
Diethylphthalate	µg/l	1800	**0.27**	3.9 U	**0.52**	3.9 U
Dimethylphthalate	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
Di-n-butylphthalate	µg/l	190	**0.091 J**	3.9 U	**0.15 J**	3.9 U
Di-n-octylphthalate	µg/l	--	0.39 U	7.7 U	0.39 U	7.7 U
Fluoranthene	µg/l	3,980	**19**	**56**	**6.3**	**110**
Fluorene	µg/l	70	**0.078 J**	**130**	**0.32**	**150**
Hexachlorobenzene	µg/l	--	0.20 U	3.9 U	0.20 U	3.9 U
Hexachlorobutadiene	µg/l	90	0.20 U	3.9 U	0.20 U	20 U
Hexachlorocyclopentadiene	µg/l	7	0.96 U	20 U	0.96 U	20 U
Hexachloroethane	µg/l	210	0.20 U	3.9 U	0.20 U	3.9 U
Indeno(1,2,3-cd)pyrene	µg/l	--	**0.36**	**3.2 J**	**0.83**	**17**
Isophorone	µg/l	117,000	0.20 U	3.9 U	0.20 U	20 U
Naphthalene	µg/l	2,300	**0.078 J**	**6900**	**0.27**	**11000**
Nitrobenzene	µg/l	27,000	0.20 U	3.9 U	0.20 U	3.9 U
N-Nitroso-di-n-propylamine	µg/l	5,850	0.20 U	3.9 U	0.20 U	3.9 U
n-Nitrosodiphenylamine	µg/l	3,800	0.20 U	3.9 U	0.20 U	3.9 U
Pentachlorophenol	µg/l	19	**0.072 J**	20 U	**0.071 J**	**2.0 J**
Phenanthrene	µg/l	--	**0.49**	**280**	**1**	**300**
Phenol	µg/l	10,200	**0.10 J**	**8.9 J**	**0.17 J**	**2.5 J**
Pyrene	µg/l	--	**20**	**58**	**6**	**110**
Volatile Organic Compounds (VOCs)						
1,1,1-Trichloroethane	µg/l	200	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2,2-Tetrachloroethane	µg/l	2,100	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2-Trichloroethane	µg/l	5,200	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2-Trichlorotrifluoroethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
1,1-Dichloroethane	µg/l	830	0.50 U	0.50 U	0.50 U	0.50 U
1,1-Dichloroethene	µg/l	450	0.50 U	0.50 U	0.50 U	0.50 U
1,2,3-Trichlorobenzene	µg/l	--	2.0 U	2.0 U	2.0 U	2.0 U
1,2,4-Trichlorobenzene	µg/l	700	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dibromo-3-chloropropane	µg/l	--	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichlorobenzene	µg/l	260	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichloroethane	µg/l	8,800	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichloropropane	µg/l	23,000	0.50 U	0.50 U	0.50 U	0.50 U
1,3-Dichlorobenzene	µg/l	630	0.50 U	0.50 U	0.50 U	0.50 U
1,4-Dichlorobenzene	µg/l	180	0.50 U	0.50 U	0.50 U	0.50 U
2-Butanone (MEK)	µg/l	240,000	20 U	20 U	20 U	20 U
2-Hexanone	µg/l	1,800	20 U	20 U	20 U	20 U
4-Methyl-2-pentanone (MIBK)	µg/l	2,200	20 U	20 U	20 U	20 U
Acetone	µg/l	--	**24**	**53**	**25**	**8.4 J**
Benzene	µg/l	2,300	0.50 U	**810**	**0.26 J**	**220**

Table 1
Elutrate Testing Analytical Summary

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	Lowest Acute Criterion[1]	RAA-03 RAA-03SD- 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD- 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD- 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD- 7/20/2004 9-11 ft Tar Body
Bromochloromethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Bromodichloromethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Bromoform	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Bromomethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Carbon disulfide	µg/l	17	0.50 U	**0.53**	0.50 U	0.50 U
Carbon tetrachloride	µg/l	180	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	µg/l	1,100	0.50 U	0.50 U	0.50 U	**0.35 J**
Chloroethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Chloroform	µg/l	490	0.50 U	0.50 U	0.50 U	0.50 U
Chloromethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
cis-1,2-Dichloroethene	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
cis-1,3-Dichloropropene	µg/l	6,060	0.50 U	0.50 U	0.50 U	0.50 U
Cyclohexane	µg/l	--	1.0 U	1.0 U	1.0 U	1.0 U
Dibromochloromethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Dichlorodifluoromethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Dichloromethane	µg/l	26,000	**0.66 J**	**0.67 J**	**0.53 J**	**0.90 J**
Ethylbenzene	µg/l	130	0.50 U	**62**	0.50 U	**290**
Isopropylbenzene	µg/l	--	2.0 U	**23**	**2.0 U**	**14**
m,p-Xylenes	µg/l	--	0.50 U	**210**	0.50 U	**210**
Methyl acetate	µg/l	--	1.0 U	1.0 U	1.0 U	1.0 U
Methyl cyclohexene	µg/l	--	1.0 U	1.0 U	1.0 U	1.0 U
Methyltert-butylether	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
o-Xylene	µg/l	--	0.50 U	**100**	0.50 U	**120**
Styrene	µg/l	--	0.50 U	**38**	0.50 U	0.50 U
Tetrachloroethene	µg/l	830	0.50 U	0.50 U	0.50 U	0.50 U
Toluene	µg/l	120	0.50 U	**320**	0.50 U	**160**
trans-1,2-Dichloroethene	µg/l	1,100	0.50 U	0.50 U	0.50 U	0.50 U
trans-1,3-Dichloropropene	µg/l	0.99	0.50 U	0.50 U	0.50 U	0.50 U
Trichloroethene	µg/l	440	0.50 U	**0.15 J**	0.50 U	**0.17 J**
Trichlorofluoromethane	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U
Vinyl chloride	µg/l	--	0.50 U	0.50 U	0.50 U	0.50 U

Notes:

Yellow shading indicates value that exceeds the guideline shown.

Detected values shown in bold

J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

U The compound was analyzed for, but was not detected at or above the MRL/MDL..

Z The chromatographic fingerprint does not resemble a petroleum product.

-- Not Available

1 Lowest acute value from EPA (2002) National Recommended Water Quality Criteria, Oak Ridge National Laboratory (1996) Tier II Values, ODEQ (2001) Guidance for Ecological Risk Assessment Level II Screening Values, and Oregon State Regulations OAR 340-041-0001 to 340-041-0350 Tables 20, 33A, and 33B (adpoted May 20, 2004).

Table 2
Input Parameters for Kuo Hayes Modeling

Parameter	Min	Med	Max	Comments
Bucket size, cy	NA	8	NA	
Cycle time, s	60.0	75.0	90.0	
Solids percentage, %	61.0	68.0	75.0	
Specific gravity of solids	1.23	2.20	2.50	
Spillage, %	0.5	1.5	2.5	
Water depth, m	2.0	3.0	14.0	
Ambient current velocity, m/s	0.03125	0.09375	0.1875	Full range of currents in July to October timeframe
Settling velocity, m/s	0.0000001	0.00001	0.005	

Table 3
Dredge Water Quality Kuo-Hayes Model Simulation Results

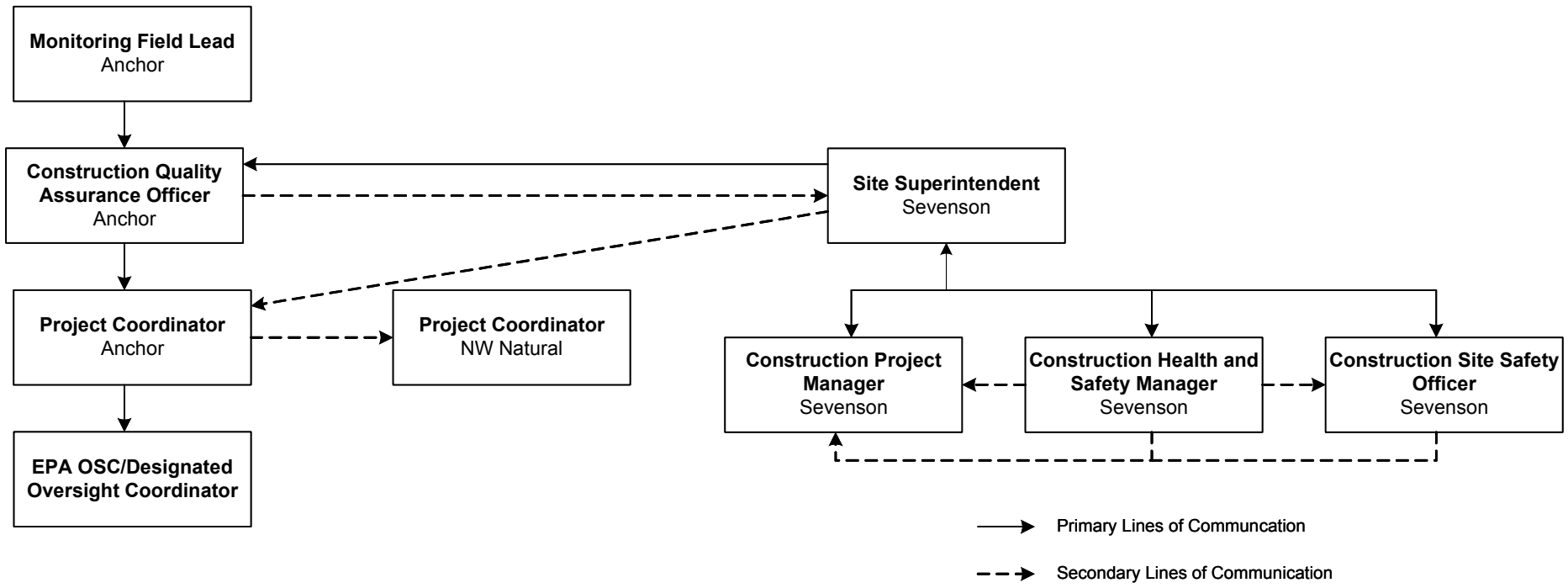
Distance from Dredge	50 ft			100 ft			200 ft			300 ft			400 ft			Acute
Percentile Result	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**50th**	**90th**	**95th**	**(µg/L)**
Total Suspended Sediment Concentration (mg/L)	263	757	961	177	491	621	114	283	375	83	209	280	65	163	223	N/AV
DRET-Based Water Concentration Ratio (unitless) - As Compared to Acute Water Quality Criteria																
Copper	3.42E-02	1.07E-01	1.43E-01	2.29E-02	6.93E-02	9.26E-02	1.45E-02	4.25E-02	5.62E-02	1.06E-02	3.11E-02	4.11E-02	8.34E-03	2.40E-02	3.24E-02	13
Cyanide	6.03E-03	6.03E-03	6.03E-03	4.11E-03	4.11E-03	4.11E-03	2.69E-03	2.69E-03	2.69E-03	2.03E-03	2.03E-03	2.03E-03	1.63E-03	1.63E-03	1.63E-03	22
Anthracene	2.64E-02	8.81E-02	1.30E-01	1.78E-02	5.94E-02	8.60E-02	1.14E-02	3.63E-02	5.31E-02	8.11E-03	2.66E-02	3.92E-02	6.26E-03	2.16E-02	3.01E-02	13
Benzo(a)anthracene	3.41E-01	1.24E+00	1.65E+00	2.31E-01	7.82E-01	1.08E+00	1.45E-01	4.79E-01	6.48E-01	1.08E-01	3.51E-01	4.69E-01	8.46E-02	2.81E-01	3.71E-01	0.49
Benzo(a)pyrene	7.12E-01	2.45E+00	3.52E+00	4.86E-01	1.63E+00	2.28E+00	3.14E-01	1.03E+00	1.42E+00	2.32E-01	7.65E-01	1.03E+00	1.81E-01	6.02E-01	8.06E-01	0.24
Benzene	5.60E-04	5.60E-04	5.60E-04	3.81E-04	3.81E-04	3.81E-04	2.49E-04	2.49E-04	2.49E-04	1.89E-04	1.89E-04	1.89E-04	1.51E-04	1.51E-04	1.51E-04	2300
Fluoranthene	8.98E-04	3.32E-03	4.31E-03	5.92E-04	2.08E-03	2.83E-03	3.79E-04	1.29E-03	1.75E-03	2.81E-04	9.29E-04	1.31E-03	2.19E-04	7.43E-04	1.05E-03	3980
Fluorene	1.24E-02	4.34E-02	6.44E-02	8.39E-03	2.78E-02	3.97E-02	5.38E-03	1.70E-02	2.38E-02	3.96E-03	1.25E-02	1.70E-02	3.08E-03	9.76E-03	1.33E-02	70
Naphthalene	3.36E-02	1.21E-01	1.71E-01	2.28E-02	7.92E-02	1.14E-01	1.45E-02	4.79E-02	7.12E-02	1.03E-02	3.36E-02	5.49E-02	7.91E-03	2.60E-02	4.37E-02	2300
Ethylbenzene	1.57E-02	5.65E-02	7.70E-02	1.05E-02	3.69E-02	4.83E-02	6.60E-03	2.21E-02	3.04E-02	4.89E-03	1.58E-02	2.30E-02	3.82E-03	1.24E-02	1.80E-02	130
Toluene	1.77E-02	5.59E-02	7.52E-02	1.18E-02	3.66E-02	4.94E-02	7.57E-03	2.19E-02	3.04E-02	5.58E-03	1.62E-02	2.18E-02	4.27E-03	1.23E-02	1.78E-02	120
Sum of Ratios	1.20E+00	4.17E+00	5.84E+00	8.16E-01	2.73E+00	3.80E+00	5.22E-01	1.70E+00	2.33E+00	3.86E-01	1.25E+00	1.69E+00	3.01E-01	9.92E-01	1.33E+00	

Note:

DRET - Dredging Elutriate Test

ATTACHMENT E-2

NOTIFICATION PROCESS FLOW CHART



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Notification Process Flow Chart
NW Natural "Gasco" Site

APPENDIX F

MONITORING AND REPORTING PLAN
(ANNOTATED OUTLINE)

Gasco Removal Action
Monitoring and Reporting Plan – Post Construction

1. Introduction

2. Project and Data Collection Objectives
    - 2.1.1. Removal Action Objectives (RAOs) per SOW
    - 2.1.2. Objectives for Pilot Cap Study
        - Pilot Cap Not a Permanent Remedy
        - Primary Objectives Related to Understanding Potential Effectiveness of Capping
    - 2.1.3. Data Collection Objectives to Meet RAOs and Pilot Study Objectives

3. Monitoring Approach
    - 3.1.1. Rationale – Meeting Project Objectives
    - 3.1.2. Monitoring Types
        - Visual/Diver Inspection (RAO specific)
        - Bathymetric Survey (RAO specific)
        - Seepage Monitoring (Grab Samples/Cores) (RAO specific)
        - Migration Rate Sampling (Cores/Porewater/Other) (Pilot Study Specific)
    - 3.1.3. Monitoring Area and Locations
    - 3.1.4. Monitoring Frequency
    - 3.1.5. Methods (QAPP as Appendix)

4. Results Reporting
    - 4.1.1. Data Reduction, Analysis, Interpretation, and Summarization
    - 4.1.2. Report Contents
    - 4.1.3. Reporting Schedule

5. Post Construction Project Controls (if needed)
    - 5.1.1. Proposed Controls
    - 5.1.2. Documentation Procedures
    - 5.1.3. Notification Procedures

6. Contingency Response and Adaptive Management Process
    - 6.1.1. Contingency Response Approach (conditions requiring immediate response and actions)
    - 6.1.2. Tiered Adaptive Management Process
    - 6.1.3. Triggers for Response Tiers
        - Controls (if needed)
        - Monitoring

7. Transition to Gasco Site-wide Remedial Action

7.1.1. Integration of Ongoing RI/FS and Source Control Data (not required by Project Statement of Work or Agreed Order on Consent)
7.1.2. Update upon Upland and Harbor-wide Remedial Action
7.1.3. Update upon Sediment Site Specific Remedial Action Long Term Monitoring

8. References

Attachment F-1 – Quality Assurance Project Plan (QAPP)

APPENDIX G

BORING LOGS

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-01
DATE BEGAN 7/21/04
DATE COMPLETED 7/21/04
TOTAL DEPTH 20 feet
SHEET 1 OF 1

Field location of boring
Mudline: 0.5 feet
Staff Gage: 2.5 feet
Latitude: 45.57977374
Longitude: 122.75818444

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								SAND (SP); black; fine to medium sand, oil saturated, sticky, sheen.
				1.5		1		
						2		
						3		
						4		
						5		
								0.3 feet: **SAND (SP)**; black; fine to medium sand, oil saturated, sticky, sheen.
						6		
				3.5				0.2 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen.
						7		
								0.3 feet: **SAND (SP)**; grayish brown; fine sand.
						8		0.3 feet: **SILT (ML)**; grayish brown; as above.
								0.1 feet: **SAND (SP)**; grayish brown; fine to medium sand.
						9		0.6 feet: **SILT (ML)**; grayish brown; as above.
								0.1 feet: **SAND (SP)**; grayish brown; fine to medium sand.
						10		1.6 feet: **SILT (ML)**; grayish brown; as above.
						11		
						12		**SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand.
				4.0				
						13		
						14		
						15		0.2 feet: **SAND (SP)**; grayish brown; fine to medium sand. (At base of sample interval)
						16		
						17		2.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand.
				4.5				
						18		
						19		2.0 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 10 to 20 percent nonplastic to low plasticity fines.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-02
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 3.2 feet
Staff Gage: 2.75 feet
Latitude: 45.57982789
Longitude: 122.75792804

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								No recovery 0-10 feet with Geoprobe. Pushed core liner 4 feet into sediment using PVC rods w/ check valve with 0.5 feet recovery.
				0.0		1		
						2		0.5 feet: **Sandy Tar**; black; fine to medium sand in tar matrix.
						3		
						4		
						5		
						6		
				0.0		7		
						8		
						9		
						10		
						11		
						12		**SILT (ML)**; grayish brown; low to medium plasticity fines; light to medium sheen.
				3.0		13		
						14		@ approximately 1 foot from top of sample interval, 0.2 foot-thick oil/tar layer; firm, sticky.
						15		@ approximately 2.5 feet from top of sample interval, 0.2 foot-thick oil/sand layer with wood fragments.
						16		
						17		**SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand; lenses of color change to black; spotty sheen.
				3.5		18		No sheen in bottom 1 foot of sample.
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-03
DATE BEGAN 7/21/04
DATE COMPLETED 7/21/04
TOTAL DEPTH 23 feet
SHEET 1 OF 1

