APPENDIX A
EPA SAMPLING PROGRAM RATIONALE

Sampling Rationale
For
EPA's Round 2 Field Sampling Plan for Sediments in Portland Harbor

Introduction

The LWG submitted a Draft Portland Harbor RI/FS Work Plan, dated March 31, 2003 and a Round 2A Field Sampling Plan (FSP), dated April 17, 2003 to EPA and its partners. EPA provided extensive comments on the Work Plan, and a revised document is scheduled to be submitted by November 26, 2003.

The purpose of the RI/FS stated in the Scope of Work (SOW) is to:

- Investigate the nature and extent of hazardous substances in the in-water portion of the site;
- Assess the potential risk to human health and the environment;
- Develop and evaluate potential remedial alternatives; and
- Recommend a preferred alternative.

The draft Work Plan states that "A critical objective of the RI/FS is to characterize the site sufficiently to allow EPA to define site boundaries and select a remedy for the river that is protective of the survival, growth, and reproduction of ecological receptors ....and human receptors that may consume fish or come in contact with sediments, surface water, or ground water seeps from the site." EPA supports that objective statement.

Evaluation of the LWG's Round 2A Field Sampling Plan

EPA and its partners do not agree with the LWG that the purposes and objective stated above can be met in a reasonable time frame with the LWG's limited sampling proposed for Round 2A, and the undefined scope for future sampling.

The LWG's approach includes three rounds of sampling. Round 1 included the fish tissue (some sample results still pending), co-located sediment chemistry and beach sediment chemistry sampling conducted in 2002. Round 2 is proposed to gather the majority of remaining data for the RI and risk assessments. Round 3 is proposed to gather data for evaluation of FS alternatives and filling data gaps, if any, for the RI.

Using the process discussed in the Round 2A FSP, the LWG identified 95 stations for surface sediment sampling in Round 2A. Of these 95 stations, 68 stations would be analyzed for sediment chemistry and bioassays, and 27 would be analyzed for sediment chemistry only. A significant factor in designing the Round 2A sample plan was the LWG's use of most of the historical sediment data which were collected during multiple investigations over the past decade. The proposed sampling approach is described as a biased approach with new sampling stations located in areas where, based on historical or current upland land use, higher chemical concentrations would be expected in sediments if releases of hazardous substances had occurred. Additional surface sediment samples are anticipated for Round 2B and possibly Round 3. Subsurface sediment chemistry would be evaluated as a part of Round 2B at a limited number of stations that meet the criteria defined by the LWG.

The FSP states "One of the objectives of Round 2A is to sample what are considered the worst-case areas to establish if unacceptable risks exist". The FSP provides that once risk from these worst-case areas was determined, future sampling would be focused only on those COPCs presenting an unacceptable risk. The FSP also states "If considered individually, many of these locations along the ISA have been adequately characterized, or nearly so, for their respective sources and COPCs."

While many major source areas in the river are known, EPA does not consider that sufficient sampling has occurred throughout the Portland Harbor site to know that all significant areas of contamination have been identified. Also, because sampling would be limited to known or suspected "worst-case" areas, there would be insufficient information about areas not sampled in Round 2A to limit the analyte list for future sampling, and to assume any other areas in the river were not contaminated. Therefore, much more sampling would be required after Round 2.

EPA also does not agree that any particular known source area has been adequately characterized. One or a few samples adjacent to potential sources is unlikely to be "worst-case" or representative due to the complex, dynamic environment, and limited knowledge of potential source areas. A higher sampling density is needed adjacent to potential sources and in known in-water source/hotspot areas. The limited sampling near most sources/hotspots is not sufficient to understand how these sources/hotspots impact the river, to characterize ecological and human health risks, to define potential Sediment Management Areas (SMA's), or to provide data to identify early action candidates or remedial alternatives. Therefore, adequate sampling to define the nature and extent of hazardous substances associated with individual sites must be included in the field sampling program.

Under the LWG's FSP, large areas of contamination could be missed in portions of Portland Harbor that are currently not well-characterized. All of the category 1 historic surface sediment chemistry sample locations and the LWG's proposed Round 2A sample locations combined still leave significant areas of the river unsampled. In order to calculated exposure point concentrations for smaller home-ranged species, it is essential to have more coverage than the LWG's plan provides.

Finally, the LWG's Round 2A FSP does not address subsurface contamination. EPA believes that samples at depth are needed since historic contaminant sources may be buried under more recent, relatively clean sediments deposited by the river system.

