# TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: Jing Liu, Washington State Department of Ecology

FROM: Stacy Lane, L.G., and Larry Beard, P.E., L.G.

DATE: December 7, 2012

**RE: REMEDIAL INVESTIGATION SURFACE SEDIMENT ANALYTICAL RESULTS**
**BLAINE MARINA INC. SITE**
**BLAINE, WASHINGTON**

## INTRODUCTION

This technical memorandum presents the results for three surface sediment samples collected at the Blaine Marina Inc. Site (Site) in Blaine, Washington and provides conclusions and recommendations regarding additional sediment quality testing. The samples were collected as part of the remedial investigation (RI) being conducted at the Site under Agreed Order No. DE 9000 (AO) between the Port and Ecology. The AO Scope of Work (Exhibit B to the AO) requires that an RI data summary technical memorandum be submitted to Ecology (Task 6). The memorandum is intended to be an informal document to inform Ecology of the RI results so a determination can be made regarding whether RI field activities are complete. The RI sediment quality data are being submitted separately from the upland data because a decision regarding additional sediment quality testing is time-sensitive and upland data will not be complete and ready for submittal to Ecology for a few weeks.

The RI work plan (Landau Associates 2012) specifies that a bioassay test will be conducted using the sediment sample with the highest concentrations of total petroleum hydrocarbons (TPH), if TPH constituents are detected in sediment at concentrations that indicate a release from the Site may have occurred. This technical memorandum describes sediment sample collection, presents and interprets the sediment analytical results, and provides conclusions and recommendations regarding the need for additional sediment quality characterization.

## SAMPLE COLLECTION AND ANALYSIS

As described in the RI work plan, the sediment investigation consisted of collecting three surface sediment samples, BMI-SS-1, BMI-SS-2, and BMI-SS-3 at the locations shown on Figure 1 (Figure 10 from the RI work plan). For the location of sample BMI-SS-2, field personnel conducted a reconnaissance of the riprap underlying the decking of the former fuel office building and determined that sufficient accumulation of sediment was present in the interstices of the riprap to allow for surface sediment sampling closer to the shoreline at this location. The final sampling location for BMI-SS-2 was

approximately 21 ft west of the bulkhead, as shown on Figure 1. Samples BMI-SS-1 and BMI-SS-3 were collected from the sample locations proposed in the RI work plan.

Sediment sample BMI-SS-2 was collected on September 25, 2012 and samples BMI-SS-1 and BMI-SS-3 were collected on October 26, 2012 using the procedures described in the marine sediment sampling and analysis plan (Appendix E of the RI work plan). The samples were submitted to Analytical Resources, Inc. laboratory located in Tukwila, Washington and analyzed for those constituents identified in the RI work plan, which consist of lead, TPH and total organic carbon (TOC). The TPH fractions were determined using volatile petroleum hydrocarbon (VPH), extractable petroleum hydrocarbon (EPH), NWTPH-D extended, and NWTPH-G methodologies. In accordance with the work plan, one blind field duplicate sample was collected at sample location BMI-SS-3.

## SAMPLE ANALYTICAL RESULTS

The analytical results for the three surface sediment samples and the blind field duplicate sample are summarized in Table 1. An internal data quality evaluation was conducted on all of the analytical data. All the data were determined to be acceptable for use. Data qualifiers (J flags) were added to some of the EPH fraction results for sample BMI-SS-3 and the blind field duplicate due to high relative percent differences between the sample concentrations, which is most likely due to sample heterogeneity commonly present in sediment samples. The flagged data are qualified as estimates.

As shown in Table 1, no gasoline-range organics or VPH fractions were detected in the samples. Diesel-range organics, lube oil range organics, and some EPH fractions were detected in each of the samples at low concentrations ranging from 30 milligrams per kilogram (mg/kg) to 76 mg/kg for diesel, 42 mg/kg to 77 mg/kg for lube oil, and 5 mg/kg to an estimated 58 mg/kg for EPH fractions. Naphthalene was detected in sample BMI-SS-3 and the duplicate sample of BMI-SS-3. The naphthalene concentrations detected were slightly above the reporting limit of 0.062 mg/kg at 0.081 mg/kg and 0.073 mg/kg, respectively.

## DATA INTERPRETATION

Based on the following considerations, it is our opinion that the concentrations of petroleum hydrocarbons detected in surface sediment in the vicinity of the Site are not likely the result of Site releases and do not warrant follow-up bioassay testing:

- The TPH concentrations detected in the three surface sediment samples are quite low and are not indicative of a point source release.
- The consistency in concentrations between the samples regardless of location relative to the shoreline and Site upland source area is not indicative of an upland source emanating from the Site.