Field location of boring
Mudline: 27.4 feet Latitude: 45.58007390
Staff Gage: 5.25 feet Longitude: 122.75794293

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								No recovery 0-8 feet with Geoprobe; rods sink to 8 feet below mudline. Pushed 3-inch outside-diameter piston core 1.5 feet into sediment on 7/22/04.
				0.0		1		
						2		
						3		0.0 to 1.5 feet: **SILT (ML)**: grayish brown; medium plasticity fines; sheen.
						4		@ 0.2 to 0.3 feet: Oil/tar layer; black; firm @ 0.6 to 0.9 feet: Oil/tar layer; black; firm @ 1.2 to 1.4 feet: Oil/tar layer; black; firm; droplets of free product.
						5		
						6		
						7		
						8		
						9		Stratified layers of **Sand (SP), SILT (ML)**, and **SILTY SAND (SM)** in layers of 0.2 to 0.3 feet thick. Trace wood chips; trace oil specks.
						10		
				3.0		11		
						12		
						13		
						14		**SAND (SP)**; grayish brown; fine to medium sand; loose; no sheen or specks.
						15		
				2.0		16		
						17		
						18		
						19		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand. 0.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity.
						20		0.3 feet: **SAND (SP)**; grayish brown; fine to medium sand. 0.6 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines.
				3.0		21		0.5 feet: **SAND (SP)**; grayish brown; fine sand. 0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						22		
						23		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-04
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/21/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/21/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Mudline: 0.5 feet above water
Staff Gage: 3.5 feet
Latitude: 45.57971933
Longitude: 122.75805875

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		1.0 foot: **SANDY TAR with SILT**; black; fine to medium sand in tar matrix; nonplastic to low plasticity fines; trace fine to medium gravel; angular to subrounded.
						2		
				2.5				1.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen.
						3		
						4		
						5		
						6		5.0 to 6.0 feet: **SAND (SP)**; black; fine to medium sand; approximately 30 percent tar; trace fine to medium gravel.
						7		
				5.0				6.0 to 20.0 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen.
						8		
						9		
						10		
						11		
						12		
				3.0				
						13		
						14		
						15		
						16		
						17		
				4.5				
						18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-05
DATE BEGAN 7/22/04
DATE COMPLETED 7/22/04
TOTAL DEPTH 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 3.1 feet
Staff Gage: 4.9 feet

Latitude: 45.57985022
Longitude: 122.75809311

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								1.3 feet: **TAR**; black; firm; sticky.
						1		0.3 feet: **SILT (ML)**; black; low plasticity fines; slight sheen.
								0.3 feet: **SAND (SP)**; black; fine sand, trace nonplastic to low plasticity fines.
						2		
				2.3				0.3 feet: **SILTY SAND (SM)**; black; fine to medium sand, 30 to 40 percent nonplastic to low plasticity fines; trace wood fragments.
						3		
								0.1 feet: **SAND (SP)**; dark gray to black; fine to medium sand.
						4		
						5		
								1.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace wood fibers; slight sheen.
						6		
								0.5 feet: **SANDY SILT (ML)**; dark gray; low to medium plasticity fines; 15 to 20 percent fine sand; medium sheen.
						7		
				3.5				0.2 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; light sheen.
						8		
								0.1 feet: **SILT (ML)**; dark gray; low to medium plasticity fines; medium sheen.
						9		
								1.1 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; light sheen in thin lenses.
						10		
						11		**SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen.
						12		
				3.5				
						13		Bottom 1 foot of interval contains lenses of fine sand 0.2 to 0.3 feet thick.
						14		
						15		
						16		
								2.0 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; loose; wet.
						17		
				5.0				
						18		
								2.0 feet: **SANDY SILT (ML)**; grayish brown; nonplastic to low plasticity fines; 30 to 40 percent fine sand.
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
BORING # RAA-06
PROJECT NUMBER 000029-02
DATE BEGAN 7/20/04
GEOLOGIST/ENGINEER J. Renda
DATE COMPLETED 7/20/04
DRILLING CONTRACTOR Geotech Explorations, Inc.
TOTAL DEPTH 20 feet
DRILLING METHOD Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER 2-inch

Field location of boring
Mudline: 4.4 feet
Staff Gage: 3.0 feet
Latitude: 45.58001600
Longitude: 122.75808147

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		0.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; loose.
						2		0.8 feet: **TAR with SILTY SAND**; black; fine to medium sand with low plasticity fines in tar matrix.
				2.2		3		0.7 feet: **SANDY SILT (ML)**; grayish brown; nonplastic to low plasticity fines; 30-40 percent fine sand.
						4		0.2 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines.
						5		
						6		0.5 feet: fine to medium gravel sized tar chunks; hard; brittle.
						7		2.0 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines.
				5.0		8		1.5 feet: **SANDY SILT (ML)**; grayish brown; nonplastic to low plasticity fines; 30-40 percent fine sand; specks of oil/sheen.
						9		1.0 feet: **SILTY SAND (SM)**; dark grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines; specks of oil/sheen.
						10		
						11		0.8 feet: **SILTY SAND (SM)**; dark grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines; specks of oil/sheen.
						12		0.3 feet: **SANDY SILT (ML)**; grayish brown; medium plasticity fines; 30-40 percent fine sand; specks of oil/sheen.
				1.1		13		
						14		
						15		
						16		3.0 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand; lenses of color change to black; spotty sheen.
						17		2.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; no sheen or spotting.
				5.0		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-07
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 16.7 feet
Staff Gage: 5.75 feet
Latitude: 45.58011224
Longitude: 122.75818444

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		No recovery 0-5 feet with Geoprobe; rods sink to 5 feet below mudline in the soft sediment.
						2		
						3		
						4		
						5		
						6		**SAND (SP)**; black; fine to medium sand; stratified with 0.3 to 0.4 foot-thick layers of TAR; firm and sticky.
						7		
				3.5		8		
						9		
						10		
						11		0.5 feet: **TAR**; black; 20 to 30 percent nonplastic to low plasticity fines; firm.
						12		0.5 feet: **SILT (ML)**; gray; medium plasticity fines. 1 foot: **TAR**; black; 20 to 30 percent fine to medium sand.
				3.5		13		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand; few tar blebs; spotty sheen.
						14		0.5 feet: **SILT (ML)**; grayish brown; medium plasticity fines; slight sheen.
						15		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand; no sheen.
						16		0.5 feet: **SILT (ML)**; grayish brown; medium plasticity fines; specks of oil/sheen.
				2.5		17		2.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; no sheen or spotting.
						18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-08
DATE BEGAN 7/21/04
DATE COMPLETED 7/21/04
TOTAL DEPTH 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 0.5 feet above water
Staff Gage: 3.2 feet

Latitude: 45.57982296
Longitude: 122.75845286

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		1 foot: **SANDY GRAVEL (GW)**; lt brown; fine to coarse; angular to subrounded; 20 to 30 percent fine to coarse sand.
						2		1 foot: **SAND (SP)**; black; fine to medium sand; oil/tar saturated.
				2.0		3		
						4		
						5		
						6		1.5 feet: **SAND (SP)**; black; fine to medium sand; saturated with oil/tar; firm and sticky.
						7		1.5 feet: **SILTY SAND (SM)**; grayish brown; fine sand; 20 to 30 percent nonplastic to low plasticity fines; no sheen.
				3.0		8		
						9		
						10		
						11		Note: no recovery; move over 1.5 feet and core 10 to 15 feet with full recovery.
						12		**SILTY SAND (SM)**; grayish brown; fine sand; 20 to 30 percent low to medium plasticity fines; no sheen.
				5.0		13		
						14		
						15		
						16		**SILT (ML)**: grayish brown; nonplastic to low plasticity fines; 5 to 10 percent fine sand; loose, wet, no sheen or spotting.
						17		
				5.0		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-09
DATE BEGAN 7/19/04
DATE COMPLETED 7/19/04
TOTAL DEPTH 20 feet
SHEET 1 OF 2

Field location of boring

Mudline: 0.2 feet
Staff Gage: 3.0 feet
Latitude: 45.57990589
Longitude: 122.75826530

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								1.8 feet: **TAR**; black; firm; sticky.
						1		
								0.2 feet: **SAND (SP)**; dark gray; fine to medium sand; heavy sheen; oil droplets.
						2		
				2.0				
						3		
						4		
						5		
								SAND (SP); dark gray; fine to medium sand; heavy sheen; oil droplets.
						6		
						7		
				3.5				
						8		
						9		
						10		
								SAND (SP); dark gray; fine to medium sand; trace tar globs; heavy sheen; trace wood fragments.
						11		
						12		
								@ 12 to 14 feet; same with approximately 30 percent nonplastic fines.
				5.0		13		
						14		
						15		
						16		@ 16 feet: No sheen
						17		
				5.0				17.5 to 20 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen.
						18		@ 19 feet: 0.1 foot sand lense; fine to medium sand.
						19		
								@ 19.5 feet: 0.1 foot sand lense; fine to medium sand.
						20		

Remarks: A boring was advanced from 0 to 4 feet below mudline with 1.5 feet recovery. 1.5 feet of of tar was observed with sand in drive shoe. In the 4 to 8 foot interval, 2 feet of SAND was observed (2 feet recovery). Borehole was decommissioned with bentonite chips and a second boring was advanced as described above.

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-09
DATE BEGAN 7/19/04
DATE COMPLETED 7/19/04
TOTAL DEPTH 20 feet
SHEET 2 OF 2

Field location of boring
Mudline: 0.2 feet
Staff Gage: 3.0 feet
Latitude: 45.57990589
Longitude: 122.75826530

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								2.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen.
						21		
								1.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; loose, soupy; trace wood fibers, no sheen.
						22		
				4.5				
						23		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand.
						24		
						25		
								SILT (ML); grayish brown; nonplastic to low plasticity fines; trace fine sand; trace wood fragments; no sheen.
						26		
						27		
				5.0				@ 27 feet: 0.1 foot-thick sand lens.
						28		
						29		
								@ 29.5 feet: increase in plasticity and firmness.
						30		
						31		
						32		**SAND (SP)**; dark gray; fine to medium sand.
				5.0		33		
						34		
						35		@ 34.5 feet: 0.2 foot-thick silt lense; grayish brown; medium plasticity fines.
						36		
						37		**SAND (SP)**; grayish brown; fine to medium sand.
				5.0		38		
						39		
						40		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-10
DATE BEGAN 7/19/04
DATE COMPLETED 7/19/04
TOTAL DEPTH 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 2.3 feet
Staff Gage: 2.0 feet
Latitude: 45.580043205
Longitude: 122.75827003

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		**SAND (SP)**; black; fine to medium sand; 20 to 30 percent oil/tar; loose to firm; wet; heavy sheen.
						2		
				3.0				
						3		
						4		
						5		
						6		**SAND (SP)**; black; fine to medium sand; 20 to 30 percent oil/tar; loose to firm; wet; heavy sheen.
						7		
				2.0				
						8		
						9		
						10		
						11		**SILT (ML)**; grayish brown; medium plasticity fines; trace wood fragments.
						12		Oily specks to a depth of approximately 12 feet.
				4.0		13		
						14		
						15		
						16		2.5 feet: **SILT (ML)**: grayish brown; medium plasticity fines; trace wood fragments.
								1.0 feet: **SAND (SP)**; grayish brown; fine to medium sand.
						17		0.5 feet: **SANDY SILT (ML)**; grayish brown; low plasticity fines; 30 to 40 percent fine sand.
				5.0				
						18		0.5 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent low plasticity fines.
						19		0.5 feet: **SANDY SILT (ML)**; grayish brown; low plasticity fines; 30 to 40 percent fine sand.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-11
DATE BEGAN 7/22/04
DATE COMPLETED 7/22/04
TOTAL DEPTH 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 2.9 feet
Staff Gage: 2.9 feet
Latitude: 45.58003730
Longitude: 122.75844474

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								1.1 feet: **TAR;** black; firm; sticky.
						1		2.2 feet: **SAND (SP)**; dark gray grading to grayish brown; fine to medium sand; slight sheen.
						2		
				3.3				@ approximately 2 feet from top of sample interval: 0.1 foot-thick silt lense
						3		@ approximately 3 feet from top of sample interval: 0.1 foot-thick silt lense
						4		
						5		
						6		**SAND (SP)**; grayish brown; fine to medium sand; few oily specks; slight heavy sheen.
						7		@ approximately 1.9 feet from top of sample interval: 0.3 foot-thick silt lense; low to medium plasticity; sheen.
				3.3		8		@ approximately 2.9 feet from top of sample interval: 0.2 foot-thick silt lense; low to medium plasticity; sheen.
						9		
						10		
						11		0.3 feet: **SAND (SP)**; grayish brown; fine to medium sand; sheen.
						12		3.7 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; Oily specks to a depth of approximately 12 feet.
				4.0		13		@ 1 foot from top of sample interval: sand lense; oily, loose, laminated with silt, sand , and wood fibers.
						14		@ 1.5 feet from top of sample interval: tar chunk; hard, brittle, < 0.1 foot.
						15		@ 2.0 feet from top of sample interval: silty sand lense.
						16		2.8 feet: **SILT (ML)**: grayish brown; low to medium plasticity fines; trace wood fragments.
						17		0.2 feet: **SAND (SP)**; grayish brown; fine to medium sand, < 10 percent nonplastic fines.
				5.0		18		0.5 feet: **SILT (ML)**: grayish brown; nonplastic to low plasticity fines.
						19		0.8 feet: **SAND (SP)**; grayish brown; fine to medium sand. 0.7 feet: **SILT (ML)**: grayish brown; nonplastic to low plasticity fines.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
PROJECT NUMBER: 000029-02
GEOLOGIST/ENGINEER: J. Renda
DRILLING CONTRACTOR: Geotech Explorations, Inc.
DRILLING METHOD: Direct Push/Geoprobe
HOLE DIAMETER: 2-inch

BORING #: RAA-12
DATE BEGAN: 7/20/04
DATE COMPLETED: 7/20/04
TOTAL DEPTH: 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 4.3 feet
Staff Gage: 4.5 feet
Latitude: 45.58016669
Longitude: 122.75850000

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								1.0 feet: **SILT (ML);** grayish brown; nonplastic fines; loose; slight sheen.
						1		0.5 feet: **SILT (ML);** dark gray to black; low plasticity fines; heavy sheen.
						2		Note: An additional sample was collected using a Piston Core sampler. Pushed 3-inch outside-diameter piston core 3.0 feet into sediment on 7/22/04.
				1.5				
						3		
						4		0.0 to 0.2 feet: **SILT (ML)**: grayish brown; nonplastic fines; loose; oily sheen.
						5		0.2 to 3.0 feet: **SILT (ML)**; grayish brown; low plasticity fines; firm; slight sheen.
						6		@ 0.4 to 0.5 feet: black oily layer
						7		
				0.0				
						8		
						9		
						10		
								SILT (ML); grayish brown; nonplastic to low plasticity fines; trace oil specks.
						11		
						12		@ 12 feet: 0.1 foot-thick oil/tar lense, black; firm.
								@ 12.1 feet: color change to dark gray/black with oily laminations.
				4.5		13		
						14		
						15		
								SILT (ML); grayish brown; nonplastic to low plasticity fines; trace oil specks.
						16		
						17		
				5.0				@ 17 to 17.5 feet: **SAND (SP)**; grayish brown; fine to medium sand; slight sheen.
						18		
						19		@ 18 to 20 feet: no sheen.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
BORING # RAA-13
PROJECT NUMBER 000029-02
DATE BEGAN 7/20/04
GEOLOGIST/ENGINEER J. Renda
DATE COMPLETED 7/20/04
DRILLING CONTRACTOR Geotech Explorations, Inc.
TOTAL DEPTH 22 feet
DRILLING METHOD Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER 2-inch

Field location of boring
Mudline: 19.9 feet
Staff Gage: 4.0 feet
Latitude: 45.58017940
Longitude: 122.75836670

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								No recovery 0-7 feet with Geoprobe. Pushed core liner 4 feet into sediment using PVC rods w/ check valve with no recovery. Outside of core tube was coated with black oil/tar.
				0.0		1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		1.0 foot: **SILT (ML);** grayish brown; nonplastic fines; loose; slight sheen.
						9		2.0 feet: **TAR**; black; silty with silt lenses and fibrous wood layers.
				4.0		10		0.4 feet: **SILT (ML);** black; nonplastic to low plasticity fines. 0.3 feet: **SILT (ML);** grayish brown; nonplastic to low plasticity fines.
						11		0.3 feet: **SAND (SP);** grayish brown; fine to medium sand.
						12		
						13		2.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; loose; slight spotty sheen.
						14		
				3.0		15		1.0 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines; no sheen or oil specks.
						16		@ 2.5 feet from top of sample interval: 0.2 foot-thick silt lense.
						17		
						18		3.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; 3 specks of oil noted in top 1.5 feet of sample interval.
						19		1.8 feet: **SILTY SAND (SM)**; grayish brown; fine sand; 20 to 30 percent nonplastic to low plasticity fines; no sheen or oil specks.
				5.0		20		
						21		0.2 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines.
						22		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-14
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Mudline: 31.1 feet
Staff Gage: 3.75 feet
Latitude: 45.58022110
Longitude: 122.75825230

