EnviroLogic Resources, Inc.

Consulting Environmental & Water Resources Scientists

September 22, 2005
10077.012

Oregon Department of Environmental Quality
Northwest Region
2020 SW Fourth Avenue
Suite 400
Portland, Oregon 97201-4987

VIA Email/First Class

Subject: **RI/FS Work Plan Addendum**
Ecological Risk Assessment Work Plan
Remedial Investigation/Feasibility Study
Astoria Area-Wide Petroleum Site
Astoria, Oregon
DEQ ECSI File #2277

Dear Ms. Coates:

Enclosed are four copies of the above-referenced document. This report is being submitted to you on behalf of the Astoria Area-Wide Cooperating Parties. This report is intended to comply with the terms of DEQ Order No. ECSR-NWR-01-11.

Please call me at (503)768-5121 if you have any questions or comments.

Sincerely,
EnviroLogic Resources, Inc.

Thomas J. Calabrese, RG, CWRE
Principal/Hydrogeologist
Project Manager

cc: Distribution list attached

ASTORIA AREA-WIDE PETROLEUM SITE
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Astoria Area-Wide Site Ecological Risk Assessment Work Plan

22 September 2005

Prepared for

Astoria Area-Wide Potentially Responsible Party (PRP) Group

K/J Project No. 0592004.00

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Section 1: Introduction

Kennedy/Jenks Consultants prepared this Level III baseline ecological risk assessment (ERA) work plan on behalf of the Astoria Area-Wide Potentially Responsible Party (PRP) Group for the Astoria Area-Wide Petroleum Site (Site) located in Astoria, Oregon. The purpose of the ERA is to evaluate the potential for adverse impacts to the environment attributable to exposure to Site-related petroleum constituents. The receptors and potential exposure pathways requiring evaluation at this Site are presented in the conceptual site model (CSM) for ecological receptors prepared as part of this ERA work plan. The results of this risk assessment will be used by the PRP Group to form the basis for selecting, designing, and monitoring a final remedy for this Site, as applicable.

The Level III ERA will be completed as part of the remedial investigation/ feasibility study (RI/FS) being performed pursuant to a Unilateral Order issued in 2001 December by the Oregon Department of Environmental Quality (DEQ) (No. ECSR-NWR-01-11). The Level III ERA work plan was prepared in accordance with the guidance established by DEQ (DEQ 2000).

Section 2: Site Background

2.1 Site Location and Study Area

The Site is located in the SW quarter of Section 7, Township 8 North, Range 9 West; the SE quarter of Section 12, Township 8 North, Range 10 West; and the NE quarter of Section 13, Township 8 North, Range 10 West of the Willamette Meridian. The Site location, relative to surrounding physical features, is shown on Figure 1.

Per DEQ ERA guidance, a Level I ERA was completed in August 2004 (Hart Crowser 2004). The study area for the Level I ERA was previously described as bounded on the north by Slip 2 (approximately 600 feet from the shore toward the Columbia River), on the east by Portway Street, on the south by West Marine Drive, and on the west by the western property boundary of the former McCall Oil Bulk Plant (Chevron) property. The ERA study area encompasses a portion of the Columbia River within Slip 2 at the Port of Astoria. The ongoing interim remedial action measure (IRAM) consists of a floating boom and free product absorbent system to contain petroleum hydrocarbons presently seeping into the Columbia River from the filled shoreline at the head of Slip 2. Further upland investigations are also underway to address the source(s) of the seep.

On 20 August 2004, DEQ issued its finding in agreement with the Level I ERA that no ecologically important species and/or habitats were present in the upland portion of the Site (DEQ 2004). Also, a preliminary Level II screening of sediment samples collected from the southeast corner of Slip 2 was conducted in November 2003 (EnviroLogic Resources 2003). The Level II screening identified several polynuclear aromatic hydrocarbons (PAHs) that exceeded their respective DEQ marine sediment screening level values (SLVs).

This Level III ERA work plan addresses only the in-water portion of the Site within the southern half of Slip 2– in particular, the area within and outside of the boom in the southeast corner of the Slip 2.