- The constituents detected in surface sediment are not consistent with the Site upland source. Specifically, oil-range petroleum hydrocarbons were detected in concentrations as high as diesel-range petroleum hydrocarbons, even though oil-range petroleum hydrocarbons do not appear to be a Site constituent of concern. Additionally, neither naphthalene nor gasoline-range petroleum hydrocarbon compounds was detected even though these are primary constituents of Site upland releases.

There are a number of potential sources of the low-level petroleum hydrocarbon detections present in surface sediment to the west of the Site other than a release from the Site uplands. First, as an active marina, minor discharges of petroleum hydrocarbons from vessels, docks and stormwater are common and could easily cause the low concentrations detected in surface sediment. Additionally, the low TPH concentrations detected in the sediment samples could be related to naturally occurring organic matter. The TOC concentrations measured in the samples ranged from 2.49 to 3.39 percent. Typical TOC concentrations for Puget Sound are about 0.5 to 4 percent, indicating that the TOC concentrations detected in the Site sediment samples are on the high end of typical concentrations. Naturally occurring organic matter is known to cause false positive detections for standard petroleum hydrocarbon analyses and may be the source of the low-level TPH concentrations detected in RI sediment samples.

## CONCLUSIONS AND RECOMMENDATIONS

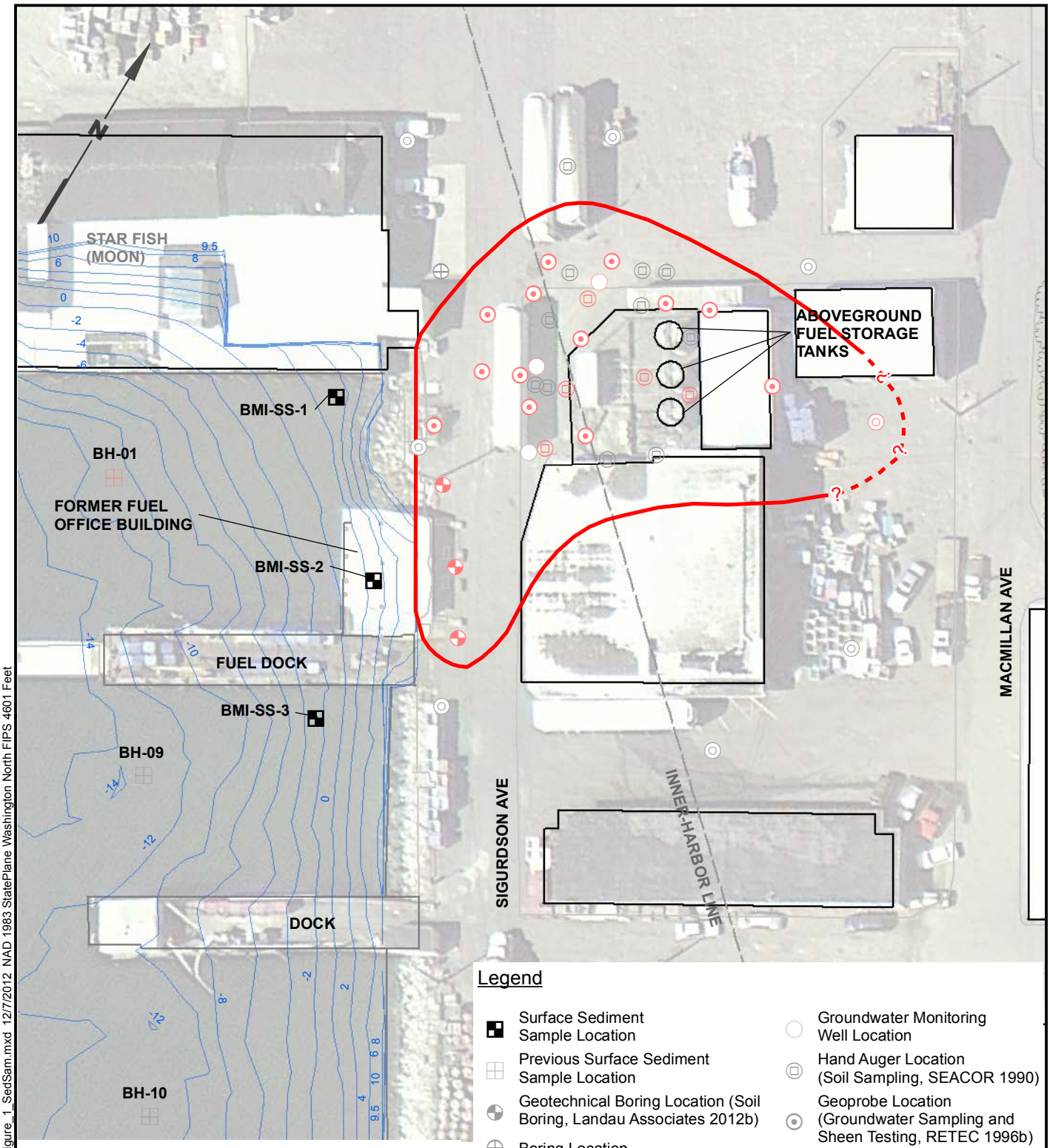
Based on the analytical results and the data evaluation provided in the previous section, we conclude that the TPH analytical results for the sediment samples do not indicate a release from the Site uplands to marine sediment has occurred. Additionally, the TPH concentrations are quite low, more than an order of magnitude below the Model Toxics Control Act Method A TPH soil cleanup levels for unrestricted site use (2,000 mg/kg for diesel- and oil-range TPH) and almost an order of magnitude below the criterion for terrestrial ecological receptors (460 mg for diesel-range TPH). Although these criteria are not directly applicable to sediment quality, they do provide context for the concentrations detected in Site RI sediment samples. Based on these conclusions, we recommend that sediment bioassay testing not be conducted and that sediment not be considered an affected Site medium.