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								No recovery 0-10 feet with Geoprobe; rods sink to 10 feet below mudline.
				1.1		1		Pushed 3-inch outside-diameter piston core 1.1 feet into sediment on 7/22/04.
						2		
						3		**SILT (ML)**; grayish brown; low to medium plasticity fines; trace wood fibers; approximately 6, 0.1 foot-thick lenses of black tar; firm and sticky.
						4		
						5		
						6		
						7		
				0.0		8		
						9		
						10		
						11		10.0 to 11.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; loose; blebs of tar/oil.
						12		11.5 to 13.5 feet: **SILT (ML)**: grayish brown to black; low to medium plasticity fines; black dense tar laminations; trace wood fibers and wood chunks.
				5.0		13		@13.5 feet: Fine Gravel.
						14		13.5 to 14.0 feet: **SANDY SILT (ML)**; grayish brown; low to medium plasticity fines; 30 to 40 percent fine sand; no sheen or spotting.
						15		14.0 to 20.0 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; no sheen or spotting.
						16		@ 14.3 to 14.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						17		
				4.0		18		@ 18.0 to 18.4 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						19		@ 19.0 to 19.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
PROJECT NUMBER: 000029-02
GEOLOGIST/ENGINEER: J. Renda
DRILLING CONTRACTOR: Geotech Explorations, Inc.
DRILLING METHOD: Direct Push/Geoprobe
HOLE DIAMETER: 2-inch

BORING #: RAA-15
DATE BEGAN: 7/21/04
DATE COMPLETED: 7/21/04
TOTAL DEPTH: 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 3 feet above water
Staff Gage: 4.0 feet
Latitude: 45.57996370
Longitude: 122.75874391

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		0.7 feet: **GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines; moist.
						2		0.3 feet: **GRAVELLY SAND (SW)**; grayish brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines; wet.
				1.0		3		@2.5 feet: standing water in borehole.
						4		
						5		
						6		1.0 feet: **SILT WITH SAND (ML)**; grayish brown; nonplastic fines; 20 to 30 percent fine sand; loose; spotty sheen; sluff?
						7		3.0 feet: **SILT WITH SAND (ML)**; grayish brown; nonplastic fines; 20 to 30 percent fine sand; firm; no sheen.
				4.0		8		@ 3 feet from top of sample interval: 0.1 foot-thick woody layer.
						9		
						10		
						11		**SILT WITH SAND (ML)**; grayish brown; nonplastic fines; 20 to 30 percent fine sand; firm; no sheen.
						12		
				3.0		13		
						14		
						15		
						16		No recovery
						17		
				0.0		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-16
DATE BEGAN 7/22/04
DATE COMPLETED 7/22/04
TOTAL DEPTH 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 2.4 feet
Staff Gage: 3.0 feet
Latitude: 45.58024746
Longitude: 122.75866807

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								0.4 feet: **SILT (ML)**; dark gray to black; low plasticity fines; loose; medium to heavy sheen; 5 to 10 percent wood chips.
						1		
								0.8 feet: **SAND (SP)**; dark gray to black; fine to medium sand; trace fines; spotty sheen.
						2		
				2.8				1.2 feet: **SILT (ML)**; black; nonplastic to low plasticity fines; spotty sheen.
						3		
								@ 1.8 feet from top of sample interval: 0.1 foot-thick heavy sheen layer.
						4		0.4 feet: **SAND (SP)**; dark gray to black; fine to medium sand; trace fines; spotty sheen.
						5		
								1.4 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; loose, light sheen.
						6		
								@ 0.2 feet from top of sample interval: 0.1 foot-thick black oily layer.
						7		0.8 feet: **SAND (SP)**; grayish brown; fine to medium sand; trace fines; light sheen.
				3.2				
						8		1.0 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; dark gray to black banding; light sheen.
						9		
						10		
								0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine to medium sand, no sheen or spotting.
						11		
								0.3 feet: **SAND (SP)**; grayish brown; fine to medium sand; trace fines; no sheen.
						12		
								0.7 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen.
				3.7		13		
								0.6 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; no sheen.
						14		1.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; black laminations; no sheen.
						15		
								SILT (ML); grayish brown; low to medium plasticity fines; < 5 percent fine sand, trace root hairs; no sheen or spotting.
						16		
						17		
				5.0				
						18		
						19		@ 18.5 to 19.2 feet: loose, soupy.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-17
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/22/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/22/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 21 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Mudline: 2.7 feet
Staff Gage: 3.0 feet
Latitude: 45.58014987
Longitude: 122.75872767

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								No recovery 0-1 feet with Geoprobe; rods sink to 1 feet below mudline.
						1		
								0.5 feet: **SILT (ML)**; dark gray to black; nonplastic to low plasticity fines; loose, trace wood chucks; heavy sheen.
						2		
								1.0 feet: **SAND (SP)**; dark gray; fine to medium sand; trace fines; light sheen.
						3		
				2.5				0.5 feet: **SILT (ML)**; dark gray; nonplastic to low plasticity fines; loose, trace wood chucks; light sheen.
						4		
								0.5 feet: **SAND (SP)**; dark gray; fine to medium sand; trace fines; light sheen.
						5		
						6		
								SILT (ML); grayish brown; low to medium plasticity fines; trace woody layers; light sheen lenses.
						7		
						8		@ 1.5 feet from top of sample interval: 0.1 foot-thick woody layer with heavy sheen.
				3.2				
						9		
						10		
						11		
								0.4 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; no sheen.
						12		
								0.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace root hairs; no sheen or spotting.
						13		
				3.5				0.7 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; trace spotty sheen.
						14		
								1.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen or spotting.
						15		
								0.1 feet: **SILT (ML)**; black; nonplastic fines; firm; brittle; no sheen or spotting.
						16		
						17		0.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen.
						18		0.2 feet: **SILTY SAND (SM)**; grayish brown; fine sand; nonplastic fines; loose, soupy.
				3.5				
						19		1.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
								0.6 feet: **SAND (SP)**; grayish brown; fine sand; trace fines.
						20		0.4 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						21		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site
PROJECT NUMBER 000029-02
GEOLOGIST/ENGINEER J. Renda
DRILLING CONTRACTOR Geotech Explorations, Inc.
DRILLING METHOD Direct Push/Geoprobe
HOLE DIAMETER 2-inch

BORING # RAA-18
DATE BEGAN 7/21/04
DATE COMPLETED 7/21/04
TOTAL DEPTH 20 feet
SHEET 1 OF 1

Field location of boring

Mudline: 4 feet above water
Staff Gage: 2.75 feet

Latitude: 45.57968324
Longitude: 122.75810387

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		**GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines; moist.
				1.2		2		
						3		
						4		
						5		
						6		5.0 to 20.0 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; 5 to 10 percent fine sand.
				1.5		7		
						8		
						9		
						10		
						11		
				4.0		12		
						13		
						14		
						15		
						16		
				4.0		17		
						18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-19
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/22/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/22/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Latitude: 45.57985626
Longitude: 122.75846549

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		1.4 feet: **GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines.
						2		0.2 feet: **GRAVELLY SAND (SW)**; gray; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines.
				2.5		3		0.6 feet: **WOOD CHIPS**; dark brown to black; 3 medium sized gravel-like tar chunks; hard.
						4		0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; 5 to 10 percent fine sand; spotty sheen.
						5		
						6		0.3 feet: **SILT (ML)**; grayish brown; nonplastic fines.
						7		2.0 feet: **TAR**; black; with oil/tar saturated lenses of sand and silt.
				2.3		8		
						9		
						10		
						11		10.0 to 20.0 feet: **SILT (ML);** gray; low to medium plastic fines; 10 to 20 percent fine sand; no sheen.
						12		
				4.0		13		
						14		
						15		
						16		
						17		
				4.5		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-20
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/22/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/22/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Latitude: 45.57975098
Longitude: 122.75829940

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		1.5 feet: **GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines.
						2		0.8 feet: **TAR**; black; with oil/tar saturated lenses of sand and silt.
				2.5				0.2 feet: **SAND (SP)**; dark gray; fine to medium; spotty sheen.
						3		
						4		0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; 5 to 10 percent fine sand; spotty sheen.
						5		
						6		5.0 to 5.5 feet: **GRAVELLY SAND (SW)**; gray; fine to coarse sand; fine to medium gravel; angular to subrounded; fine to coarse sand; spotty sheen.
						7		5.5 to 5.6 feet: **SAND (SP)**; dark gray; fine to medium sand; spotty sheen.
				5.0		8		5.6 to 20.0 feet: **SILT (ML);** grayish brown; nonplastic to low plasticity fines; 10 to 20 percent fine sand; trace fine sand lenses; no sheen.
						9		
						10		
						11		10.0 to 20.0 feet: **SILT (ML);** gray; low to medium plastic fines; 10 to 20 percent fine sand; no sheen.
						12		
				4.5		13		
						14		
						15		
						16		
						17		
				5.0		18		
						19		
						20		

Remarks:

HAHN & ASSOCIATES, INC. 434 NW Sixth Avenue Portland, Oregon (503) 796-0717	**SOIL BORING NUMBER**		**AN-2-1**	
	HAI LOGGER:	Kim Magruder/Rob Ede	DRILL	DRILL
PROJECT:	SAMPLING METHOD:	Stainless Steel Soil Sampler	START	FINISH
NW Natural	DRILLING METHOD:	Vibracore	Time:	Time:
Gasco Facility	EQUIPMENT TYPE	Same as above	9:23	9:28
Portland, Oregon	DRILLER:	Bill Jaworski	Date:	Date:
PROJECT #: 2708	DRILLING CONTRACTOR:	Marine Sampling Systems	04/11/01	04/11/01

BORING DIAMETER: 3-inch OD
CASING DIAMETER: N/A
SURFACE ELEVATION: Estimated to be: N/A
TOP OF CASING ELEVATION: N/A

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)
				AN2-1A				
			2.0			1		ML
						2		
						3		
			1.4			4		
				AN2-1B		**5**		
						6		
						7		
			0.0			8		ML
				AN2-1C		9		
						10		
						11		
						12		
						13		
						14		
						15		

SOIL DESCRIPTION

AN2-1A (4' 2" core length)
SILT, brown, wet, soft (soupy), small fraction very fine sand (<5%), organic matter (rootlets, wood fiber), no sheen, slight hydrocarbon odor (0 to 10 cm), slight increase in sand content and slight sheen (10 to 20 cm); increased organic matter, decreased moisture content, no sheen, no hydrocarbon odor (30 to 40 cm).

SILT, as above to 3', at 3' have a 2" thick tar layer (black and oily with some elastic tar and associated oily tar), slight sheen, hydrocarbon odor, 3-inch thick sandy silt zone from 3'11" to 4'2.

AN2-1B (3' 11" core length)
SILT, olive grey with black mottling, moist, medium soft, with weathered tar layers to 5' 11" bgs, below weathered tar zone silt is olive grey, no sheen, no hydrocarbon odor.

AN2-1C (3' 3" core length)
SILT, olive grey, moist, medium soft, no sheen, no hydrocarbon odor.

Total Core Push =
Total Recovered Core Length = 11' 4"

HAHN & ASSOCIATES, INC. 434 NW Sixth Avenue Portland, Oregon (503) 796-0717	**SOIL BORING NUMBER**		**AN-2-2**	
	HAI LOGGER:	Kim Magruder/Rob Ede	DRILL	DRILL
PROJECT:	SAMPLING METHOD:	Stainless Steel Soil Sampler	START	FINISH
NW Natural	DRILLING METHOD:	Vibracore	Time:	Time:
Gasco Facility	EQUIPMENT TYPE	Same as above	10:06	10:11
Portland, Oregon	DRILLER:	Bill Jaworski	Date:	Date:
PROJECT #: 2708	DRILLING CONTRACTOR:	Marine Sampling Systems	04/11/01	04/11/01

BORING DIAMETER: 3-inch OD
CASING DIAMETER: N/A
SURFACE ELEVATION: Estimated to be: N/A
TOP OF CASING ELEVATION: N/A

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)	SOIL DESCRIPTION
				AN2-2A		1		ML	**AN2-2A (4' 0" core length)** SILT, light brown, wet, medium soft, several hard tar fragments with associated oil blebs (0 to 10 cm). SILT, as above, increased tar fragment content, decreased moisture (10 to 20 cm). SILT, as above, slightly moist, no tar or oil, slight sheen (30 to 40 cm). SILT, as above to 1'8", then encounter a weathered black, stiff tar layer (tar w/out the elasticity), black viscous oil below weathered tarry zone extends to base of core at 4'.
						2			
						3			
						4			
				AN2-2B		**5**			
						6		ML	**AN2-2B (4' 4" core length)** SILT, olive grey and black, moist, few thin fine grained sand layers, much plant material, black, weathered tar layers with viscous oil to 5' 6" bgs, below which Silt becomes olive grey with no tar or oil to base of core at 8' 4"
						7			
						8			
						9			
				AN2-2C		10			**AN2-2C (3' 8" Core length)** Sandy SILT, light brown and grey mottled, moist, some fines, plant matter, no sheen, slight odor (organic?), fine grained sand across 10'10" to 11'6" interval (moist, grey), no sheen, no odor to base of core at 12 feet bgs.
						11			
						12		S ML	Total Core Push = Total Recovered Core Length = 12' 0"
						13			
						14			
						15			

HAHN & ASSOCIATES, INC. 434 NW Sixth Avenue Portland, Oregon (503) 796-0717	**SOIL BORING NUMBER**		**AN-2-3**	
	HAI LOGGER:	Kim Magruder/Rob Ede	DRILL	DRILL
PROJECT:	SAMPLING METHOD:	Stainless Steel Soil Sampler	START	FINISH
NW Natural	DRILLING METHOD:	Vibracore	Time:	Time:
Gasco Facility	EQUIPMENT TYPE	Same as above	10:40	10:45
Portland, Oregon	DRILLER:	Bill Jaworski	Date:	Date:
PROJECT #: 2708	DRILLING CONTRACTOR:	Marine Sampling Systems	04/11/01	04/11/01

BORING DIAMETER: 3-inch
CASING DIAMETER: N/A
SURFACE ELEVATION: Estimated to be: N/A
TOP OF CASING ELEVATION: N/A

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)	SOIL DESCRIPTION
				AN2-3A		1		ML	**AN2-3A (4' 0" core length)** SILT, olive grey, wet, soft, slight sheen on outside of core, few wood chips, no sheen, no hydrocarbon odor, no product (0 to 10 cm). SILT, as above, 2 small tar fragments (10 to 20 cm)
						2			
						3			SILT, as above, slightly moist, firm, plant matter - rootlets present, very slight sheen, no hydrocarbon odor, no tar (30 to 40 cm).
						4			SILT, as above to 2'9" where layers of black weathered tar (not elastic) are present, patches of viscous oil below weathered tar zone, magnitude of oil (patchy) decreasing to base of core at 4" 0".
				AN2-3B		**5**			**AN2-3B (4' 0" core length)** Sandy SILT, light brown, moist, much plant matter, minor black mottling, no sheen, moderate petroleum odor to 5'10", where 4" thick weathered tar is present, tar layer contains several small leaves, tar layer is underlain by light brown sandy SILT with rootlets, no tar, no oil, no sheen (6'2" to 8').
						6			
						7			
						8			
				AN2-3C		9		ML	**AN2-3C (4' 2" core length)** Sandy SILT, as above, light brown, soft to medium-stiff, minor rootlets, no odor, no sheen, no oil, no tar, (8' to 11'10").
						10			
						11			
						12			SAND, grey, moist, very fine grained, no odor, no sheen 11' 10" to 12' 2").
			0.0			13		SP	Total Core Push = Total Recovered Core Length = 12' 2"
						14			
						15			

HAHN & ASSOCIATES, INC. 434 NW Sixth Avenue Portland, Oregon (503) 796-0717	**SOIL BORING NUMBER**		**AN-2-4**	
	HAI LOGGER:	Kim Magruder/Rob Ede	DRILL	DRILL
PROJECT:	SAMPLING METHOD:	Stainless Steel Soil Sampler	START	FINISH
NW Natural	DRILLING METHOD:	Vibracore	Time:	Time:
Gasco Facility	EQUIPMENT TYPE	Same as above	15:05	15:10
Portland, Oregon	DRILLER:	Bill Jaworski	Date:	Date:
PROJECT #: 2708	DRILLING CONTRACTOR:	Marine Sampling Systems	04/11/01	04/11/01

BORING DIAMETER: 3-inch
CASING DIAMETER: N/A
SURFACE ELEVATION: Estimated to be: N/A
TOP OF CASING ELEVATION: N/A

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)	SOIL DESCRIPTION
				AN2-4A		1		ML	**AN2-4A (4' 0" core length)** SILT, brown, wet, very soft, brown oily blebs on outside of core, no sheen on interior, moderate petroleum odor (0 to 10 cm).
						2			
						3			SILT, as above, moist, soft, piece of wood and several blebs of brown oil product within core (10 to 20 cm). SILT, olive grey, moist, medium-soft, no visible oil product on interior of core, slight sheen (30 to 40 cm).
						4			
				AN2-4B		**5**			SILT, as above to 2'7" where sand content increases and a zone of black, weathered tar (moist, non-elastic, disintegrates with pressure) surrounded by patchy viscous black oil, rootlets, sticks, twigs (2'7" to 4' 0").
						6			
						7			
			7.2			8		SP	**AN2-4B (4' 2" core length)** Sandy SILT, brown, moist, much plant material, weathered tar zone at 6'0" to 6'6"
				AN2-4C		9			SAND, grey, moist, fine grained, hydrocarbon odor, no sheen, no product (6'6" to 8'2").
			6.3			10			**AN2-4C (2' 0" core length)** SAND, as above, petroleum odor, no oil, no tar, sheen on outside of core only.
						11			
						12			Total Core Push = Total Recovered Core Length = 10' 2"
						13			
						14			
						15			

Table G-1
Sample Station Geographical Coordinates

Station ID	Geographical Coordinates (NAD 83)	
	Latitiude (DD.mmm)	Longitude (DDD.mmm)
RAA-01	45.57977374	122.75795025
RAA-02	45.57982789	122.75792804
RAA-03	45.58007390	122.75794293
RAA-04	45.57971933	122.75805875
RAA-05	45.57985022	122.75809311
RAA-06	45.58001600	122.75808147
RAA-07	45.58011224	122.75818444
RAA-08	45.57982296	122.75845286
RAA-09	45.57990589	122.75826530
RAA-10	45.580043205	122.75827003
RAA-11	45.58003730	122.75844474
RAA-12	45.58016669	122.7585000
RAA-13	45.5801794	122.7583667
RAA-14	45.58022110	122.7582523
RAA-15	45.57996370	122.75874391
RAA-16	45.58005925	122.75862963
RAA-17	45.58014987	122.75872767
RAA-18	45.57968324	122.75810387
RAA-19	45.57976742	122.75854962
RAA-20	45.57975098	122.75829940

APPENDIX H

SLOPE STABILITY ANALYSIS

APPENDIX H

SLOPE AND CAP STABILITY ANALYSES
FINAL DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

On Behalf of

NW Natural
220 NW Second Avenue
Portland, Oregon 97209

November 2004

1 INTRODUCTION 1

2 SLOPE STABILITY DESIGN STANDARD 2

3 SOIL AND GROUNDWATER CONDITIONS 3
3.1 Soil Properties 3
3.2 Water Elevation 4

4 POST-REMEDIATION SLOPE GEOMETRY 5

5 SLOPE STABILITY RESULTS 6

List of Tables

Table H-1 – Soil Parameters Used in Slope Stability Analyses

Table H-2 – Lower Willamette River Water Elevations

List of Figures

Figure H-1 – Dredge Plan and Cross Section Locations

Figure H-2 – Existing Slope Condition – Station 1+50

Figure H-3 – Post-Remediation Condition (2.5H:1V) – Station 1+50

List of Attachments

Attachment H-1 – Memorandum on Cap Grain Size Stability

Attachment H-2 – Memorandum on River Velocities

1 INTRODUCTION

Slope stability, cap material stability, and river velocity analyses for the submerged slopes at the "Gasco" site were performed for the Removal Action Project. The main text of this document is focused on slope stability analysis. Attachment H-1 to this report presents a memorandum on cap grain size erosion stability, and Attachment H-2 presents a memorandum on river velocities.