EPA's Round 2 Field Sampling Plan

EPA's plan provides a sampling strategy which characterizes nature and extent of contamination in the river for a RI/FS and ROD that could lead to an expeditious cleanup. EPA's plan targets both known major source areas and areas river-wide not well characterized or not sampled at all. The sampling location logic differs for the river wide contamination nature and extent (a grid sampling logic), than for the individual major sources near facilities along the river (source area sampling logic). Combining source area sampling and river-wide contaminant distribution sampling is intended to provide adequate sediment chemistry data for nature and extent characterization, and sufficient data necessary to complete a baseline risk assessment and begin to develop the Feasibility Study.

The EPA sampling program is a coordinated effort to develop a comprehensive sediment chemistry sampling strategy for Portland Harbor. To meet the objectives of the RI/FS in a timely fashion, the EPA team has increased the sediment sample density from that proposed by the LWG. After thoroughly evaluating the historical data as set forth later in this rationale, approximately 535 sediment sampling locations were identified, broken down into the following groups:

- 217 locations for the grid sampling (186 near shore and 31 mid-channel);
- 318 sample locations related to specific sources/areas of contamination;
- Out of the 535 sampling locations, 276 include sampling at depth.

In addition to the locations shown above, some additional beach sampling locations were identified to provide information related to shorebird habitat. These locations could add an additional 20 to 25 samples.

The purpose of the grid samples is to evaluate overall river sediment quality; identify potential contaminant source to define the nature and extent of contaminants within Portland Harbor; to ensure sufficient density to assess ecological risks; and evaluate the upstream and downstream areas of contamination adjacent to the initial study area. Source/hotspot specific sample locations were selected to characterize the nature and extent of in-water contaminated hotspots associated with specific sources of sediment contamination; to provide sufficient data to evaluate potential early action alternatives; and to provide sufficient data to assess localized risks to human health and ecological receptors.

In addition to increased sample density, another major difference between EPA's alternative sampling program and the one proposed by the LWG is the addition of samples collected at depth. EPA does not concur with the LWG's conclusion that subsurface sediment chemistry is needed only where boat scour may occur, where substantial historic releases are documented or in areas of sediment scour, and where maintenance dredging or shoreline development are expected. Subsurface contamination may provide information on ongoing sources or potential threats of releases of contaminants to the river. Moreover, understanding subsurface contaminant levels is critical to understanding the nature and extent of contaminants in Portland Harbor and evaluating cleanup alternatives. Therefore, EPA's sampling program includes subsurface sampling to be conducted concurrent with surface sediment sampling.

And finally, as with any sampling effort, additional data gaps may be identified through evaluation of the sediment chemistry data proposed in this sampling program. These data gaps would need to be filled in subsequent sampling rounds.

(A) Sample Locations

The following paragraphs discuss how the grid and source/hotspot samples were selected by EPA and its partners. The enclosed figures show the selected sample locations. The enclosed tables list the samples selected for grid and sources/hotspots, including the chemicals that need to be analyzed in each sample.

<u>Sample Design</u>

EPA and its partners developed the field sampling (sediment chemistry and toxicity) plan using historical sediment chemistry and toxicity data from the LWG and GIS layers from many sources including the LWG, USEPA, City of Portland, Oregon DEQ and NOAA. NOAA's Query Manager (database query software) was used for query and analysis of historical chemical and biological data which was then brought into our GIS Project. ArcInfo 8.3 and ArcView 3.3 were used for spatial data analysis, sample plan generation and map production.

Sample Plan Creation

The first step in developing the sample plan was establishing a centerline of the Lower Willamette River extending from just upstream and just downstream of the ISA. Transects along the river were generated at 1/10th mile intervals generally perpendicular to the river centerline. These transects, which divide the river into approximately 528 foot segments, were used to segment the river. The nearshore zone, which extends from the –20 ft. depth contour to the riverbank on either side of the river, was used to create 2 nearshore zone cells (both banks) and a midchannel cell from each segment.

Nearshore Grid Samples

The first tier of nearshore samples was generated at the centroids of each nearshore zone cell. In general, within every river mile, 10 samples are located on each side of the river bank for a total of 20 nearshore samples within each river mile. Exceptions are nearshore areas where a bulkhead is present or odd-shaped areas (like slips). Sample locations were manually adjusted or removed in these cases.