2.2 Ecological Setting

Slip 2 is located south of the Columbia River and is armored with riprap, wooden bulkheads, and sheetpiling around the pier faces. Dock ruins and historic wooden pilings were observed in the water just offshore of the piers. An Oregon Responder Barge and associated tug are moored on the east side of Slip 2. In the mid-1980s, there was a fire on Pier 2 adjacent to the hydrocarbon seep. The fire damage is still evident from numerous burned or charred pilings and timbers. The slips at the Port of Astoria are dredged on an annual basis, which causes annual disturbance of the benthic community that may be present in the slip. A mudflat in the southwest corner of Slip 2 is exposed during low tide, with cattails and rushes the emergent vegetation growing out of the mudflat. The area within the current containment boom in Slip 2 is also exposed as a mudflat under low tide conditions. The intertidal habitat of Slip 2 is illustrated on Figure 2.

Section 3: Conceptual Site Model

3.1 Ecological Conceptual Site Model

The CSM provides a framework for the baseline ERA by identifying and organizing potential exposure pathways (sources of contamination, release mechanisms, transport media, exposure points, exposure routes, and receptors) and identifying which of those pathways are complete and which are incomplete. The ecological CSM was developed focusing on site-specific exposure pathways, exposure routes, and receptors. Current and reasonably likely future land use conditions were considered in the development of the CSM.

An ecological CSM identifying exposure pathways was developed for this Site (Figure 3). The model illustrates the conceptual understanding of the chemical sources, releases, transport mechanisms and potential exposure pathways, exposure routes, and receptors.

The media to be investigated in this Level III baseline ERA are surface sediment and surface water. The identified potentially complete exposure pathways are:

- Direct contact of Site constituents to benthic invertebrate receptors residing in surface sediments
- Direct contact of Site constituents in surface water to resident pelagic receptors.

3.2 Endpoint Selection

Based on the ecological CSM developed for the Site (Figure 3), assessment and measurement endpoints have been identified for this ERA. These assessment and measurement endpoints were established to guide the completion of the risk characterization portion of the ERA. The assessment and measurement endpoints are presented in narrative form below.

Assessment Endpoints. The assessment endpoints proposed for the ERA for the Site are:

- Protection of the benthic invertebrate community from reproductive impairment caused by Site constituents
- Protection of resident pelagic organisms (e.g., sculpin, stickleback, perch) from reproductive impairment caused by Site constituents.

Assessment endpoints establish the direction and boundaries of the ERA and are explicit expressions of the environmental values to be protected. Assessment endpoints also assist in identifying the measurable attributes to be quantified in the ERA.

Measurement Endpoints. Measurement endpoints are measurable responses related to the valued characteristics selected as assessment endpoints. Measurement endpoints are used to approximate, represent, or lead to assessment endpoints when assessment endpoints cannot be directly measured. Specific to the assessment endpoints identified above, measurement endpoints for this ERA are:

- For protection of the benthic invertebrate community, compare test sediment bioassay results to reference and control sediment bioassay results
- For protection of resident pelagic organisms, compare surface water chemistry data to appropriate surface water screening criteria.

Additional assessment and measurement endpoints may become applicable during preparation of the feasibility study. Because the Port of Astoria will be dredging the area covered by this ERA, additional potential assessment and measurement endpoints may become apparent and will be addressed as balancing factors in the detailed analysis of the feasibility study.

Details regarding bioassay protocols and surface water screening criteria are discussed further in Sections 4.3 through 4.5 below.

Section 4: Additional Sampling and Risk Screening

4.1 Proposed Samples

Based on comments received in DEQ's 20 August 2004 memo and subsequent discussions with Paul Seidel (DEQ risk assessor), Kennedy/Jenks Consultants proposes collecting additional co-located surface sediment and surface water samples from within and outside of the boom area in the southeast corner of Slip 2 (Figure 2). The following samples are proposed:

- 5 surface sediment samples
  - 3 surface sediment samples inside the boom area
  - 2 surface sediment samples outside the boom area
- 5 surface water samples
  - 3 surface water samples inside the boom area
  - 2 surface water sample outside the boom area
- 2 reference surface sediment samples.