2 SLOPE STABILITY DESIGN STANDARD

For both the existing slope conditions as well as the proposed dredged/capped configuration, strength and index properties of the in situ soils were determined from exploration and laboratory programs. The model and soil parameters were calibrated using the existing slope configuration, water surface, and stability conditions. These soil parameters were then used in conjunction with the soil parameters for the proposed capping materials to evaluate the post-remediation configuration (dredged and capped).

Slope stability analyses were performed using a cross section through Station 1+50. The location of the cross section is shown on Figure H-1. The same cross section location was used for the existing and post-construction conditions, as shown on Figure H-2.

Static slope stability conditions were modeled using the computer software Slide (version 5.0). The program calculates the factor of safety against slope instability for a two-dimensional cross section. The factor of safety as it relates to strength is generally defined as the ratio of available soil shear resistance (strength) to the gravitational forces (shear stress) tending to cause failure along a potential failure surface. For the case where the shear strength is equal to the shear stress, a factor of safety equal to 1.0 exists and the slope is in a state of impending failure. Generally for slope stability engineering purposes, a minimum factor of safety of 1.3 is considered acceptable under static conditions (Army Corps of Engineers 1987, Confined Disposal of Dredged Material, EM 1110-2-5027, September 30, 1987).

3 SOIL AND GROUNDWATER CONDITIONS

Subsurface conditions used in the slope stability analyses were based on data collected from geotechnical explorations and laboratory testing. Data was obtained from the following exploration locations as described in the Removal Action Project Plan (RAPP).

- RAA-05
- RAA-06
- RAA-03

3.1 Soil Properties

Based on review of the explorations listed above, the following major existing stratigraphic units were identified with depth, as shown on Figure H-2:

- Tar Body: This layer consists of varying amounts of tar mixed with sediment. The thickness of the layer is variable along cross section 1+50, ranging from approximately 2 to 6 feet.
- Loose Silt/Sand: Based on observations of the geotechnical explorations, this layer is approximately 5 to 8 feet thick along the cross section. This layer was often penetrated by the weight of the rods of the Geoprobe sampler.
- Medium Dense Silty Sand/Sandy Silt: This layer was similar in nature to the overlying loose silt/sand, but with notably increased density.

The physical properties of each unit were initially obtained from correlations with field and/or laboratory measurements. Laboratory testing included moisture content, grain size distribution, and Atterberg Limits.

The physical parameters of each soil unit were then calibrated using the results of the initial slope stability analyses of the existing conditions. If necessary, the soil parameters were slightly adjusted so that the computed factor of safety was representative of the condition of the existing slope, which is observed to be stable. Table H-1 presents the physical parameters used in the modeling, following initial calibration. The cap material modeled is consistent with the materials selected for design (see RAPP).

3.2 Water Elevation

The following water elevations for the Lower Willamette River were developed through a statistical analysis of historical data (Table H-2)

Similar to selection of the soil parameters, a sensitivity analysis of the river water elevation was also performed to identify the conservative condition. However, due to the elevation of the slope relative to the water surface, varying the water elevation had little or no effect on the factor of safety against slope failure.

4 POST-REMEDIATION SLOPE GEOMETRY

Several configurations of the dredge cut slope were modeled to determine the geometry that would provide acceptable stability, while still considering the volume of dredge material to be removed. Based on these iterations, the most efficient dredge cut was determined to be a stair-stepped cut with a maximum slope angle of approximately 2.5H:1V beginning near the base of the slope. At station 1+50, this corresponds to a dredge cut between approximately elevation -34 and 8 feet (NAVD 88).

The proposed 1-foot-thick sand/gravel cap would be placed on the slope following completion of the dredging.

5 SLOPE STABILITY RESULTS

Slope stability analyses were performed using the Slide computer software (version 5.0) with the soil and water parameters discussed above to simulate static conditions. The model predicted a minimum factor of safety of approximately 1.44 for a failure surface approximately 5-feet deep, as shown on Figure H-3. The factor of safety for a deeper (global) failure surface is predicted to be greater than 2.0. Therefore, the proposed 2.5H:1V dredge cut and cap configuration is considered stable under static conditions.

Tables

Table H-1
Soil Parameters Used in Slope Stability Analyses

Stratigraphic Unit	Moist Unit Weight, g (pcf)	Angle of Internal Friction, ϕ (deg)	Cohesion, c (psf)
Existing Slope Stratigraphy			
Tar Body	105	24	25
Loose Silt/Sand	105	26	5
Med. Dense Silty Sand/Sandy Silt	105	28	5
Slope Capping Materials			
Sand/Gravel Cap	120	30	5

Table H-2
Lower Willamette River Water Elevations

Percentile	NAVD 88
10th	7.55
50th	9.92
90th	14.95

Figures

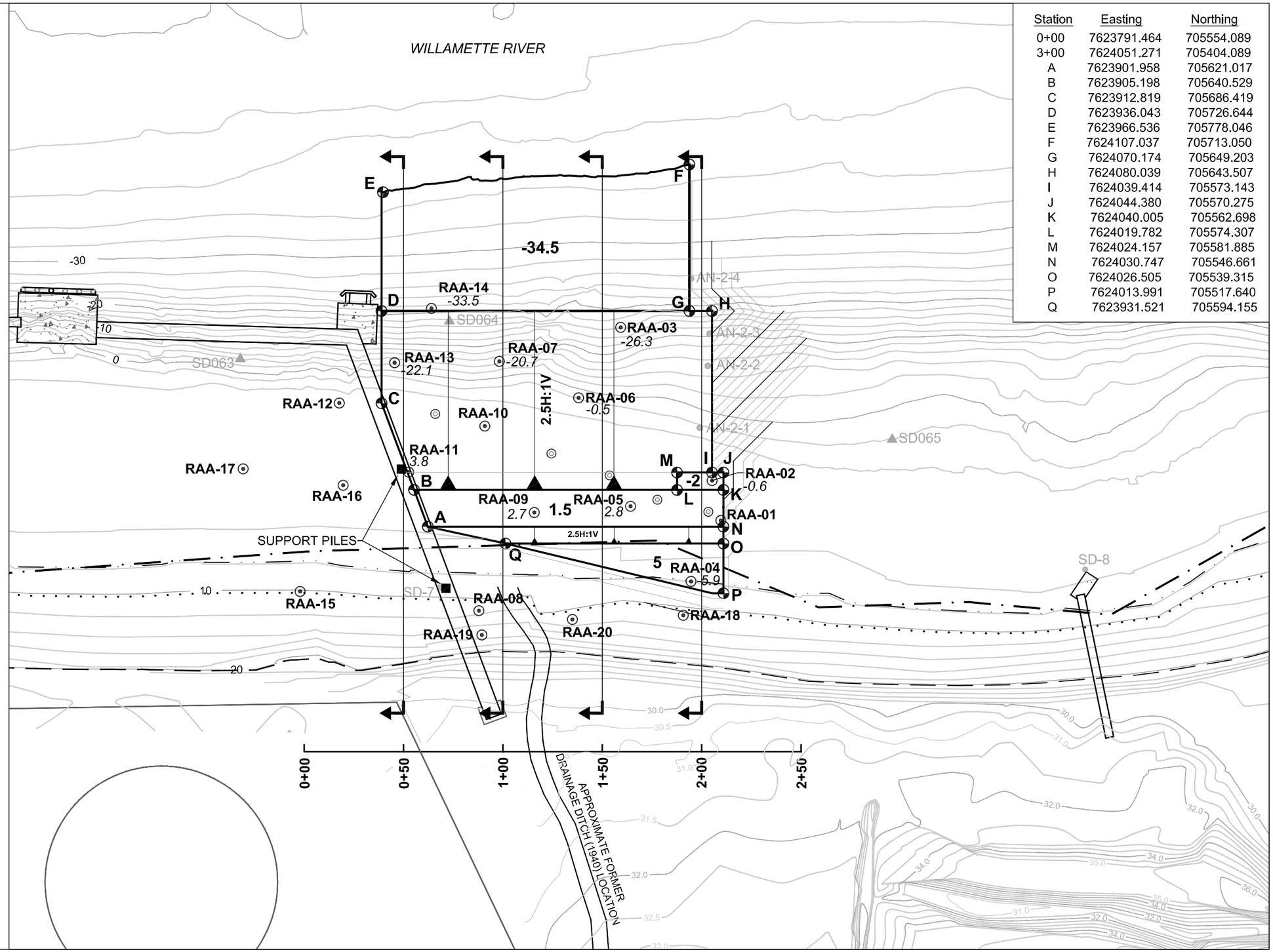
Legend:

- **1.5** Dredge Prism and Dredge Elevation
- ⊙RAA-01 Sample Location and Number (July 2004, Anchor)
- -33.5 Bottom Elevation of Surface Tar Body in Removal Action Area (ft NAVD 88)
- AN-2-1 ● Previous Sediment Core Location (Anchor 2001)
- SD063 ▲ Previous Sediment Core Location (Weston 1998)
- SD-7 ● Previous Sediment Core Location (HAI 1996)
- ◎ Pile Location (To be removed during dredging)
- ■ Support Pile Locations (to be protected during dredging)
- Property Line
- OHW = 20.41 ft NAVD 88
- OLW = 7.91 ft NAVD 88
- 50% River Stage Elevation = 10.23 ft NAVD 88

0 50
Scale in Feet

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study (2003).
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002)
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD 88 (ft).
5. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.

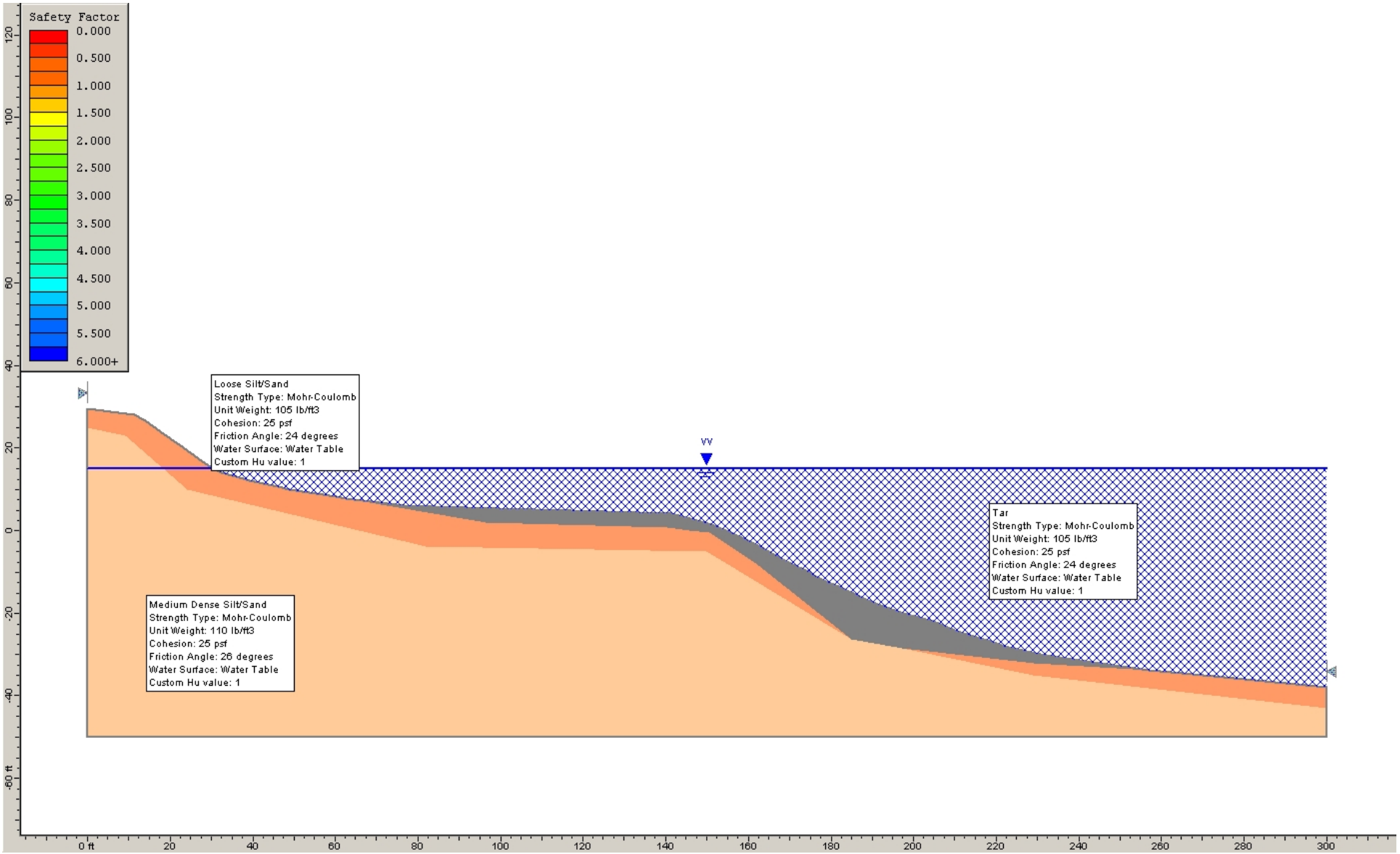


Station	Easting	Northing
0+00	7623791.464	705554.089
3+00	7624051.271	705404.089
A	7623901.958	705621.017
B	7623905.198	705640.529
C	7623912.819	705686.419
D	7623936.043	705726.644
E	7623966.536	705778.046
F	7624107.037	705713.050
G	7624070.174	705649.203
H	7624080.039	705643.507
I	7624039.414	705573.143
J	7624044.380	705570.275
K	7624040.005	705562.698
L	7624019.782	705574.307
M	7624024.157	705581.885
N	7624030.747	705546.661
O	7624026.505	705539.315
P	7624013.991	705517.640
Q	7623931.521	705594.155

Nov 11, 2004 10:25am cdavidson K:\Jobs\000029-GASCO\00002902\00002902-46.dwg FIG H-1

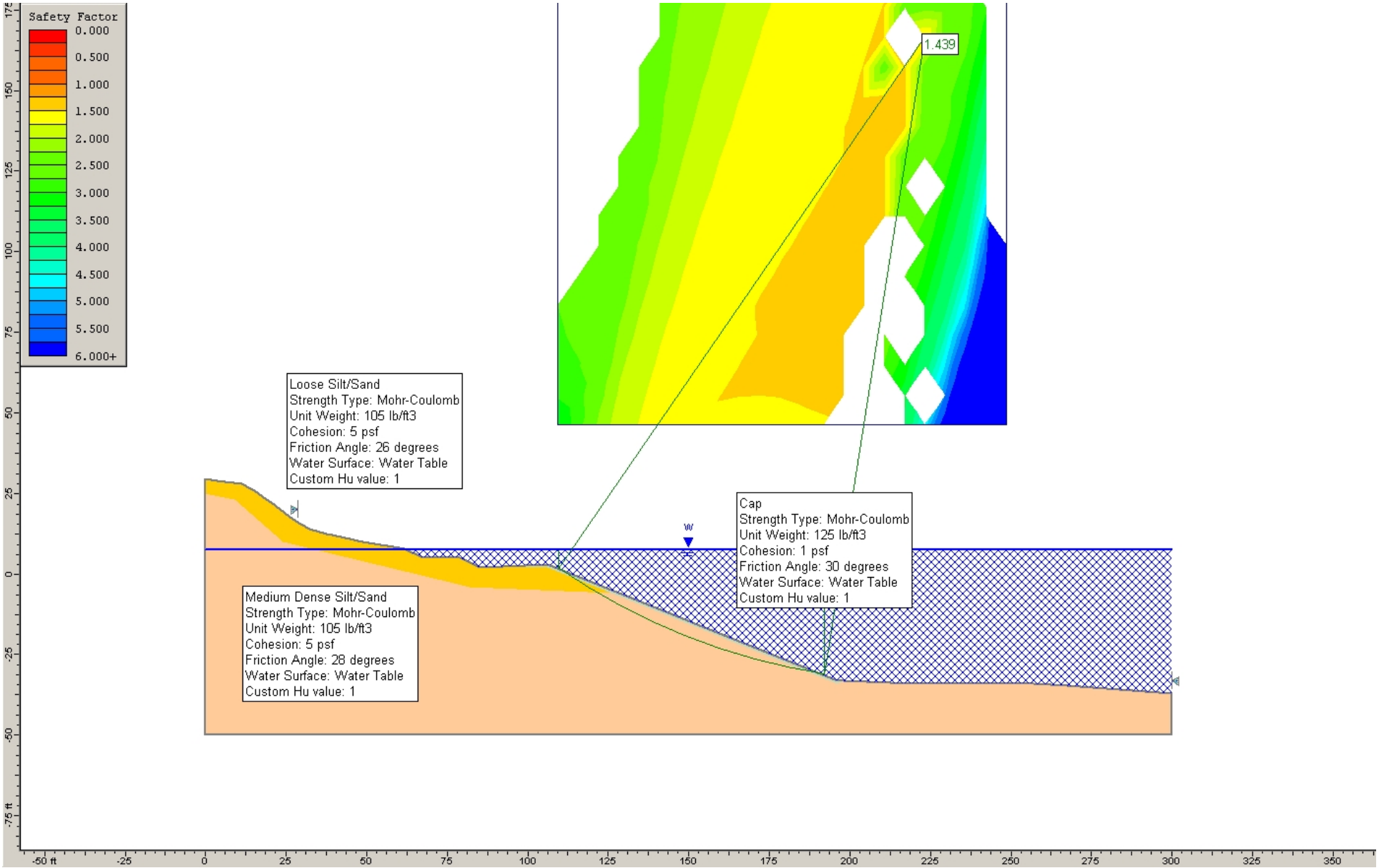
ANCHOR ENVIRONMENTAL, L.L.C.