## REFERENCES

Landau Associates. 2012. *Remedial Investigation Work Plan, Blaine Marina Inc. Site, Blaine, Washington.* Prepared for Port of Bellingham. October 4.

## ATTACHMENTS

Figure 1: Sediment Investigation Sampling Locations
Table 1: Surface Sediment Analytical Results




Legend

- Surface Sediment Sample Location
- Previous Surface Sediment Sample Location
- Geotechnical Boring Location (Soil Boring, Landau Associates 2012b)
- Boring Location
- Approximate Site Boundary; Site Boundaries to be Determined in the RI/FS
- Groundwater Monitoring Well Location
- Hand Auger Location (Soil Sampling, SEACOR 1990)
- Geoprobe Location (Groundwater Sampling and Sheen Testing, RETEC 1996b)
- Geoprobe Location (Soil Sampling, Farallon 2008)
- Bathymetry Contours
- Existing Building Location

Notes

1. Explorations shown in Red indicate contaminant levels exceed preliminary screening levels.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 50 100

Scale in Feet

Data Sources: Wilson Engineering; Port of Blaine 2011; Walker and Associates, Inc.; Google Earth Professional 2010

Y:\Projects\001034\010.014\Workplan\Figure_1_SedSam.mxd 12/7/2012 NAD 1983 StatePlane Washington North FIPS 4601 Feet