Reference sample locations will be identified by field reconnaissance through coordination with DEQ, the U.S. Army Corps of Engineers (Corps), and other parties with knowledge of sediment characteristics in the area prior to initiation of sampling. Appropriate reference locations will need to be identified with sediment grain size characteristics similar to those collected from Slip 2 and with chemical concentrations below DEQ marine sediment SLVs.

Two potential reference sample locations are currently proposed. Based on prior Corps sampling results, an area inside of and away from the breakwater of the Astoria East Boat Basin was targeted as a potential reference location. A second potential reference location was identified following discussion with the Corps on previous sampling conducted in Skipanon Channel. The second reference location will be along the western shore of Youngs Bay, southeast of the entrance to Skipanon Channel. If further information on potential reference locations is obtained prior to the fieldwork, these proposed locations may be amended or replaced in consultation with the PRP Group and DEQ.

4.2 Field Sampling Methods

Surface sediment and surface water samples will be collected by Northwest Underwater Construction (NWUC) of Vancouver, Washington. The NWUC diver will be deployed from the sampling vessel as close to the desired station as possible. At low tide, the diver may walk to the desired location within the boom area. The diver will collect surface sediment samples from 0 to 10 centimeters using a handheld coring or sampling device. The device will be pushed below mudline and retrieved without loss of fine material by capping both ends of the device. Multiple cores or deployments will be needed to obtain enough sediment at each location for both chemical and bioassay testing (approximately 6 liters total). Sediment obtained through multiple deployments at each station will be composited prior to placement into precleaned

sample jars. The sample jars will be placed into coolers with ice and transported with chain-of-custody documentation to the appropriate laboratories for testing.

Water column samples will also be collected by the diver during an outgoing high tide. The mid-water column samples will be co-located with the sediment sample stations. The diver will collect surface water into a precleaned sample bottle for chemical testing and will place the bottle into a cooler with ice for transport with chain-of-custody documentation to Columbia Analytical Services (CAS) of Kelso, Washington.

Sample station coordinates will be obtained by handheld global positioning system (GPS) or NWUC's marine GPS. Depth to mudline will be measured using the sampling vessel's depth finder or by the diver in shallow, inaccessible areas. Other field observations, including weather, field personnel, sampling method, and sediment characteristics, will be documented on field sampling forms.

4.3 Sediment Chemical Analyses

CAS will analyze all surface sediment samples for the full suite of chemicals on the Puget Sound Dredged Disposal Analysis (PSSDA) list. In addition to quantifying the constituents of concern in Site sediments, the purpose of analyzing the full PSSDA list is to evaluate whether other non-target constituents may potentially confound the biological testing results (see Section 4.4 below). Table 1 summarizes these constituents and the associated method detection limits.

Table 1: Proposed Sediment Analyte List and Method Detection Limits

Chemical Parameter	**Method Detection Limit**
Metals	(in milligrams per kilogram [mg/kg])
Arsenic	0.07
Cadmium	0.07
Chromium	0.04
Copper	0.02
Lead	0.02
Mercury	0.008
Silver	0.003
Zinc	0.2
PAHs	(in micrograms per kilogram [µg/kg])
Total light PAHs (LPAHs)	0.3
Naphthalene	0.3
Acenaphthylene	0.2
Acenaphthene	0.3
Fluorene	0.2
Phenanthrene	0.2
Anthracene	0.2
2-methylnaphthalene	0.3