Figure H-1
Dredge Plan and Cross Section Locations
NW Natural "Gasco" Site



ANCHOR ENVIRONMENTAL, L.L.C.

Figure H-2
Existing Slope Conditions – Station 1+50
NW Natural "Gasco" Site



ANCHOR ENVIRONMENTAL, L.L.C.

Figure H-3
Post-Remediation Condition (2.5H:1V) – Station 1+50
NW Natural "Gasco" Site

ATTACHMENT H-1

MEMORANDUM ON CAP GRAIN SIZE STABILITY

Anchor Environmental, L.L.C.
1423 3rd Avenue, Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131

Memorandum

To: Project File

From: Greg Guannel, John Verduin

CC:

Date: August 24, 2004

Re: Gasco Pilot Cap Grain Size Stability

Remediation of a portion of the Willamette River involves the removal of tar and sediments at the Gasco site and the temporary placement of a pilot cap over a portion of the site. The pilot cap will be temporarily placed while remediation investigations for the entire site are conducted. This memorandum presents stable cap sediment size that can resist river flows for at least 5 years.

West Consultants (West) conducted a river currents analysis to determine 10, 25, 50, and 100 year flow values, as well as associated river currents and bottom shear stress. Results of this analysis are presented in Attachment 1. Because of the temporary nature of the cap and the necessity to place an isolation layer that can also serve as an erosion layer, West also computed the probability of occurrence of such return flows within the next 5 years (Dunne and Leopold, 1978). Table 1 presents the results of this analysis.

Table 1
Results of Hydraulic Modeling

Return Period [Years]	Water Surface Elevation [ft]	Average Channel Velocity [ft/s]	Average Shear Stress [lbs/sf]	Probability of Occurrence Within 5 Years
10	25.00	3.91	0.10	41.00%
25	27.90	4.58	0.14	18.50%
50	30.30	5.06	0.16	9.60%
100	31.00	5.70	0.21	4.90%

Based on these results, we computed a stable sediment size for each of the return period flow values. Two methods were used to compute stable sediment size at the site, based on

Hjulstrom's (Vanoni 1975) and Shields' (Shields 1936) diagrams respectively (diagrams are presented in Attachment 2).

The Hjulstrom diagram relates flow velocity to the Shields diagram, and relates sediment size and shear stress based on the following equation:

$$\alpha = \frac{\tau_*}{(\gamma_s - \gamma_w)D}$$

Where:

α represents the non-dimensional Shields' coefficient, which depends on the flow's Reynolds' number

τ_* represents the shear stress

γ_s represents density of sediment

γ_w represents density of water

D represents sediment diameter

A conservative Shields' coefficient of 0.03 was used for this exercise.

Table 2 presents the result of this analysis. It appears that both methods led to similar results, namely, a fine gravel to coarse gravel would be stable for all flow conditions with the mean diameter (d_{50}) varying between 10 and 21 mm. Considering that a 50 or 100 year flow has a low probability of occurrence, cap d_{50} could be between 17 and 21 mm, assuming that such a material would also effectively isolate contaminated sediments.

Table 2
Stable Sediment Size at Gasco Site

Return Period [Year]	Shear Stress [lbs/sf]	Sediment Size* [mm]	
		Shields	Hjulstrom
10	0.1	9.9	10
25	0.14	13.9	14
50	0.16	15.9	17
100	0.21	20.8	20

* Stable sediment size was computed using the Shields and Hjulstrom methods.

Final gradation of the cap will depend on cost and availability of material from quarries in the vicinity of the site. In general, it is important to have poorly sorted materials. That way, all

voids created by coarser material are filled with finer sediments to create a uniform, "compact" surface. Two types of material seemed to more or less match our gradation requirements, although their gradation curve is not perfect. Figure 1 shows the shoulder ballast gradation curve (WSDOT 9-03.9 [2]) and Figure 2 shows the crushed surfacing gradation curve (WSDOT 9-03.9 [3]). Discussion with quarries can provide more information on what is available and how much we can change these gradations.

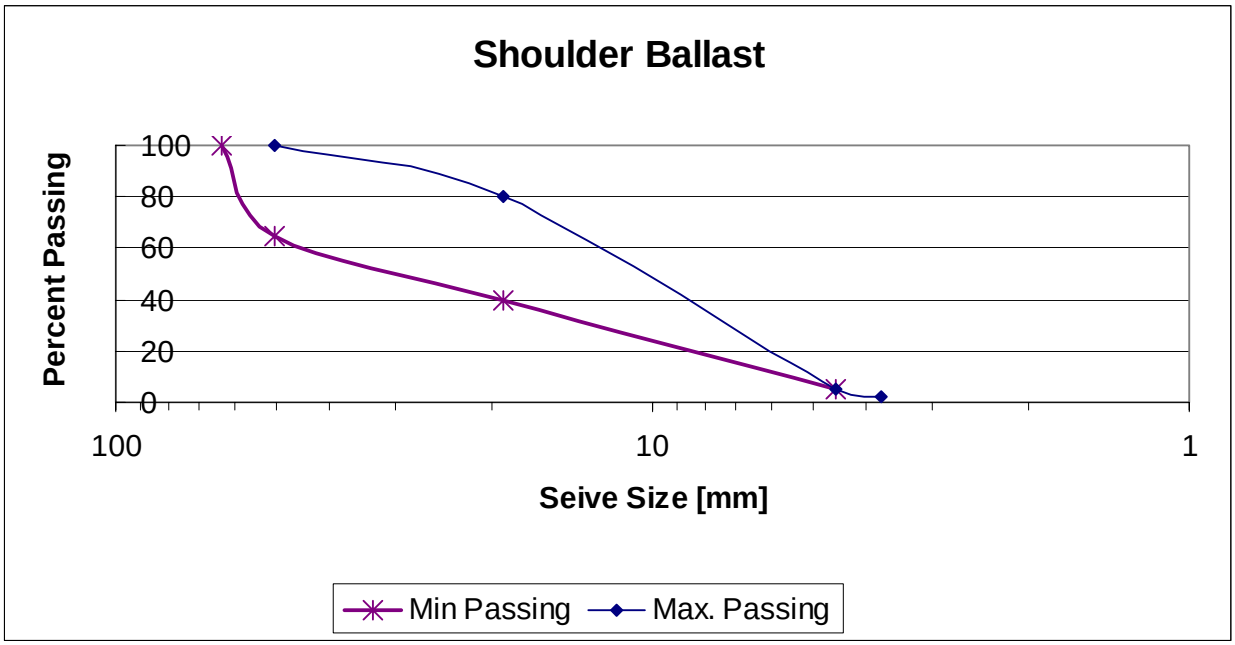


Figure 1 Shoulder Ballast Gradation Curve

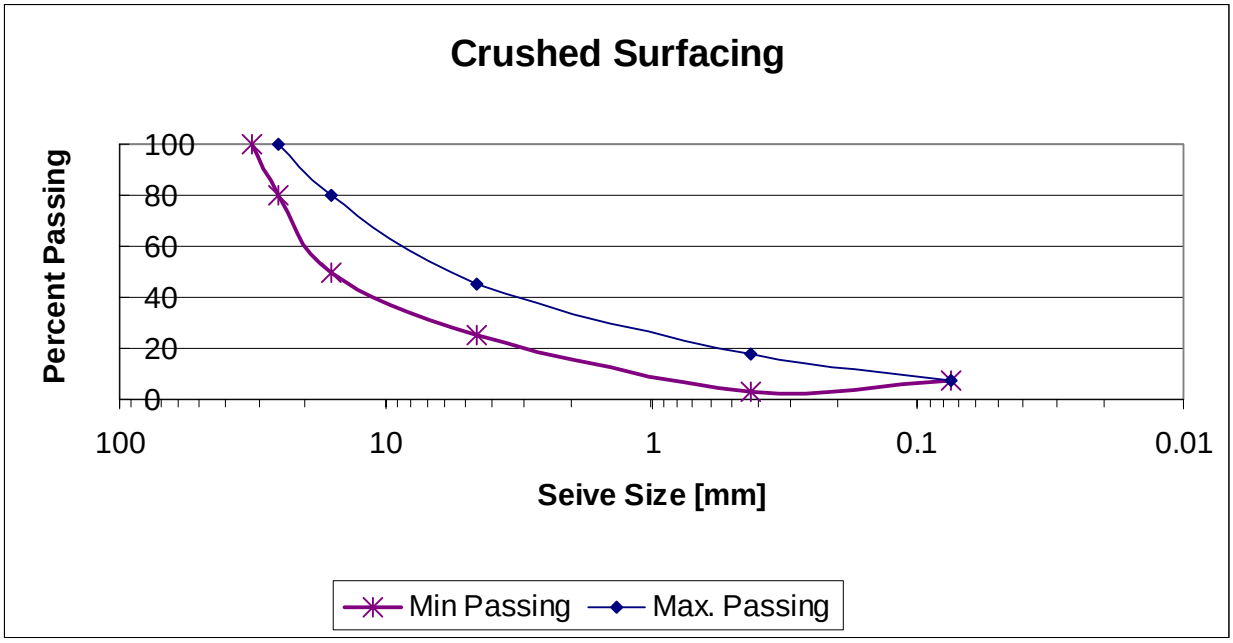


Figure 2 Crushed Surfacing Gradation Curve

REFERENCES:

Dunne, T., and L. B. Leopold, 1978. "Water in Environmental Planning," W. H. Freeman, New York.

Shields, A., 1936. "Anwendung der Aenlichkeitsmechanik und der Turbulenzforsschung auf die Geschiebebewegung," *Mitteilungen der Preussichen Versuchsanstalt fur Wasserbau und Schiffbau*, Berlin, Germany, translated by W.P. Ott and J.C. van Uchelen, California Institute of Technology, Pasadena, California

Vanoni, V.A., 1975. "Sedimentation Engineering," ASCE Manuals and Reports on Engineering Practice-No. 54, New York, 745 pp.

Attachment 1
WEST Consultants Report

MEMORANDUM

To: Greg Guannel, Anchor Environmental
From: Dan Eggers
Date: August 23, 2004
Subject: ESTIMATION OF VELOCITIES AT GASCO SITE

WEST CONSULTANTS, INC.
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Bellevue, WA 98005-2535
Phone: (425) 646-8806
Fax: (425) 646-0570
www.westconsultants.com

1 INTRODUCTION AND APPROACH

Anchor Environmental is evaluating a remediation alternative for the Gasco Site on the Willamette River in Portland, OR. One alternative is to dredge and cap contaminated sediments. To size bed materials, they need to know the potential velocities in the river under design conditions, particularly in the vicinity of the site. This memorandum summarizes the approach and results for evaluating velocities in the Willamette River near the Gasco Site. The Gasco Site is located at approximately river mile 6.3 on the Willamette River. A river cross section at the site, generated from topographic data supplied by Anchor Environmental, was evaluated using the HEC-RAS Version 3.1.1 standard-step backwater hydraulic model.

2 MODEL DEVELOPMENT AND RESULTS

To compute the velocities, the HEC-RAS model was developed based on the following information:

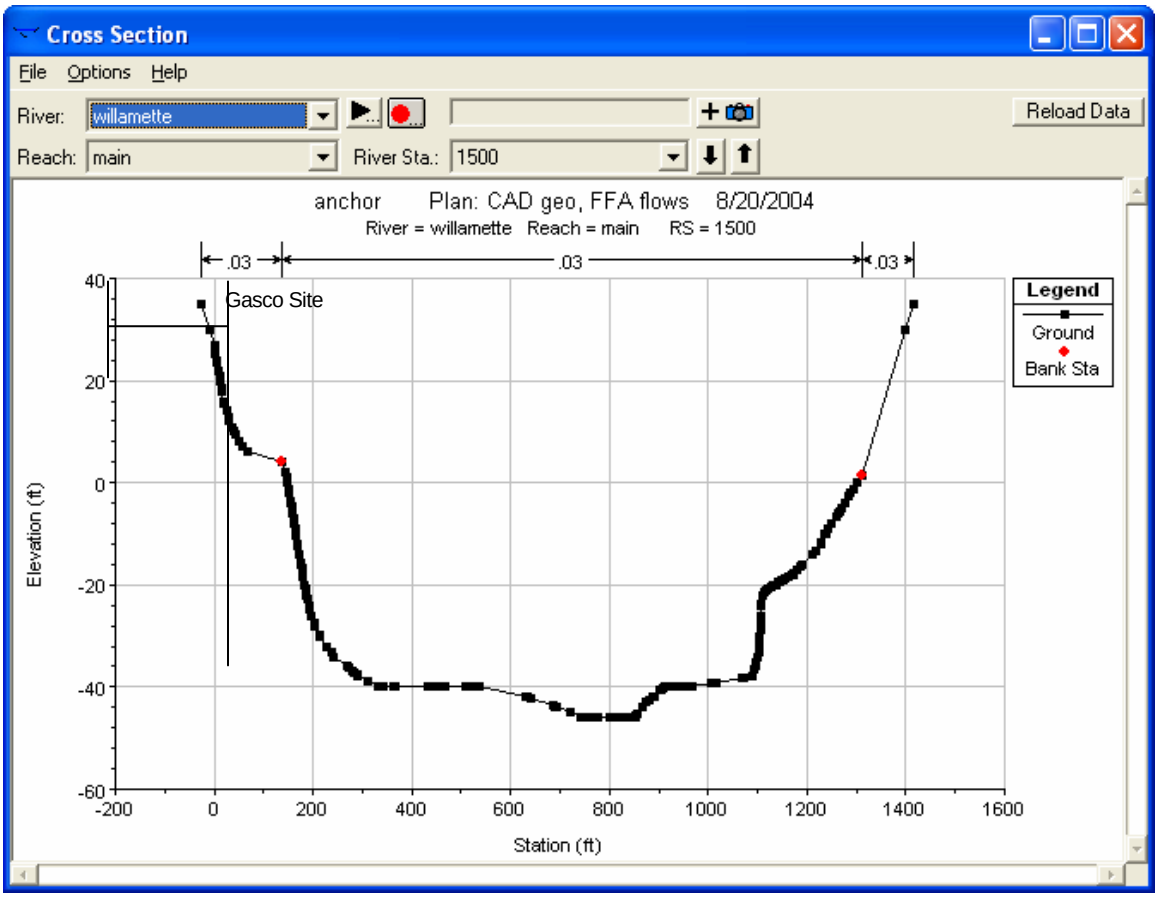
- Whilst not strictly appropriate for a relatively impounded system, a flood frequency analysis (FFA) was conducted for the USGS Portland gage, located at the Morrison Street Bridge (River Mile 12.8). Because there are no major tributaries between the USGS gage and the Gasco site, the FFA flows at the USGS gage, shown in Table 1, were modeled.

Table 1. Willamette River flows used in hydraulic modeling.

Return Period (years)	Flow (cfs)
10	276,000
25	340,000
50	392,000
100	446,000

- The cross section geometry generated from the topographic data supplied by Anchor Environmental is shown in Figure 1. The Gasco Site covers that portion of the cross section from approximately cross section station 15 to cross section station 230. The HEC-RAS program requires at least two cross sections to create a river reach. For this reason, the cross section at the site was copied an arbitrary distance upstream of the site to create a “dummy” cross section. Results are only reported for the cross section at the site.

Figure 1. Gasco Site cross section geometry.



- A Manning's *n* value of 0.03 was selected for the Willamette River channel.

- The starting water surface elevations for the four flood events were not based on normal flow assumptions. Instead, the starting water surface elevations used in the HEC-RAS model were taken from the flood profiles found in the Flood Insurance Study for the City of Portland, Oregon at river mile 6.3.

Table shows the results of the hydraulic modeling. The minimum and maximum velocities are intended to show the range of velocities in the Gasco Site. The minimum velocities reported occur near cross section station 15 and the maximum velocities reported occur near cross section station 230. The probability is the likelihood that the specified return period flood event will occur in a consecutive five year period.

Table 2. Results of hydraulic modeling.