A second tier of grid samples were placed farther out from shore on the 1/10th mile segments at the –30 ft. depth contour. These samples are staggered from the nearshore centroids by approximately 1/20th of a mile. The staggering allows for better spatial coverage both laterally and perpendicular to the shore. The intent of these deeper samples is to bound nearshore sample locations, characterize contaminants associated with upland or nearshore sources migration towards the main channel and capture contaminant concentration gradients.

Mid-Channel Grid Samples

A third tier of grid samples was generated at the centroid of the main channel cells. A sampling density of generally one sample every three tenths of a mile was used at either end of the investigation area. A higher density of mid channel samples (one every tenth of a mile) were placed in areas where historical data indicate elevated levels of contamination within the main channel.

Source Samples

In an effort to characterize the nature and extent of current and historical sources of sediment contamination, samples were placed adjacent to known sources of contaminants and/or hotspots of contamination. In most cases, historical chemical, physical and biological data was used to place these additional samples. In other cases, knowledge about upland activities or historical use of the site was considered in the placement of samples. Thematic GIS layers were used to consider physical factors such as sediment type, shore structures or bank conditions, sediment transport (morphology) and sediment elevation difference analysis, bathymetric contours, dredged areas and the USACOE navigation channel. Historical sediment chemistry data including contaminant concentrations, suites of analytes, detection limits and sample date were integrated in our GIS for decision making.

Within this GIS context, DEQ project managers provided input on appropriate sample locations associated with specific upland sites. Based upon their knowledge of the site, including contaminant and toxicity data, the DEQ project managers made recommendations on sample numbers, locations, depth and analyte suites. Source sample locations were reconciled with grid samples in the nearshore, -30 ft. contour and mid channel to eliminate duplicate sampling locations.

EPA is aware that the City of Portland collected surface (0 to 15 centimeters) sediment samples adjacent to selected city stormwater outfalls within the Portland Harbor ISA in the Fall of 2002. These samples were analyzed for metals, SVOCs, PCBs (Aroclors), and pesticides. EPA's plan includes a "depth only" sample at city outfalls. Subsurface samples are needed at the outfalls to: define the nature and extent of contamination; provide insight into historical releases from these outfalls; and provide information to assess whether these deeper sediments present an ongoing source to surface sediments. Specifically, sediment cores should be advanced and samples from selected sediment intervals collected and analyzed to characterize whether these areas pose unacceptable risk or are acting as an ongoing contamination source to Portland Harbor. We have not identified analytes for these samples. The sample scheme proposed by EPA and its partners for the outfalls will be finalized following our review of the surface chemistry data.

(B) Sample Depth

Subsurface contamination may provide an ongoing source of contaminants in some locations or may pose a potential threat of a release in the future. An understanding subsurface contaminant levels is also critical to understanding the nature and extent of contaminants in Portland Harbor. EPA's sampling program includes a substantial subsurface sampling effort. In addition to the criteria proposed by the LWG, EPA considered the following: 1) areas of known surface sediment contamination (where we know we need to define the vertical extent of contamination); 2) areas of known or suspected historical contamination (i.e., contamination potentially buried by clean surface sediment; and 3) areas of known or suspected historical sediment contamination that may have contaminants mobilized by ground water passing through it.

Based on the presentation of available data and the approach proposed by the LWG in the RI Work Plan, it does not appear that all sources of contaminants and/or contaminant migration in the river, nor nature and extent of contamination in the river would be defined nor contaminant fate and transport understood after Round 2B. The dynamics of the river, together with the historical releases and long-term ground water and product discharges (at and below the sediment surface) has likely resulted in highly contaminated surface sediments in some locations, and also subsurface contaminants which have been covered by clean surface sediments deposited after those deeper sediment sources were in place. In addition, there are the ground water and product discharges from many old sites which are continuing to discharge to the sediments at depth (Atofina, Gasco, and Wacker). Sufficient sediment samples must be collected at depth to define the vertical extent of contamination, specifically at individual sites. The RI must develop a comprehensive site conceptual model that incorporates the sources, nature, and extent of contamination and understanding of contaminant fate and transport in the system to feed into the risk assessment process.

Although the historical data set includes some samples collected at depth, this data is limited with respect to overall characterization and analytical suites. The attached tables indicate which source/hotspot samples should be analyzed at depth and to what depth samples should be collected. The location and the depth of these samples was made concurrently with the selection of surface sediment samples. As with the surface sediment samples, the decision on subsurface sediment samples was based upon historical data, knowledge about upland activities or historical use of the site, and interviews with DEQ project managers. The number of samples at depth may be reduced by the use of field screening techniques (see Field Screening/Field Laboratory Section below). Visual inspection of cores may also help in selecting samples at depth for analysis.