Chemical Parameter	Method Detection Limit
Total Heavy PAHs (HPAHs)	0.2
Fluoranthene	0.2
Pyrene	0.2
Benz(a)anthracene	0.2
Chrysene	0.2
Total benzofluoranthenes (b+k)	0.2
Benzo(a)pyrene	0.2
Indeno(1,2,3-cd)pyrene	0.2
Dibenz(a,h)anthracene	0.2
Benzo(g,h,i)perylene	0.1
Semivolatile Organic Compounds (SVOCs)	(in µg/kg)
1,2-dichlorobenzene	2
1,4-dichlorobenzene	2
1,2,4-trichlorobenzene	2
Hexachlorobenzene	3
Dimethyl phthalate	2
Diethyl phthalate	4
Di-n-butyl phthalate	3
Butyl benzyl phthalate	2
Bis(2-ethylhexyl)phthalate	2
Di-n-octyl phthalate	2
Dibenzofuran	2
Hexachlorobutadiene	2
N-nitrosodiphenylamine	3
Phenol	2
2-methylphenol	4
4-methylphenol	3
2,4-dimethylphenol	6
Pentachlorophenol	9
Benzyl alcohol	4
Benzoic acid	96
Polychlorinated biphenyls (PCBs)	(in µg/kg)
Total PCBs	12
Organotins	(porewater in micrograms per liter [µg/l])
Tri-n-butyltin	0.007

4.4 Sediment Biological Analyses

Because chemical analyses from previous sediment samples collected exceeded DEQ marine/estuarine sediment SLVs (EnviroLogic Resources 2003), bioassay testing will be required on the five surface sediment samples from Slip 2 and at least one of the reference

surface sediment samples. Northwestern Aquatic Sciences (NAS) of Newport, Oregon will conduct the sediment bioassay tests. The suite of proposed marine/estuarine biological tests, selected according to the Dredged Material Evaluation Framework (DMEF) (Corps et al. 1998) for the Lower Columbia River Management Area (LCRMA), is as follows:

- Acute 10-day amphipod mortality test
- Chronic 20-day juvenile polychaete survival/growth test
- Acute 48-hour larval echinoderm/bivalve mortality/abnormality test.

The response of the bioassay organisms exposed to the tested Site sediment will be compared to the response of these organisms in both control and reference treatments (Corps et al. 1998). Biological test interpretation relies on two levels of observed response in the test organisms: one-hit or two-hit criteria. In general, a one-hit failure is a marked response in any one biological test. A two-hit failure is a lower intensity of response, found in two or more biological tests (Corps et al. 1998).

The determination of a "statistically significant" response involves different conditions for the different test organisms, per the DMEF (Corps et al. 1998):

- Amphipod bioassay: mean test mortality >20% absolute over the mean negative control response, >30% absolute over the mean reference sediment response, and statistically different from the reference (alpha = 0.05) is considered a "one-hit."
- Juvenile infaunal growth test: mean test individual growth rate <80% of mean negative control growth rate, <50% (relative) of mean reference sediment growth rate, and statistically different from the reference (alpha = 0.05) is considered a "one-hit."
- Sediment larval bioassay: test and reference sediment responses are normalized to the negative seawater control response, (i.e., divide the number of normal larvae from test/reference treatment at the end of the exposure period by the number of normal larvae in seawater control at the end of the exposure period, and multiply by 100 to convert to percent). The normalized combined mortality and abnormality (NCMA) is equivalent to 100 minus this number. If the mean NCMA for a test sediment >20%, is 30% absolute over the mean reference sediment NCMA, and is statistically different from the reference (alpha = 0.10), it is considered a "hit."

If the test sediments from the southeast corner of Slip 2 pass bioassay testing (i.e., no one- or two-hit failures), the conclusion is that surficial sediments in the study area do not pose an ecological risk to benthic organisms residing in the substrate.

4.5 Surface Water Chemical Analyses

The purpose of analyzing surface water chemistry from the southeast corner of Slip 2 is to evaluate whether petroleum constituents in the seep or sheen may pose an ecological risk to pelagic aquatic receptors. Surface water samples will be analyzed by CAS for SVOCs and volatile organic compounds (VOCs), focusing on petroleum constituents detected in upland soil and groundwater. Analytical results will be compared against appropriate surface water screening criteria to determine whether constituents in surface water pose an ecological risk to

resident pelagic receptors. The proposed surface water screening criteria are final chronic values (FCVs) for chronic toxicity of individual PAHs in water exposures (EPA 2003). These FCVs are proposed in lieu of DEQ surface water SLVs because they were derived more rigorously and include more recent toxicity data. If surface water concentrations are below FCVs, the conclusion is that petroleum constituents in the water column do not pose an unacceptable ecological risk to pelagic aquatic receptors.