Return Period (years)	Water Surface Elevation (ft, NAVD)	Minimum Velocity (ft/s)	Maximum Velocity (ft/s)	Average Channel Velocity (ft/s)	Probability of occurring in a five year period
10	25.00	0.81	3.85	3.91	41.0%
25	27.90	1.14	4.52	4.58	18.5%
50	30.30	1.40	5.01	5.06	9.6%
100	31.00	1.62	5.63	5.70	4.9%

Attachment 2

Shields' and Hjulstrom Diagram for Computation of Stable Sediment Size

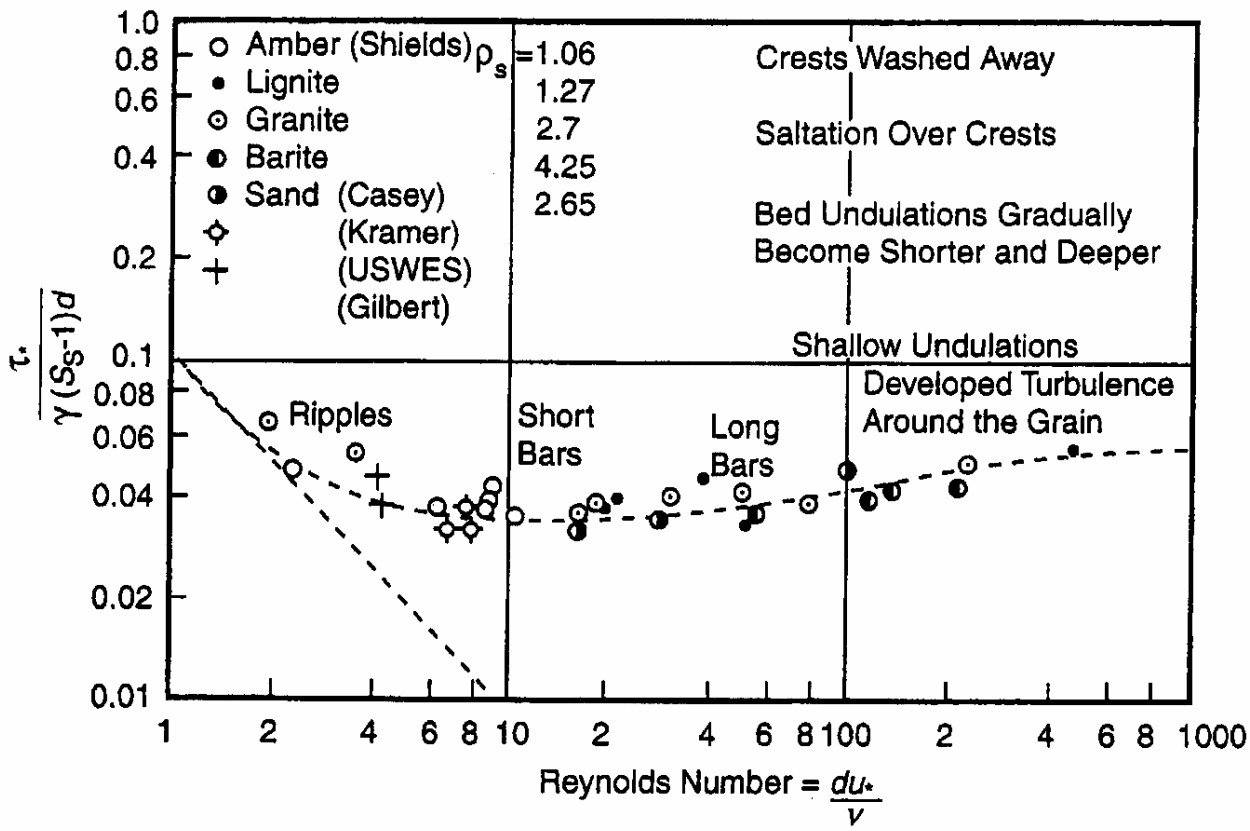


Figure B1: Shields Diagram for Initiation of Cap Material Movement (Shields 1936)

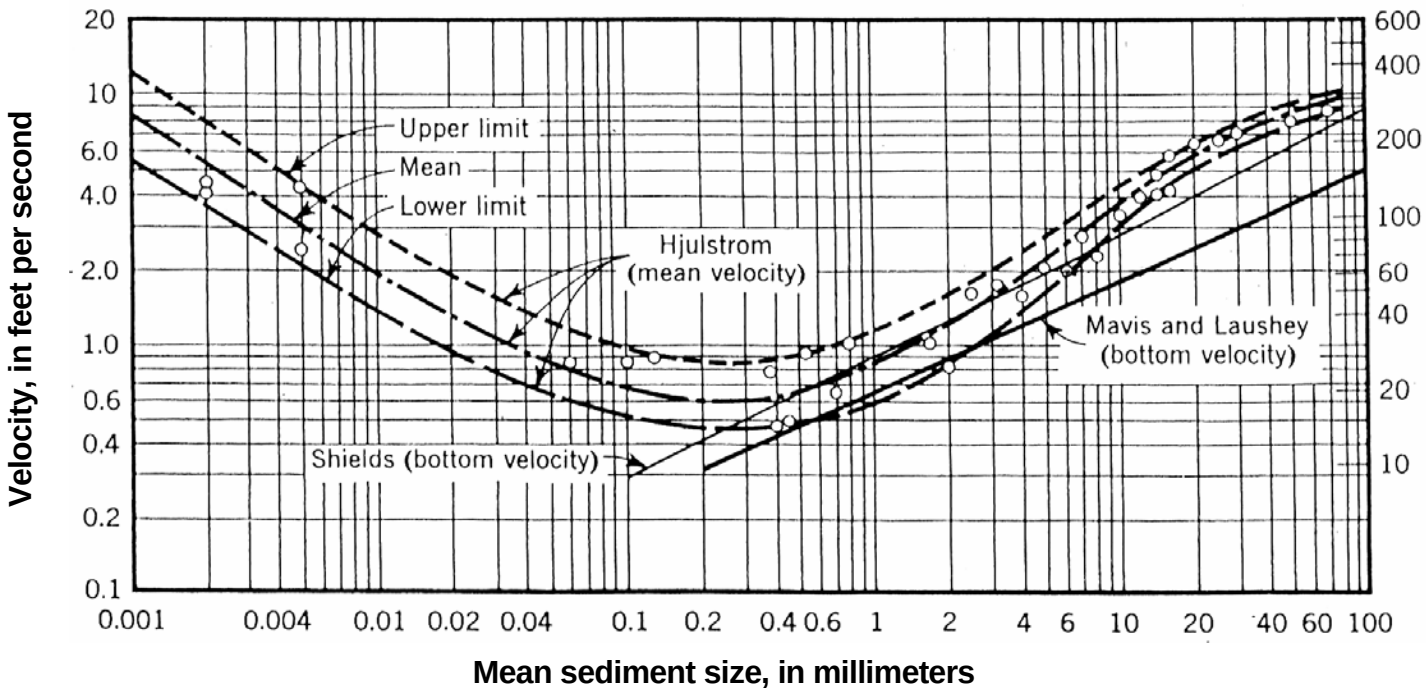


Figure 2: Critical Water Velocities for Quartz Sediment as Function of Mean Grain (Vanoni 1975)

ATTACHMENT H-2

MEMORANDUM ON RIVER VELOCITIES

Anchor Environmental, L.L.C.
1423 3rd Avenue, Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131

Memorandum

To: Project File

From: Greg Guannel and John Verduin

CC:

Date: October 12, 2004

Re: Average River Velocities at Gasco

This memo presents the results of a flow velocities analysis near the Gasco site to help with water quality modeling efforts and to evaluate stability of a silt curtain during construction activities. USGS gage number 14211720, located at the Morrison Street Bridge (River Mile 12.8), gives daily average flow values in the river at this station since 1973. In a previous memo (Appendix H, Attachment H-1), we used this dataset to evaluate velocities near the site that would occur during a 10, 25, 50, and 100 year event; these values are presented again in Table 1. For this memo, we used monthly flow values for the entire period record to evaluate "average conditions" at the site, and tried to compare winter conditions and summer conditions. These monthly flow values represent the average flow values for each month of each year of the record period.

Table 1
River Currents at Gasco for 10, 25, 50, and 100 Year Flows

Return Period (years)	Water Surface Elevation (ft, NAVD)	River Velocity (ft/s)
10	25.00	3.85
25	27.90	4.52
50	30.30	5.01
100	31.00	5.63

Because the USGS station is located approximately 6 miles away from the site, and because we do not have water surface elevation values associated with flow values, we assumed that water surface elevation at the site is at Mean Lower Low Water. Considering that river flow is equal

to river current velocity times river cross-sectional area, a low water surface elevation will lead to a small cross-sectional area and a conservative value for river current velocities.

NOAA operates a gage at the Morison Bridge (Station 9439221), and published benchmark data for this site were used in our analysis. Table 2 summarizes tidal elevations at the site. Average river currents were computed based on the USGS record, tidal elevations, and the river cross-section presented in Figure 1.

Table 2
Tidal Elevations Near Gasco Site

	Tidal Elev. (m)	Tidal Elev. (ft)
MEAN HIGHER HIGH WATER (MHHW)	1.59	5.22
MEAN HIGH WATER (MHW)	1.43	4.70
MEAN TIDE LEVEL (MTL)	1.01	3.31
MEAN SEA LEVEL (MSL)	0.96	3.15
MEAN LOW WATER (MLW)	0.58	1.91
MEAN LOWER LOW WATER (MLLW)	0.51	1.68
COLUMBIA RIVER DATUM (CRD)	0.00	0.00
NATIONAL GEODETIC VERTICAL DATUM-1929 (NGVD)	-0.56	-1.85
NORTH AMERICAN VERTICAL DATUM-1988 (NAVD)	-1.62	-5.33

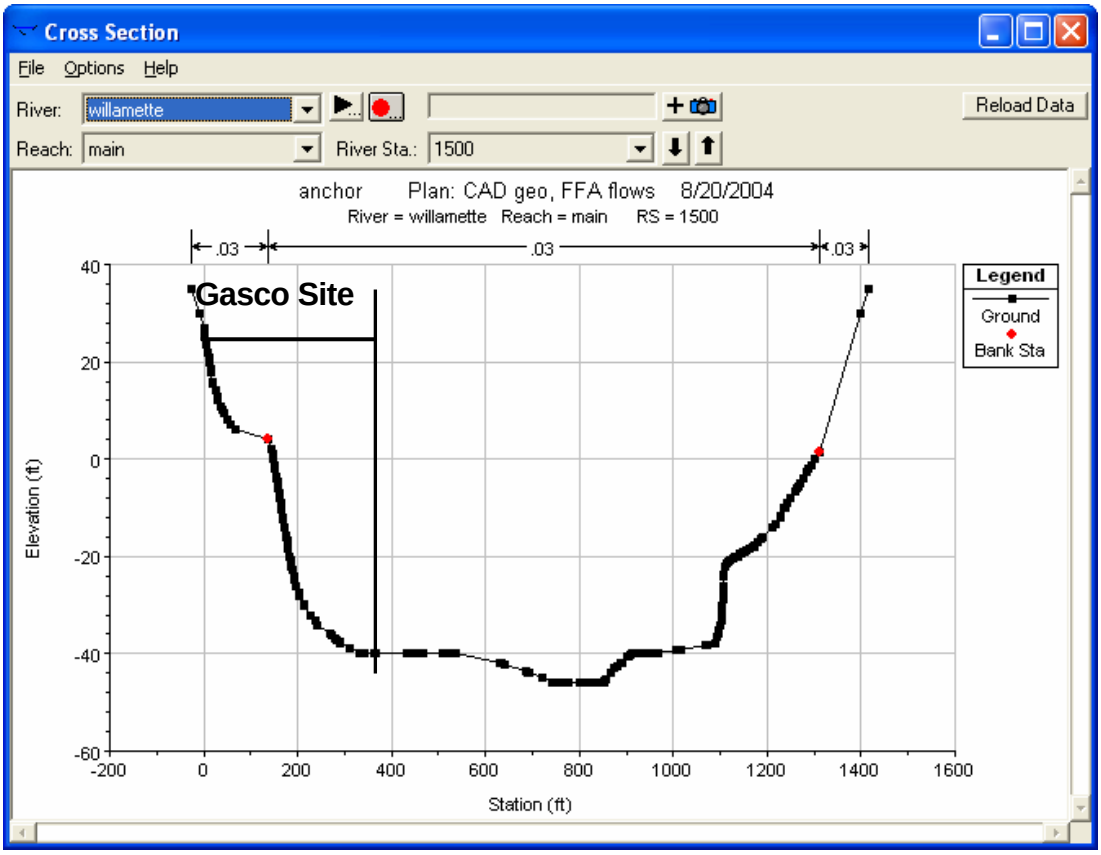


Figure 1. Gasco Site Cross Section Geometry

We investigated river currents near the Gasco site, which is on the left side of the river if looking downstream, therefore, side currents were computed. The Manning's equation relates the velocity in a portion of a channel to the channel's energy gradient, or loss of head:

$$V = \frac{k}{n} R^{2/3} S^{1/2}$$

where:

V represents the channel's velocity

k is a dimensional coefficient equal to 1.486 (English) or 1 (SI)

n represents the Manning's coefficient, equal to 0.03 in our case

R represents the channel hydraulic radius, equal to the channel cross-sectional area divided by the wetted perimeter, as illustrated in Figure 2

S represents the slope of energy gradient line (head loss)

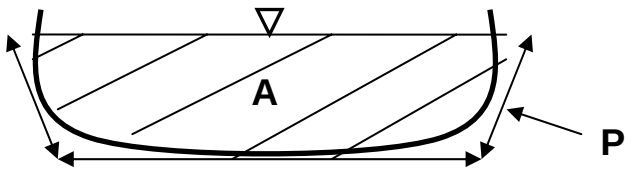


Figure 2. Channel Cross-Section and Parameters

In figure 2, ***A*** represents the channel cross-sectional area, and ***P*** represents the wetted perimeter. As illustrated, these two parameters, which define the hydraulic radius, are both dependent on the water surface elevation. For the Gasco site, we assumed that the energy gradient line is the same for each sub-section of the river cross-section; this assumption might not be true all the time, especially considering the channel's irregular shape. We computed this energy slope based on average velocity value. Then, we assumed that the Gasco site is located on the left side of the channel, as illustrated in Figure 1, and recomputed the river velocity in the sub-section defined in Figure 1, that ends at approximately 300 feet away from the bank. Results of this exercise are presented in Table 3. We also conducted the same exercise with maximum flow velocities recorded during the dataset period, and computed side velocities at the Gasco site. Results are presented in Table 4. All average flow values presented in Table 3 and 4 have a value between 1-year and 2-year flows (49,600 and 156,000 cfs, respectively).

Table 3
Mean Flow Velocities Extrapolated to Gasco Site

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Flow [cfs]	65,590	54,469	45,230	35,860	26,520	18,110	9,573	8,484	11,230	15,950	39,580	68,470
Mean Vel. [ft/s]	1.61	1.34	1.11	0.88	0.65	0.44	0.23	0.21	0.28	0.39	0.97	1.68
En. Slope [ft/ft]	8E-06	5.5E-06	3.8E-06	2.4E-06	1.3E-06	6.1E-07	1.7E-07	1.3E-07	2.34E-07	4.7E-07	2.9E-06	8.68E-06
Gasco Site Vel. [ft/s]	0.9	0.7	0.6	0.5	0.4	0.2	0.1	0.1	0.2	0.2	0.5	0.9

Table 4
Maximum Flow Velocities Extrapolated to Gasco Site

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Flow [cfs]	124,200	149,500	77,790	72,060	46,730	38,730	15,870	11,860	17,350	28,860	93,070	155,600
Max Vel. [cfs]	3.0	3.7	1.9	1.8	1.1	0.9	0.4	0.3	0.4	0.7	2.3	3.8
En. Slope [ft/ft]	2.9E-05	4.1E-05	1.1E-05	9.6E-06	4E-06	2.8E-06	4.7E-07	2.6E-07	5.57E-07	1.5E-06	1.6E-05	4.48E-05
Gasco Site Vel. [ft/s]	1.7	2.0	1.1	1.0	0.6	0.5	0.2	0.2	0.2	0.4	1.3	2.1

Results of this analysis were compared to Acoustic Doppler Current Profiler (ACDP) data that was collected near the site in May 2002 and in January 2004. During both events, David Evans and Associates measured river currents right off Gasco site along the same transect number, Transect 8, that corresponded to two different river flow values. Figure 3 shows the location of that transect during the January 2004 event, and Figures 4 and 5 show the transect data; the Gasco site is located on the left side of these transects.

It appears that in May 2002, total flow in the river was approximately 71,113 cfs and velocity at the site was evaluated to be approximately 0.98 cfs. In January 2004, total flow was approximately 130,142 cfs and velocity at Gasco site approximately 2.18 cfs. Both flow values are between the 1-year and 2-year return flow values.

The velocity on the left side of the transect was computed with a software called WinRiver. This software compiles data recorded by the ACDP and evaluates left and right bank velocities based on subsection defined by the user. For May 2002, the left velocity was computed for a subsection length of 107 feet, starting from the left bank, and for January 2004, that distance was 330 feet. A comparison between these values and the ones we presented in Table 4 show that we underestimated bank velocities. However, as shown in Figures 4 and 5, the ACDP cross-section is not complete, and left bank values may be over-conservative. Indeed, we presume that the survey vessel did not survey bathymetry and current values under the dock adjacent to the site, and the ACDP software had to "guess" the left bank configuration.

In any case, because the Manning's equation is function of water surface elevation, we computed velocities at the site assuming mean water surface elevation and average velocity presented in the January 2004 ACDP data in order to do a direct comparison. We evaluated water depth and compared it to our cross-section presented in Figure 1, then we used the same methodology presented earlier to evaluate velocities at the site, assuming a subsection of 330 feet, starting from the left bank. This resulted in a site velocity of 1.5 feet/s, which is much less than what the WinRiver software computed (see Table 5). Table 5 is organized by ascending flow values, and average currents computed by Anchor and by WinRiver software are organized in a logical manner. The problem is with the bank values (see Jan 2004, Jan 2004 extrapolated, and other values).