LANDAU ASSOCIATES

Blaine Marina Inc. Site
Blaine Harbor
Blaine, Washington

**Sediment Investigation Sampling Locations**

Figure 1

# TABLE 1
# SURFACE SEDIMENT ANALYTICAL RESULTS
# BLAINE MARINA INC.
# BLAINE, WASHINGTON

| | 6 | | | | | Dup of BMI-SS-3 |
|---|---|---|---|---|---|---|
| | Sediment Management Standards (SMS) | | BMI-SS-1 | BMI-SS-2 | BMI-SS-3 | Dup-1 |
| | SQS (a) | CSL (b) | VP65A 10/26/2012 | VK89A/VN78A 09/25/2012 | VP65B 10/26/2012 | VP65C 10/26/2012 |
| **TOTALS METALS (mg/kg)** | | | | | | |
| **Method SW6010C** | | | | | | |
| Lead | 450 | 530 | **8** | **6** | 8 U | 8 U |
| **TOTAL PETROLEUM HYDROCARBONS (mg/kg)** | | | | | | |
| **NWTPH-Dx** | | | | | | |
| Diesel Range Organics | -- | -- | **76** | **30** | **56** | **41** |
| Lube Oil | -- | -- | **77** | **74** | **63** | **42** |
| **NWTPH-Gx** | | | | | | |
| Gasoline Range Organics | | | 9.2 U | 6.7 U | 16 U | 14 U |
| **EXTRACTABLE PETROLEUM HYDROCARBONS (mg/kg)** | | | | | | |
| **Method NWEPH** | | | | | | |
| C8-C10 Aromatics | -- | -- | 3.3 U | 2.4 U | 3.1 U | 3.2 U |
| >C10-C12 Aromatics | -- | -- | 3.3 U | 2.4 U | 3.1 U | 3.2 U |
| >C12-C16 Aromatics | -- | -- | 3.3 U | 2.4 U | 3.1 U | 3.2 U |
| >C16-C21 Aromatics | -- | -- | **9.8** | **5** | **10** J | **31** J |
| >C21-C34 Aromatics | -- | -- | **35** | **27** | **22** J | **58** J |
| C8-C10 Aliphatics | -- | -- | 3.3 U | 6.8 U | 3.1 U | 3.2 U |
| >C10-C12 Aliphatics | -- | -- | 3.3 U | 2.4 U | 3.1 U | 3.2 U |
| >C12-C16 Aliphatics | -- | -- | 3.3 U | 2.4 U | **3.1** | **3.2** |
| >C16-C21 Aliphatics | -- | -- | **12** | **10** | **14** | **14** |
| >C21-C34 Aliphatics | -- | -- | **51** | **42** | **50** | **54** |
| Total EPH | | | **108** | **84** | **99** | **160** |
| **VOLATILE PETROLEUM HYDROCARBONS (mg/kg)** | | | | | | |
| **Method NWVPH** | | | | | | |
| Benzene | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| Toluene | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| Ethylbenzene | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| m, p-Xylene | -- | -- | 3.5 U | 2.8 U | 4.7 U | 4.7 U |
| o-Xylene | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| Methyl tert-Butyl Ether | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| n-Pentane | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| n-Hexane | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| n-Octane | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| n-Decane | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| n-Dodecane | -- | -- | 1.8 U | 1.4 U | 2.3 U | 2.3 U |
| C8-C10 Aromatics | -- | -- | 18 U | 14 U | 23 U | 23 U |
| >C10-C12 Aromatics | -- | -- | 18 U | 14 U | 23 U | 23 U |
| >C12-C13 Aromatics | -- | -- | 18 U | 14 U | 23 U | 23 U |
| C5-C6 Aliphatatics | -- | -- | 18 U | 14 U | 23 U | 23 U |
| >C6-C8 Aliphatatics | -- | -- | 18 U | 14 U | 23 U | 23 U |
| >C8-C10 Aliphaatics | -- | -- | 18 U | 14 U | 23 U | 23 U |
| >C10-C12 Aliphaatics | -- | -- | 18 U | 14 U | 23 U | 23 U |
| **SEMIVOLATILES (mg/kg)** | | | | | | |
| **Method SW8270D** | | | | | | |
| Naphthalene | 2100 | 2100 | 0.064 U | 0.061 U | **0.081** | **0.073** |
| 2-Methylnaphthalene | 670 | 670 | 0.064 U | 0.061 U | 0.062 U | 0.062 U |
| 1-Methylnaphthalene | -- | -- | 0.064 U | 0.061 U | 0.062 U | 0.062 U |
| **CONVENTIONALS (%)** | | | | | | |
| Total Solids (SM2540B) | -- | -- | 57.30 | 83.40 | 60.90 | 59.10 |
| Total Organic Carbon (SW9060M) | -- | -- | 2.99 | 2.49 | 3.39 | 3.24 |

# TABLE 1
# SURFACE SEDIMENT ANALYTICAL RESULTS
# BLAINE MARINA INC.
# BLAINE, WASHINGTON

| 6 | Sediment Management Standards (SMS) | | BMI-SS-1 VP65A | BMI-SS-2 VK89A/VN78A | BMI-SS-3 VP65B | Dup of BMI-SS-3 Dup-1 VP65C |
|---|---|---|---|---|---|---|
| | SQS (a) | CSL (b) | 10/26/2012 | 09/25/2012 | 10/26/2012 | 10/26/2012 |
| **GRAIN SIZE (%)** | | | | | | |
| **ASTM_D422** | | | | | | |
| Particle/Grain Size, Gravel | -- | -- | 21 | 56.3 | 10.3 | 11 |
| Particle/Grain Size, Sand | -- | -- | 62.3 | 40.8 | 72.9 | 72.8 |
| Particle/Grain Size, Silt | -- | -- | 10.8 | 1.2 | 10.4 | 9.7 |
| Particle/Grain Size, Clay | -- | -- | 5.7 | 1.7 | 6.5 | 6.4 |

(a) Sediment Quality Standards
(b) Cleanup screening level.
U = Indicates the compound was not detected at the reported concentration.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Bold = Detected compound.