4.6 Uncertainty Analysis

There are several sources of uncertainty associated with this ERA. One is whether the measured responses in sediment bioassays are related to site-related contaminants or other "confounding" factors. Another is the source of petroleum constituents found in surface water. The sampling and data interpretation program proposed for this ERA were designed to address these areas of uncertainty. For this ERA, these uncertainties will be evaluated qualitatively. A qualitative evaluation of uncertainty is a descriptive discussion of the sources of uncertainty in the assessment accompanied by an estimation of the degree of uncertainty associated with each source (e.g., low, medium, and high) and an estimation of the direction of uncertainty contributed by that source (under- or over-estimation). A qualitative uncertainty assessment does not provide alternative risk values, but provides a framework in which to place the results of the ERA.

Section 5: Reporting

Kennedy/Jenks Consultants will prepare a report presenting the results of this ERA. Specifically, the report will cover the following major topics:

- Deviations from the accepted work plan
- Results of sediment bioassay testing
- Quality assurance/quality control (QA/QC) evaluation of sediment bioassay program
- Summary of the bioassay results in accordance with biological interpretative criteria previously discussed
- Analytical chemistry results of the water column samples
- Summary of the comparison of the water column analytical results with appropriate screening levels
- Qualitative uncertainty evaluation
- General conclusions.

Backup documentation (analytical laboratory certificates and bioassay reports) will be included as an appendix to the ERA report.

Section 6: References

Corps. 1998. Dredged Material Evaluation Framework, Lower Columbia River Management Area. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Washington State Department of Ecology, Oregon Department of Environmental Quality, and Washington State Department of Natural Resources. November 1998.

DEQ. 2000. Guidance for Ecological Risk Assessment: Level III Baseline. Oregon Department of Environmental Quality, Waste Management & Cleanup Division, Cleanup Policy & Program Development Section. Portland, Oregon. Last updated 2000 March.