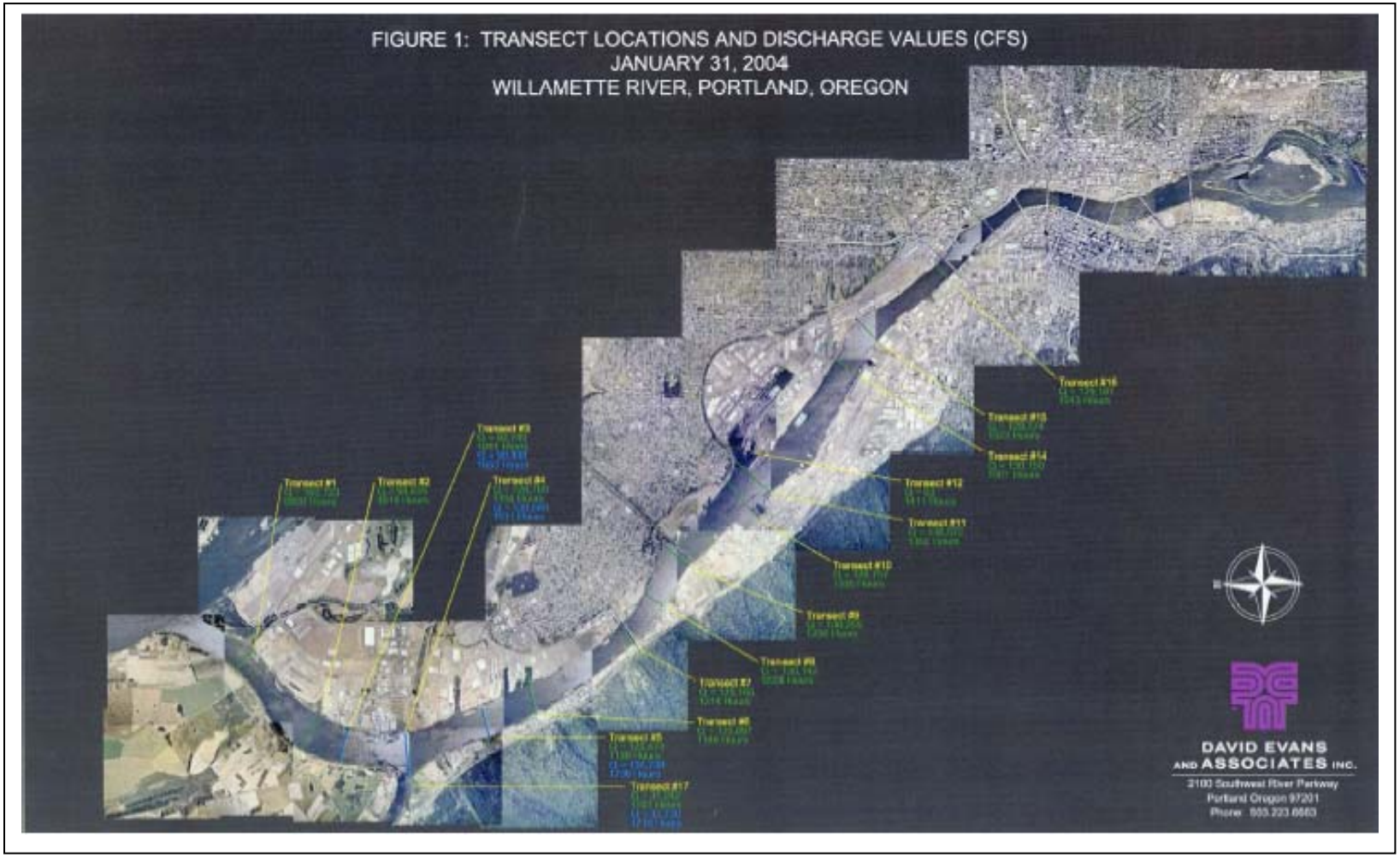


Figure 3. Gasco Site Location (next to transect 8) in the ACDP Survey Map during the January 2004 Event

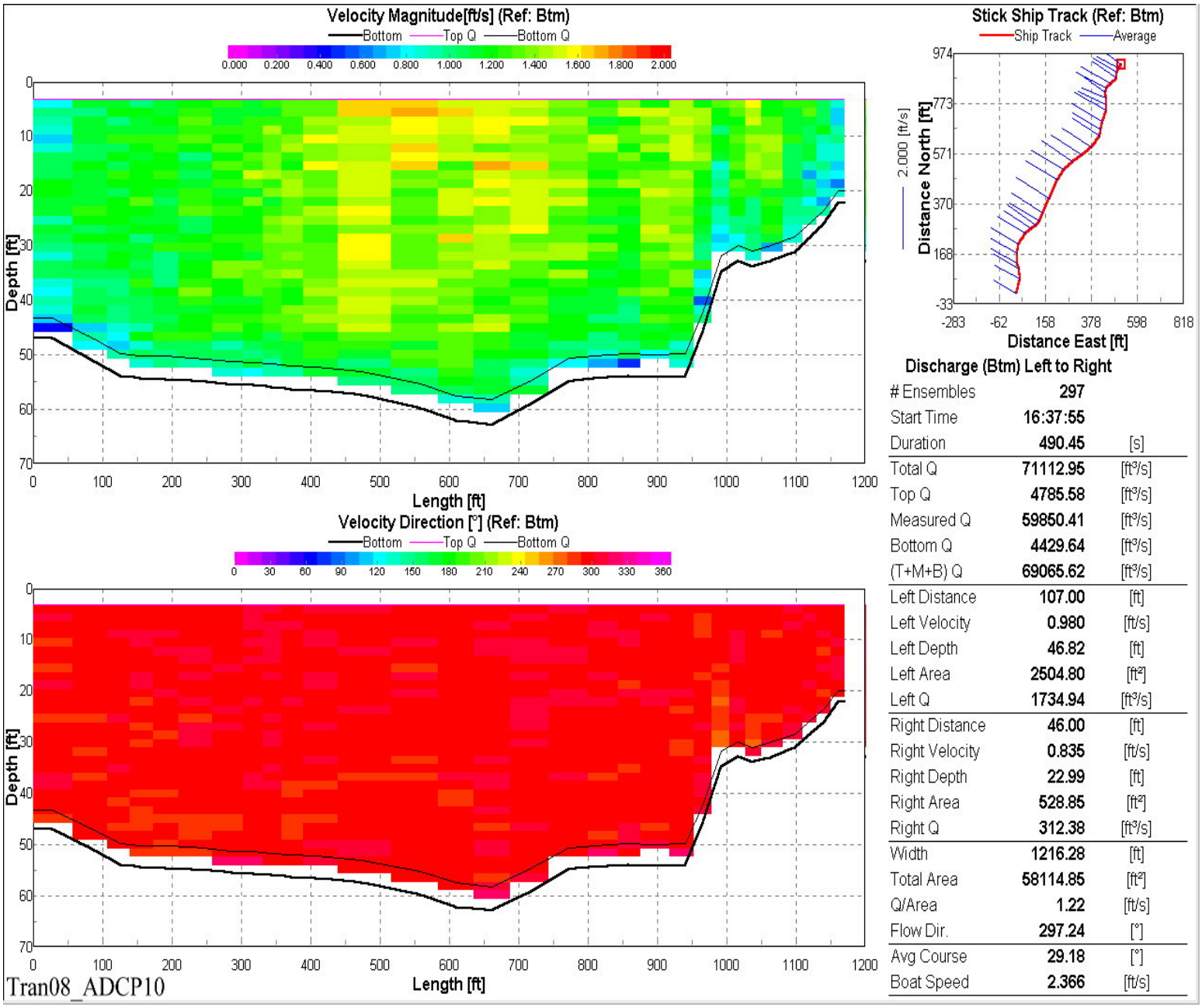
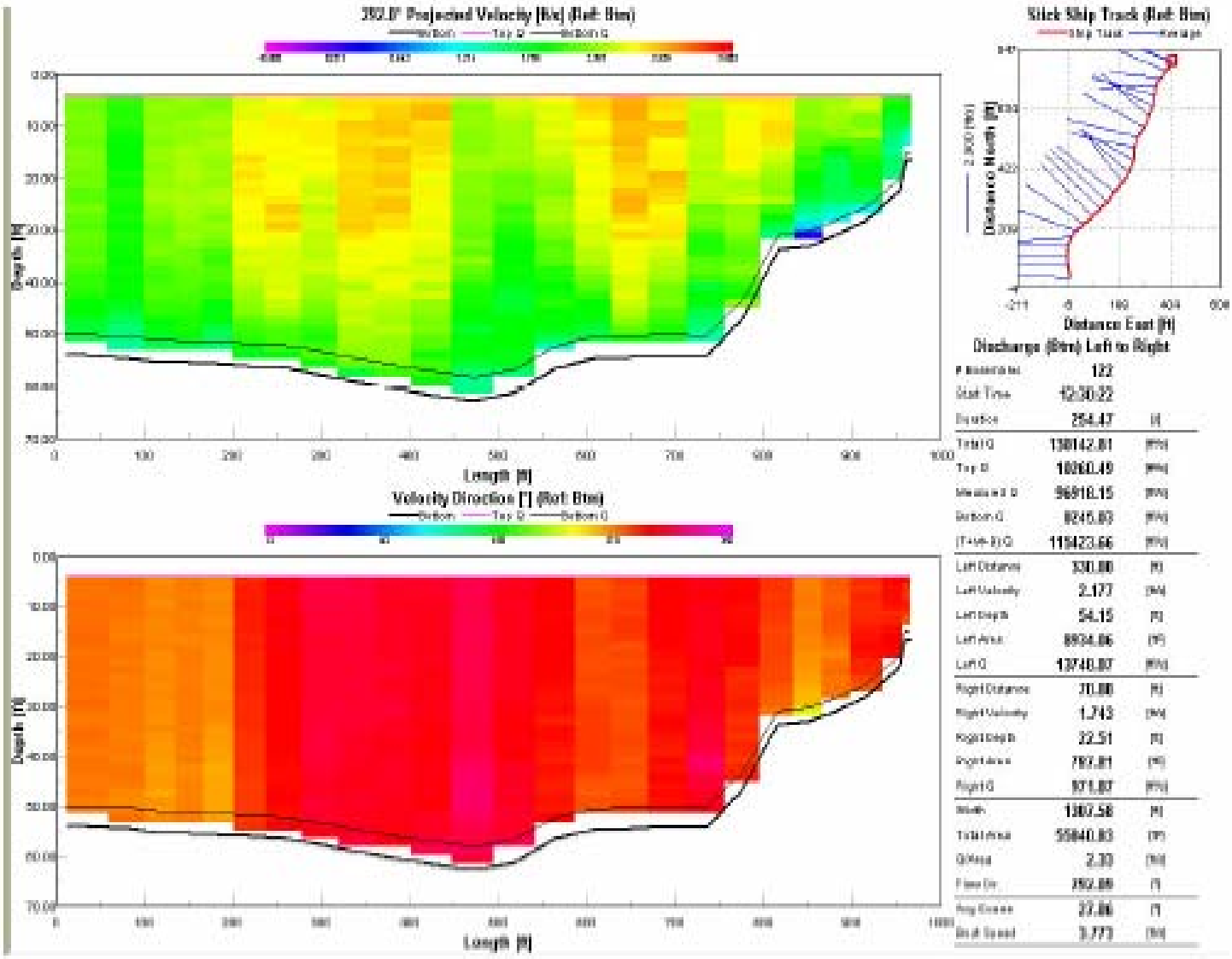


Figure 4. ACDP Transect Result for the May 2002 Event



Transect 8 at 12:29 hours – River Mile 6.3

Figure 5. ACDP Transect Result for the January 2004 Event

Table 5
Comparison Between Table 4 Data and ACDP Data

	Max Flow [cfs]	Max Vel. [ft/s]	En. Slope [ft/ft]	Velo. @ Gasco [ft/s]
Aug	11,860	0.3	2.6E-07	0.2
Jul	15,870	0.4	4.7E-07	0.2
Sep	17,350	0.4	5.6E-07	0.2
Oct	28,860	0.7	1.5E-06	0.4
Jun	38,730	0.9	2.8E-06	0.5
May	46,730	1.1	4E-06	0.6
May 02	***71,112***	***1.22***	***5E-06***	***0.98***
Apr	72,060	1.8	9.6E-06	1.0
Mar	77,790	1.9	1.1E-05	1.1
Nov	93,070	2.3	1.6E-05	1.3
Jan	124,200	3.0	2.9E-05	1.7
Jan 04	***130,142***	***2.33***		***2.1***
Jan 04 Extrapolated	***130,142***	***2.33***	***1E-05***	***1.5***
Feb	149,500	3.7	4.1E-05	2.0
Dec	155,600	3.8	4.5E-05	2.1

This discrepancy can be explained by the uncertainty that is associated with the fact that the ACDP data extrapolated side velocities without complete bathymetry or by use of the Manning's equation. We assumed that energy slope is constant throughout the cross-section, and it might not be the case here. To try to get a sense of "all possible ranges" of velocities at the site, we performed two other operations:

- We computed the ratio between average velocities and left bank velocities for the May 2002 and January 2004 data, computed the average between the two, and applied this ratio to the USGS max and mean velocities data. This coefficient, which is equal to 1.17, does not have a real physical sense because the water surface elevation between the different events varies, as does the energy slope, hydraulic radius, etc., so one should be careful when using these values
- We computed the ratio between the January 2004 ACDP value for the left bank and the January 2004 extrapolated value, and applied this ratio to the USGS data. Again, the real physical sense of this operation is unclear.

Results of the operations presented above are summarized in Tables 6 and 7, under the heading Velo. Oper. 1 and Velo. Oper. 2, respectively. We also presented results from the previous operation (Tables 3 and 4). Tables 6 and 7 should help give a sense of possible flow values in the river.

Table 6
Summary of Velocities Computed at the Gasco Site Based on Mean Flow Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Flow [cfs]	65,590	54,469	45,230	35,860	26,520	18,110	9,573	8,484	11,230	15,950	39,580	68,470
Side Velo. [ft/s]	0.9	0.7	0.6	0.5	0.4	0.2	0.1	0.1	0.2	0.2	0.5	0.9
Velo. Oper. 1 [ft/s]	1.1	0.9	0.7	0.6	0.4	0.3	0.2	0.1	0.2	0.3	0.6	1.1
Velo. Oper. 2 [ft/s]	1.3	1.0	0.9	0.7	0.5	0.3	0.2	0.2	0.2	0.3	0.8	1.3

Table 7
Summary of Velocities Computed at the Gasco Site Based on Max Flow Data

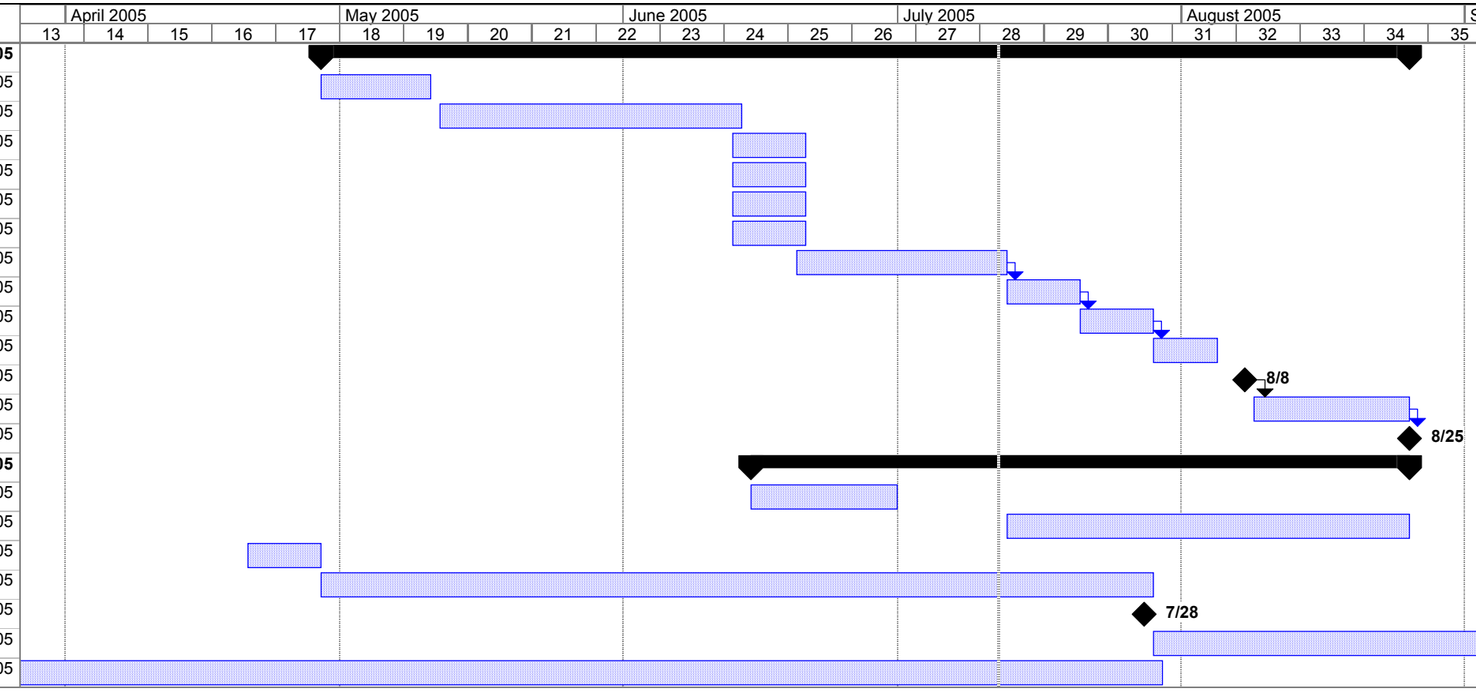
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Flow	124,200	149,500	77,790	72,060	46,730	38,730	15,870	11,860	17,350	28,860	93,070	155,600
Side Velo. [ft/s]	1.7	2.0	1.1	1.0	0.6	0.5	0.2	0.2	0.2	0.4	1.3	2.1
Velo. Oper. 1 [ft/s]	2.0	2.4	1.2	1.2	0.7	0.6	0.3	0.2	0.3	0.5	1.5	2.5
Velo. Oper. 2 [ft/s]	2.4	2.9	1.5	1.4	0.9	0.7	0.3	0.2	0.3	0.6	1.8	3.0

APPENDIX I

PROJECT SCHEDULE

Documentation Schedule

ID	Task Name	Duration	Start	Finish
1	**Design Document Preparation**	**85 days**	**Fri 4/29/05**	**Thu 8/25/05**
2	Final EE/CA	8 days	Fri 4/29/05	Tue 5/10/05
3	Public Comment Period	23 days	Thu 5/12/05	Mon 6/13/05
4	EPA Review of Public Comments	6 days	Mon 6/13/05	Mon 6/20/05
5	Opalski Decision on Sheet Pile	6 days	Mon 6/13/05	Mon 6/20/05
6	Region 10 Consultation with HQ	6 days	Mon 6/13/05	Mon 6/20/05
7	EPA Issues Action Memorandum (decision)	6 days	Mon 6/13/05	Mon 6/20/05
8	Revise Final Design	17 days	Mon 6/20/05	Tue 7/12/05
9	EPA Review of Final Design	6 days	Wed 7/13/05	Wed 7/20/05
10	Final Design Submittal (address EPA comments)	6 days	Thu 7/21/05	Thu 7/28/05
11	EPA Approval of Final Design	5 days	Fri 7/29/05	Thu 8/4/05
12	Notification to EPA of Construction Start	0 days	Mon 8/8/05	Mon 8/8/05
13	Mobilization for Construction	13 days	Tue 8/9/05	Thu 8/25/05
14	Construction Begins	0 days	Thu 8/25/05	Thu 8/25/05
15	**Construction Preparations**	**52 days**	**Wed 6/15/05**	**Thu 8/25/05**
16	Silt Curtain Design	12 days	Wed 6/15/05	Thu 6/30/05
17	Silt Curtain Fabrication	32 days	Wed 7/13/05	Thu 8/25/05
18	Prepare and Submit Transfer Facility Permit Application	6 days	Thu 4/21/05	Thu 4/28/05
19	DEQ Review Permit Application	65 days	Fri 4/29/05	Thu 7/28/05
20	DEQ Authorization for Permit	0 days	Thu 7/28/05	Thu 7/28/05
21	Preparation of Transfer Facility	26 days	Fri 7/29/05	Fri 9/2/05
22	ESA Consultation Process - Obtain B.O.	275 days	Mon 7/12/04	Fri 7/29/05