(C) Historical Data

EPA and its partners used the historic category 1 surface sediment chemistry data in developing our sampling plan. We first developed a sampling plan without using the historic data, placing grid samples and source-specific samples as described above. We then brought in the historic data, and eliminated samples from our sampling plan wherever there was historic data close to a proposed sampling point. Our proximity evaluation followed these rules:

- Mid-channel grid samples: if there was a historic data point within a 500 foot radius of a proposed sample, and the historic station was collected from a depth of >30 feet, then our sample was eliminated.

- 30-foot transect samples: if there was a historic data point within a 200 foot radius of a proposed sample, and the historic sample was collected from a depth of –15 to –25 feet, then our sample was eliminated.

- Near shore grid samples: if there was a historic data point within our nearshore grid cell, then our sample was eliminated.

- Source samples: if there was a historic data point within 100 feet of our proposed sample, then our sample was eliminated.

EPA and its partners value the historical data that the LWG has collected within Portland Harbor, and we used the data to the fullest extent possible. However, several factors were considered when deciding whether a historic data point could replace a proposed sampling location. These factors were considered on a sample-by-sample basis. In most cases, we eliminated samples from our proposed plan where nearby historic data met our proximity rules. However, in some cases, we decided that the historic data was not sufficient to replace a new sampling station. Factors that we used when making these decisions are listed below.

- Samples collected from areas that have since been dredged do not represent current conditions.

- Older samples and/or samples collected in areas of significant bathymetric change may not represent current conditions.

- Analytical suites for much of the historical data are limited. In addition, dioxin/furan congeners were analyzed in very few historic samples, despite the likelihood that these contaminants are associated with specific sources in Portland Harbor (e.g., wood treatment facilities, chemical manufacturers).

- Detection limits from the historical data are often very poor. The detection limits in the historical data do not allow for very much confidence that certain contaminants were not identified. For contaminants that were detected at relatively high frequencies in the historical data, this issue may not be as important as chemicals that were detected rarely, if at all.

- Historical data may not have adequate data validation for use in the RI and risk assessment.

The result of this historic data review is reflected in the sample locations selected in the attached tables and maps (i.e., the samples that we originally proposed but eliminated due to the presence of historic data nearby are not shown).

(D) Field Screening/Field Laboratory

The LWG Work Plan and FSP did not mention the use of field screening techniques or use of a field laboratory. The LWG should consider utilizing these options in the in-water sediment sampling effort where appropriate. Decision criteria for evaluating field screening or field laboratory results should be developed and approved prior to sampling.

Because of the relatively high cost associated with some analytical techniques, EPA and its partners are open to the use of field screening techniques to make decisions about which samples to send to a fixed laboratory for analysis. While field screening techniques generally do not yield data of sufficient quality for use in risk assessment, they can give “yes/no” type information about the presence of certain groups of contaminants. Field screening techniques could be useful in areas near sources where large numbers of samples are needed to characterize the depth and extent of in-water contamination. Field screening techniques should not be used for grid sample locations; the purpose of these samples is to characterize harbor-wide nature and extent of contaminants.

Access to a field laboratory for the field work would allow for quick turn around on sample analysis. This quick turn around would be extremely useful for site work so that decisions, including depth, lateral extent of sampling and modification of analytical suites, could be made while sampling personnel are in the field and equipment has been mobilized. In addition, it may be more cost-effective to have analyses conducted by a field laboratory rather than a standard laboratory. There can be considerable cost savings in the use of a field lab due to the decrease in time and labor necessary for processing samples.

EPA Team Benthic Approach Sampling Rationale

Introduction

As explained above, EPA and its partners feel that the sediment chemistry sampling proposed by the LWG for Round 2A is inadequate. Our concerns about sampling adequacy extend to the benthic toxicity sampling approach. The LWG developed an approach for benthic assessment that relies on finding a correlation between toxicity and chemistry. The LWG did a nice job of placing a limited number of samples, and the EPA team kept a large percentage of the LWG's proposed sediment chemistry and toxicity stations. However, EPA and its partners do not believe that the sampling proposed is sufficient to develop a predictive relationship. Moreover, the bioassay sampling proposed by the LWG would not provide sufficient data to meet other important objectives described below. We are therefore providing an alternate sampling plan that we believe will meet our shared objectives.