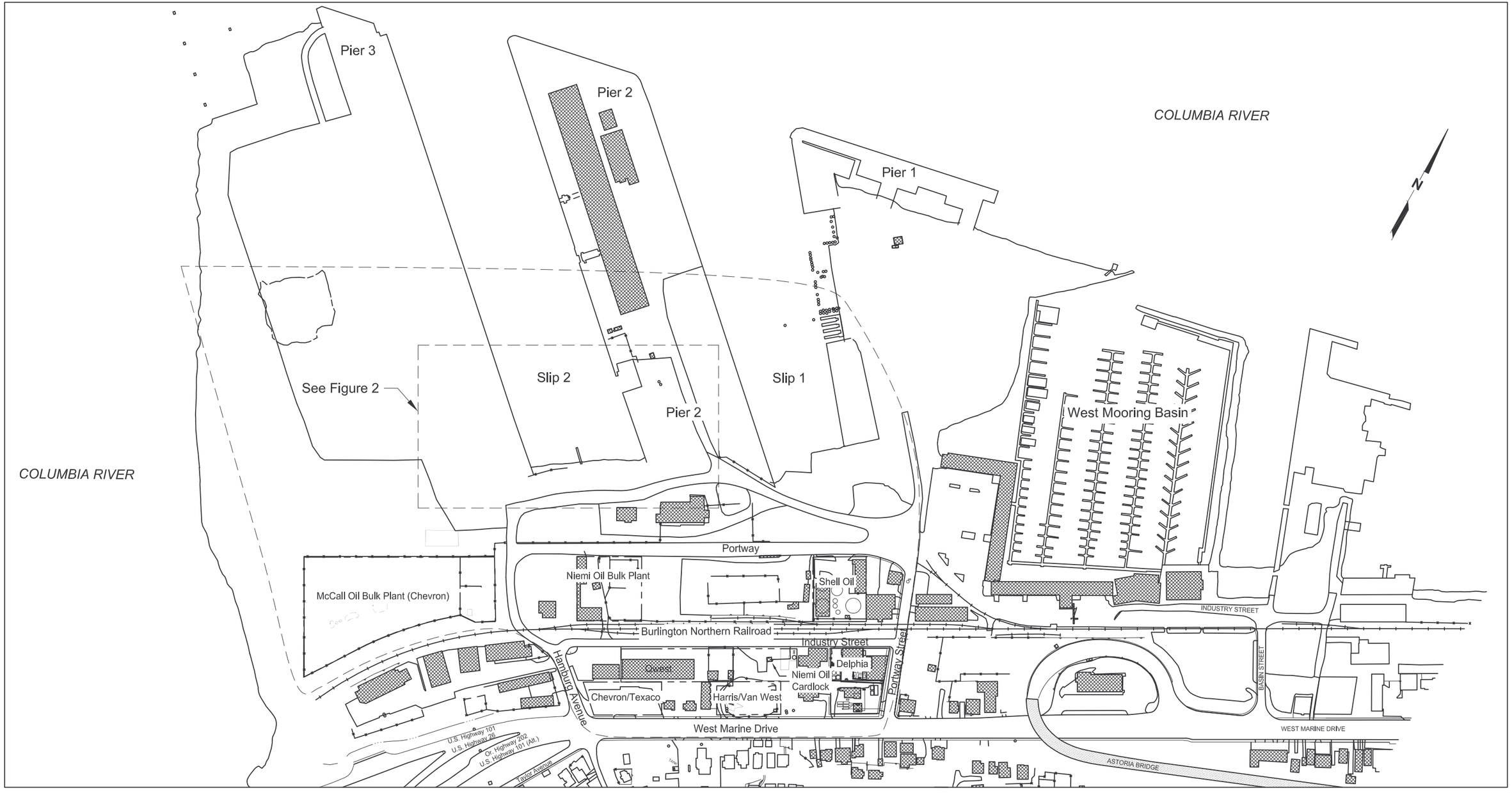
DEQ. 2004. Memorandum to Tom Calabrese re: Remedial Investigation/Feasibility Study/Interim Removal Action Measures, Level 1 Ecological Risk Assessment, Astoria Area-Wide Petroleum Site, Astoria, Oregon, ECSI Number 2277, Order ECSR-NWR-01-11. Oregon Department of Environmental Quality. 20 August 2004.

EnviroLogic Resources. 2003. Technical Memorandum – Sediment Sampling, Remedial Investigation/Feasibility Study/Interim Removal Action Measures, Astoria Area-Wide Petroleum Site, Astoria, Oregon, DEQ ECSI File #2277. #10077.006.

Hart Crowser. 2004. Level 1 Ecological Risk Assessment, Remedial Investigation/Feasibility Study, Astoria Area-Wide Petroleum Site, DEQ ECSI File #2277. #15435-00. Hart Crowser, Lake Oswego, Oregon.

U.S. EPA. 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA/600/R-02/013. U.S. Environmental Protection Agency. Narragansett, Rhode Island, Duluth, Minnesota, and Newport, Oregon. November 2003.

Figures



LEGEND :

– – – – – AREA EVALUATED IN LEVEL 1 SCOPING ECOLOGICAL RISK ASSESSMENT

Note: Base map prepared from AutoCAD file provided by EnviroLogic Resources, Inc., dated 5/02.