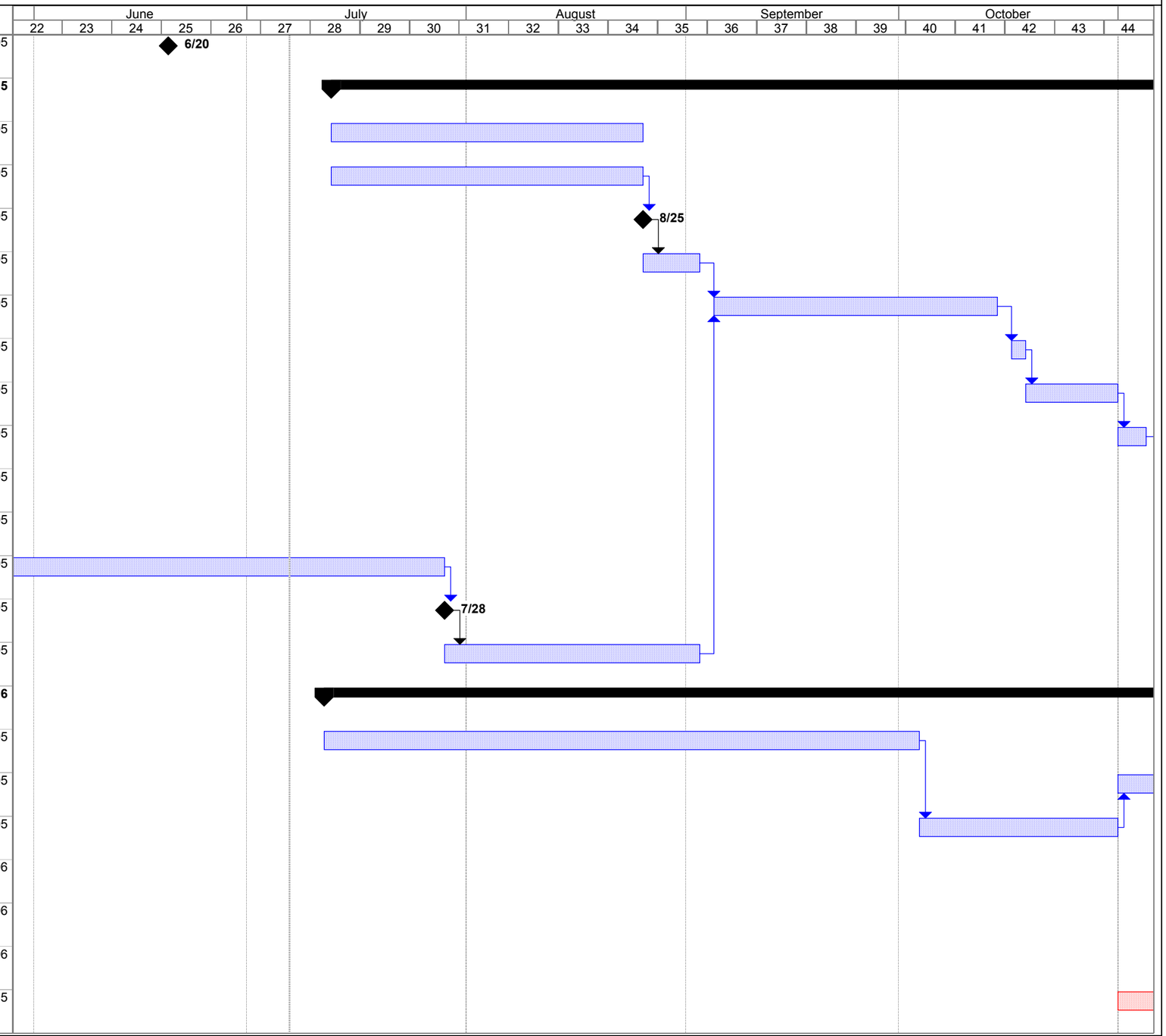


Project: Gasco Schedule_Documentat
Date: Tue 7/12/05

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Construction and Post-Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**EPA Action Memorandum**	0 days	Mon 6/20/05	Mon 6/20/05
2	**Construction Preparation and Implementation**	**93 days**	**Wed 7/13/05**	**Fri 11/18/05**
3	Silt Curtain Fabrication	32 days	Wed 7/13/05	Thu 8/25/05
4	Secure and Mobilize Equipment	32 days	Wed 7/13/05	Thu 8/25/05
5	Start Construction	0 days	Thu 8/25/05	Thu 8/25/05
6	Deploy Silt Curtain	6 days	Fri 8/26/05	Fri 9/2/05
7	Dredging/Disposal	30 days	Mon 9/5/05	Fri 10/14/05
8	Pre-Cap Baseline Sediment Sampling	2 days	Mon 10/17/05	Tue 10/18/05
9	Capping	9 days	Wed 10/19/05	Mon 10/31/05
10	Removal of Silt Curtain	4 days	Tue 11/1/05	Fri 11/4/05
11	Demobilize and Restore Site	10 days	Mon 11/7/05	Fri 11/18/05
12	Prepare and Submit Transfer Facility Permit Application	6 days	Thu 4/21/05	Thu 4/28/05
13	DEQ Review Permit Application	65 days	Fri 4/29/05	Thu 7/28/05
14	DEQ Authorization for Permit	0 days	Thu 7/28/05	Thu 7/28/05
15	Preparation of Transfer Facility	26 days	Fri 7/29/05	Fri 9/2/05
16	**Post Construction Documentation**	**169 days**	**Tue 7/12/05**	**Fri 3/3/06**
17	Monitoring and Reporting Plan (MARP)	60 days	Tue 7/12/05	Mon 10/3/05
18	EPA MARP Review	20 days	Tue 11/1/05	Mon 11/28/05
19	Submit Final MARP	20 days	Tue 10/4/05	Mon 10/31/05
20	Remedial Action Completion Report (RACR)	40 days	Mon 11/21/05	Fri 1/13/06
21	EPA RACR Review	15 days	Mon 1/16/06	Fri 2/3/06
22	Submit Final RACR	20 days	Mon 2/6/06	Fri 3/3/06
23	**Fish Window (November 1 - November 30)**	22 days	Tue 11/1/05	Wed 11/30/05

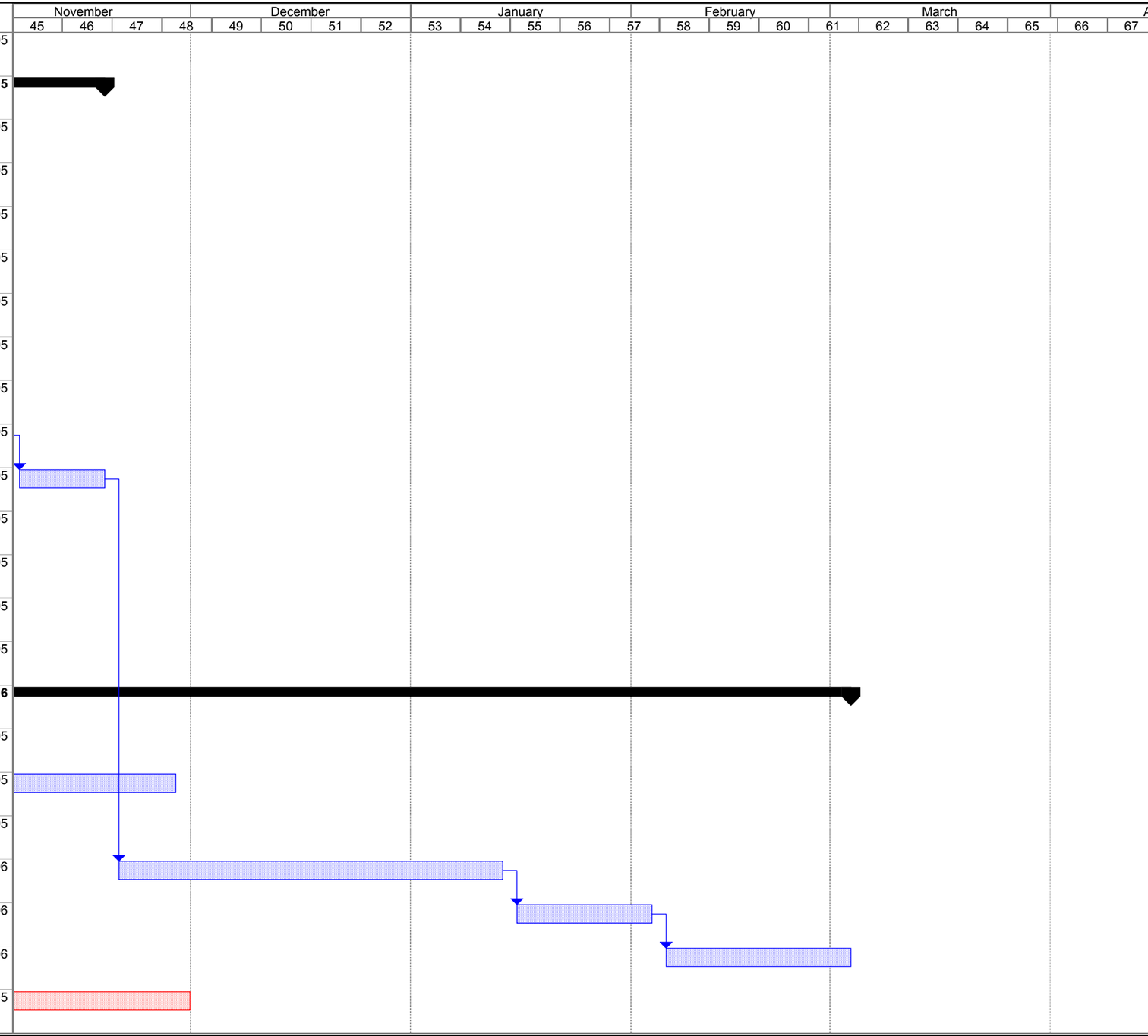


Project: Gasco Schedule_Silt Curtain_
Date: Thu 7/7/05

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Construction and Post-Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**EPA Action Memorandum**	0 days	Mon 6/20/05	Mon 6/20/05
2	**Construction Preparation and Implementation**	**93 days**	**Wed 7/13/05**	**Fri 11/18/05**
3	Silt Curtain Fabrication	32 days	Wed 7/13/05	Thu 8/25/05
4	Secure and Mobilize Equipment	32 days	Wed 7/13/05	Thu 8/25/05
5	Start Construction	0 days	Thu 8/25/05	Thu 8/25/05
6	Deploy Silt Curtain	6 days	Fri 8/26/05	Fri 9/2/05
7	Dredging/Disposal	30 days	Mon 9/5/05	Fri 10/14/05
8	Pre-Cap Baseline Sediment Sampling	2 days	Mon 10/17/05	Tue 10/18/05
9	Capping	9 days	Wed 10/19/05	Mon 10/31/05
10	Removal of Silt Curtain	4 days	Tue 11/1/05	Fri 11/4/05
11	Demobilize and Restore Site	10 days	Mon 11/7/05	Fri 11/18/05
12	Prepare and Submit Transfer Facility Permit Application	6 days	Thu 4/21/05	Thu 4/28/05
13	DEQ Review Permit Application	65 days	Fri 4/29/05	Thu 7/28/05
14	DEQ Authorization for Permit	0 days	Thu 7/28/05	Thu 7/28/05
15	Preparation of Transfer Facility	26 days	Fri 7/29/05	Fri 9/2/05
16	**Post Construction Documentation**	**169 days**	**Tue 7/12/05**	**Fri 3/3/06**
17	Monitoring and Reporting Plan (MARP)	60 days	Tue 7/12/05	Mon 10/3/05
18	EPA MARP Review	20 days	Tue 11/1/05	Mon 11/28/05
19	Submit Final MARP	20 days	Tue 10/4/05	Mon 10/31/05
20	Remedial Action Completion Report (RACR)	40 days	Mon 11/21/05	Fri 1/13/06
21	EPA RACR Review	15 days	Mon 1/16/06	Fri 2/3/06
22	Submit Final RACR	20 days	Mon 2/6/06	Fri 3/3/06
23	**Fish Window (November 1 - November 30)**	22 days	Tue 11/1/05	Wed 11/30/05



Project: Gasco Schedule_Silt Curtain_
Date: Thu 7/7/05

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

APPENDIX J

DRYING REAGENT BENCH SCALE TESTING RESULTS

Analytical Resources, Incorporated
Analytical Chemists and Consultants

June 21, 2005

Mr. Ryan Barth
Anchor Environmental, Inc.
1423 Third Avenue
Seattle, WA 98101

Subject: "Gasco" Site
ARI Project No.: ID55

Dear Mr. Barth;

We have completed the treatability testing you requested. The work is described on the following narrative and tables. Please call me to discuss any questions, or comments you may have on the data or its presentation.

Best Regards,
Analytical Resources, Incorporated

Harold Benny

Harold Benny
Geotechnical Division Manager
206-695-6246
haroldb@arilabs.com

Enclosures

cc: File ID55

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Client: Anchor Environmental, Inc.	Project No.: ID55
Client Project: NW Natural "Gasco" Site	

Case Narrative

1. The sample was submitted for bench scale treatability testing. The sample consisted of four, 2 gallon buckets.
2. Each bucket contained standing water, about 1.5 inches, which was mixed into the sediment using a large spoon and then a hand drill with a mixer paddle. The sample was screened over a 5/8 inch screen to remove large pieces of debris. Many of these large debris pieces were tar-like agglomerations that were broken up by hand and added back into the mix. The slurry was then ready for testing.
3. An aliquot of slurry was placed in a paint filter and initially passed this test. Because the paint filter test does not have a time limit, the sample was allowed to sit for 60 minutes. At the end of this time, water had separated out of the slurry and the material failed paint filter.
4. An aliquot of sediment slurry was weighted out and the appropriate amount of cement was added. Mixing was done with a lab mixer, for 1 minute, then the bowl was scraped down and another 1 minute mixing cycle. The six was then poured into plastic bottles with screw top lids. The lids were screwed down and they were set aside to cure at room temperature.
5. On each testing day, the lid was removed and a pocket penetrometer was used to measure the strength of the mix. The top surface was noted and the presence of bleed water was noted. At the direction of Anchor, the lids were removed to allow evaporation at day 2. By day 3, the bleed water on the 5, 7, and 10% mixes had evaporated. The 12% mix did not have any bleed water at any age.
6. The data is provided in the tables provided by Anchor.
7. There were no noted anomalies in the samples or methods on this project.

Approved by: Harold Benny Date: 6/21/05
Title: Geotechnical Division Manager

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

NW Natural "Gasco" Site
Admixture Bench Scale Results
June 2005

Material	Solidification Reagent	Admixture Proportion (Percent)	0 Day	1 Day		3 Days		5 Days		7 Days	
			tsf	tsf	PFT (Y/N)	tsf	PFT (Y/N)	tsf	PFT (Y/N)	tsf	PFT (Y/N)
Comp-DredgePrism	Portland Cement	0	0	0	N	0	N	0	N	0	N
		3	0	0.25	N	0.25	N	0.5	N	0.5	N
		5	0	1	N	1.25	Y	1.25	Y	1.5	Y
		7	0	2	N	2.5	Y	3	Y	3.5	Y
		10	0	4.25	N	>4.5	Y	>4.5	Y	>4.5	Y
		12	0	>4.5	Y	>4.5	Y	>4.5	Y	>4.5	Y

tsf = tons per square foot as measured by a pocket pentrometer
PFT = Paint Filter Test (pass Yes or No)

NW Natural "Gasco" Site
Admixture Bench Scale Description Log
June 2005

Admixture Proportion (%)	Time (days)	Physical Description/Other Comments
	0	Not much change from 0% very soupy
	1	Bleed water, distinct sheen
	3	Bleed water, distinct sheen
	5	Bleed water, distinct sheen
3	7	Bleed water, distinct sheen
	0	Getting thicker, but still very loose, sloppy mix
	1	Bleed water, distinct sheen
	3	Bleed water has evaporated, light crust on top, distinct sheen
	5	Bleed water has evaporated, light crust on top, distinct sheen
5	7	Bleed water has evaporated, crust on top, distinct sheen
	0	Thicker, not very sloppy, sheen
	1	Bleed water, distinct sheen
	3	Bleed water has evaporated, light crust on top, distinct sheen
	5	Bleed water has evaporated, light crust on top, distinct sheen
7	7	Bleed water has evaporated, light crust on top, distinct sheen
	0	Thicker than starting slurry, no sheen
	1	Bleed water, distinct sheen
	3	Bleed water has evaporated, light crust on top, distinct sheen
	5	Bleed water has evaporated, crust on top, distinct sheen
10	7	Bleed water has evaporated, distinct crust on top, sheen dissipating
	0	Thick, viscous, very much drier than the starting slurry, no sheen.
	1	No Bleed water, slight crust forming on top, no Sheen
	3	No Bleed water, slight crust on top, no Sheen
	5	No Bleed water, slight crust on top, no Sheen
12	7	No Bleed water, slight crust on top, no Sheen

Note: The bleed water is saturated in calcium. Over time it reacts with carbon dioxide in the air and a thin crust of calcium carbonate forms on the top of the bleed water. As the water evaporates, this crust becomes pretty hard and is chemically/physically bound to the top of the sample, forming a barrier.