300 0 600

Scale in Feet

Kennedy/Jenks Consultants

ECOLOGICAL RISK ASSESSMENT WORK PLAN
ASTORIA, OREGON

ASTORIA AREA-WIDE SITE

Figure 1
K/J 0592004.00

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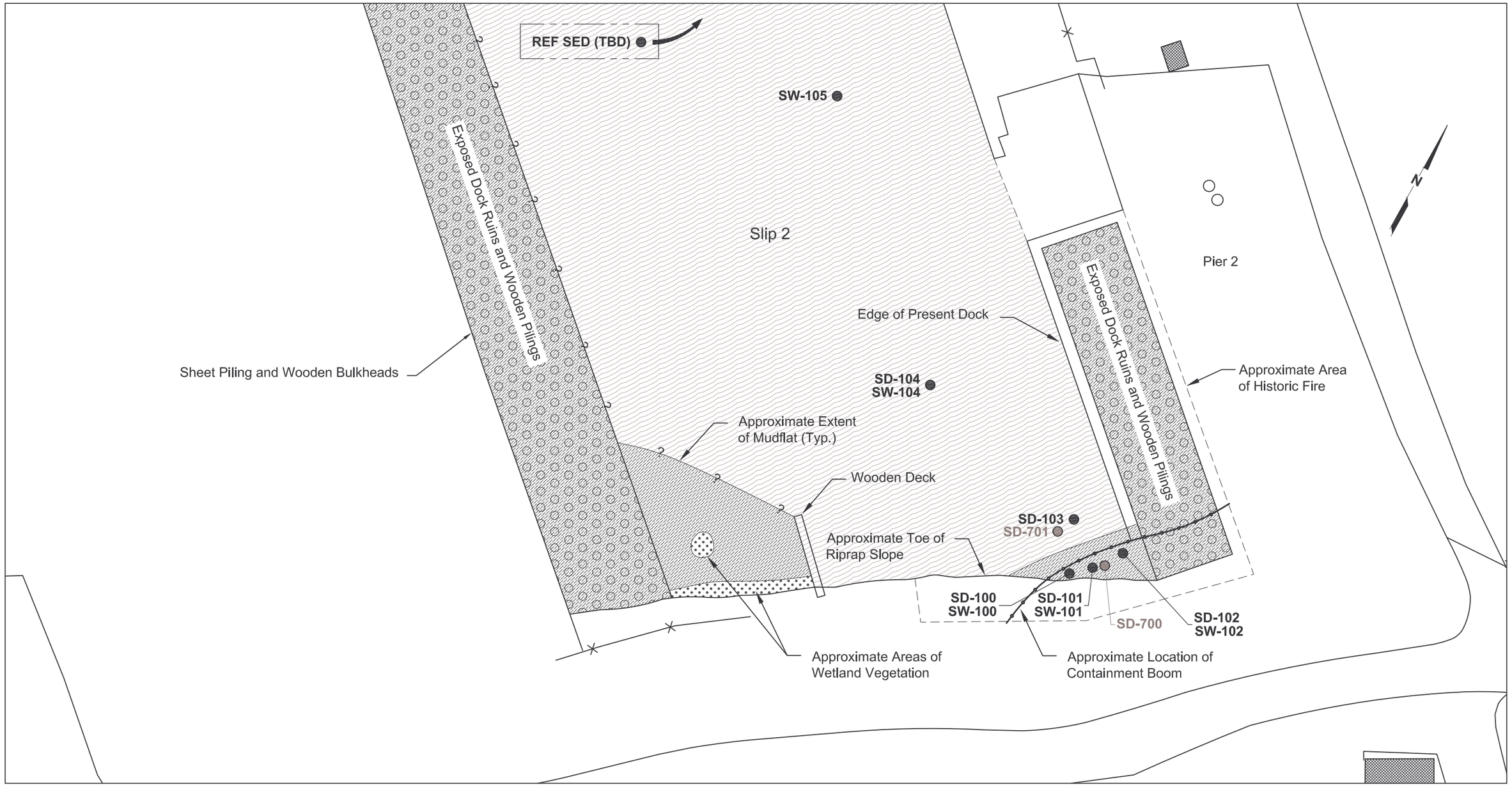

LEGEND :

SD-700 ●	APPROXIMATE SEDIMENT SAMPLE LOCATION AND NUMBER (EnviroLogic, June 19, 2003)
SD-101 ●	PROPOSED SURFACE SEDIMENT SAMPLE
SW-101 ●	PROPOSED WATER COLUMN SAMPLE

Notes:

1. Base map prepared from AutoCAD file provided by EnviroLogic Resources, Inc., dated 5/02.
2. Conditions shown as observed at approximate tidal height of +2.5' Columbia River Datum (CRD).

60 0 120

Scale in Feet

Kennedy/Jenks Consultants

ECOLOGICAL RISK ASSESSMENT WORK PLAN
ASTORIA, OREGON

SLIP 2 INTERTIDAL HABITAT

Figure 2
K/J 0592004.00

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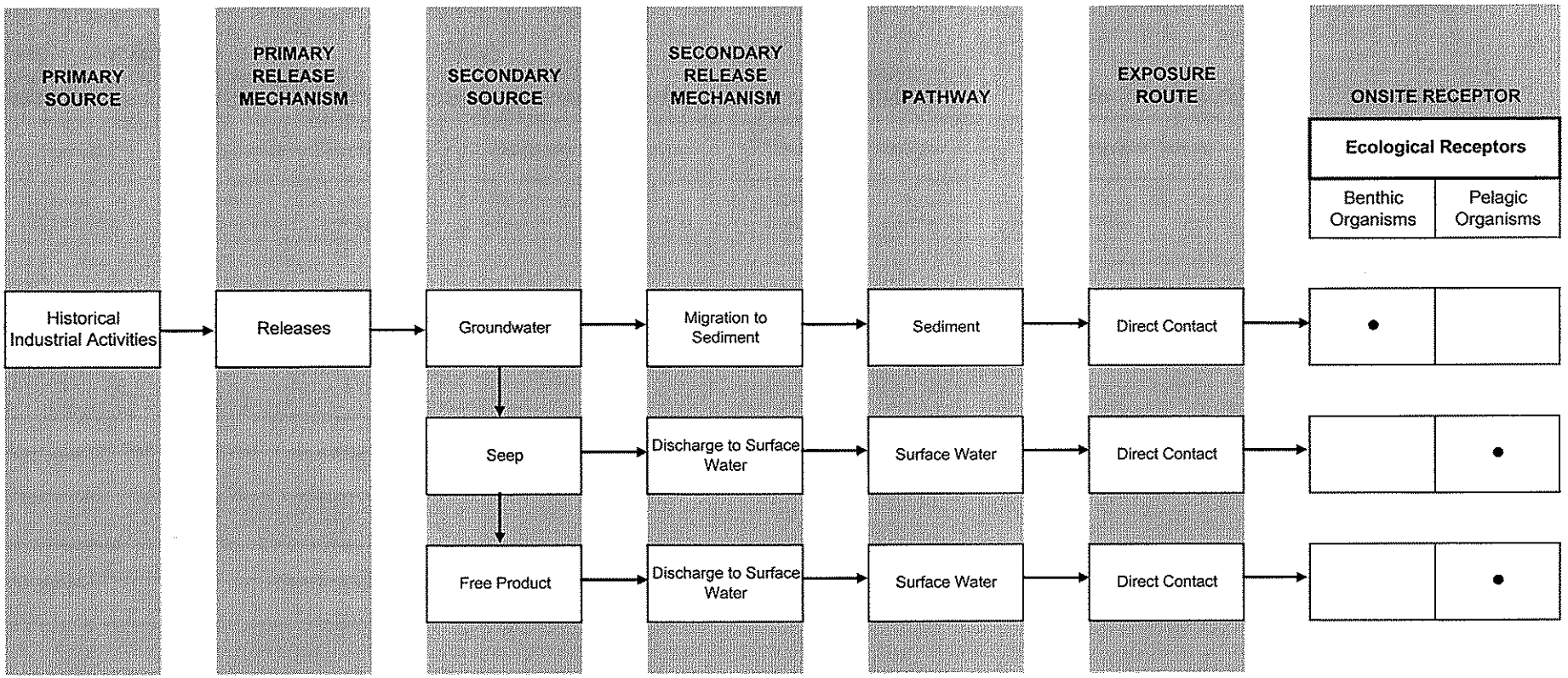
Figure 3. Ecological Conceptual Site Model



Notes:

● Potentially complete pathway; quantitative evaluation

→ Complete Pathway