EPA's Alternate Approach

EPA's alternate sampling plan was developed specifically for the next round of sampling. Additional rounds of bioassay testing may be needed, especially if a predictive relationship between toxicity and sediment chemistry is not found after this round of sampling. The nature and extent data from this round would be used to guide future rounds of bioassay testing.

There are several advantages to placing bioassays this year including the cost savings in coordinating chemistry and bioassay sampling. Sediment chemistry samples will be taken in the next round to define nature and extent of contamination. Therefore, since bioassay testing requires a concurrent sediment chemistry sample, it is efficient to collect bioassay samples at the same time. We used the historic data to guide sample placement. However, the historic data is limited. Additional chemistry sampling may reveal hot spots or unusual chemicals that we were unaware of when this sampling plan was prepared. Additional bioassay testing may be required if this occurs.

EPA's bioassay sampling program is based on the following objectives:

1. **Confirm Toxicity**. We placed bioassays in high priority areas based on some indication that the sediment is toxic to the benthic community (PEC exceedances, information about chemistry and/or historic practices at upland sites, or

toxicity in previous bioassay tests). Confirming toxicity in high priority areas will allow EPA to identify Sediment Management Areas and good candidate sites for early actions. Confirming toxicity will also provide useful information for the LWG to work with other potentially responsible parties.

2. **Support the development of a predictive relationship**. EPA hopes that a predictive relationship can be developed that will allow us to use sediment chemistry information, including those samples with chemistry data but no toxicity data, in the benthic assessment. Due to the variety of chemical sources at Portland Harbor, the heterogeneity of the historical data, and the sheer size of the site, we believe that meeting this goal will require a substantial sampling effort.

3. **Determine toxicity where the physical environment or the form of the chemical may modify toxicity**. This would include special cases, or areas where the predictive relationship between chemistry and toxicity does not hold true (e.g. TBT bound in paint chips). A predictive approach may work over large areas of the site, but EPA recognizes that in some places, the physical form of the chemical may affect bioavailability. In such areas, EPA will use a more traditional approach, meaning the results of the bioassays will be used to determine directly whether or not an area is toxic to the benthic community, instead of relying on a relationship between chemistry and toxicity. It should be noted that bioassays results from these areas will not be used in the development of a predictive relationship.

4. **Determine the toxicity of chemicals for which no sediment quality values exist**. Any predictive approach will rely at least in part on national screening guidelines or other sediment quality values. There are some unusual chemical in Portland Harbor for which there are no screening guidelines (e.g., perchlorate, chlorinated herbicides). EPA's benthic approach will allow us to rely on a more traditional approach in areas where toxicity in the bioassays cannot be explained by chemicals in the national models.

5. **Provide at least moderate coverage across the entire site**. By sampling in areas where we don't have good chemistry information, we will increase our chances of developing a predictive model, get a good head start on a traditional approach in case the predictive approach fails, and provide sufficient data to confirm that sites where we don't expect toxicity are in fact clean.

Bioassay Station Selection

We placed bioassay stations after we determined the location of sediment chemistry stations. We then used the selected sediment chemistry stations as the basis for the selection of bioassay locations. This allowed us to minimize sampling costs and to build upon extensive work carried out to determine locations of sediment samples.

EPA's strategy for the next (first) round of bioassay sampling draws on two different “approaches,” including a predictive approach and a more traditional approach. A traditional approach is recommended for areas where there is no relationship between sediment chemistry and toxicity in bioassay tests. It should also be used where the SQVs are not reliable, which is usually in the moderate range. McCormick and Baxter used a traditional approach to determine the sediment cap footprint. The contaminated area was gridded with bioassays, and the hit/no hit criteria determined the area toxic to the benthic community. A predictive approach draws on known relationship between sediment chemistry and toxicity. Once this relationship is established, one can predict toxicity in areas where only sediment chemistry exists.

In order to develop a predictive relationship for Portland Harbor, we placed bioassays across a range of sediment chemistry conditions. We determined the maximum PEC quotient for all of the historic surface sediment chemistry. The objective of using national sediment quality guidelines is to draw off the large database of information relating toxicity to the benthic community to sediment chemistry in order to place bioassays in Portland Harbor. These SQVs will not be used as cleanup numbers, but were used to help us place bioassay samples. We selected bioassay stations across a range of PEC quotients, with an emphasis on areas with a maximum PEC quotient greater than three. We also placed samples across gradients of chemistry moving away form known significant sources. This will help us develop a predictive approach, and if a predictive approach fails, it will help us begin to draw sediment management unit boundaries based on toxicity.

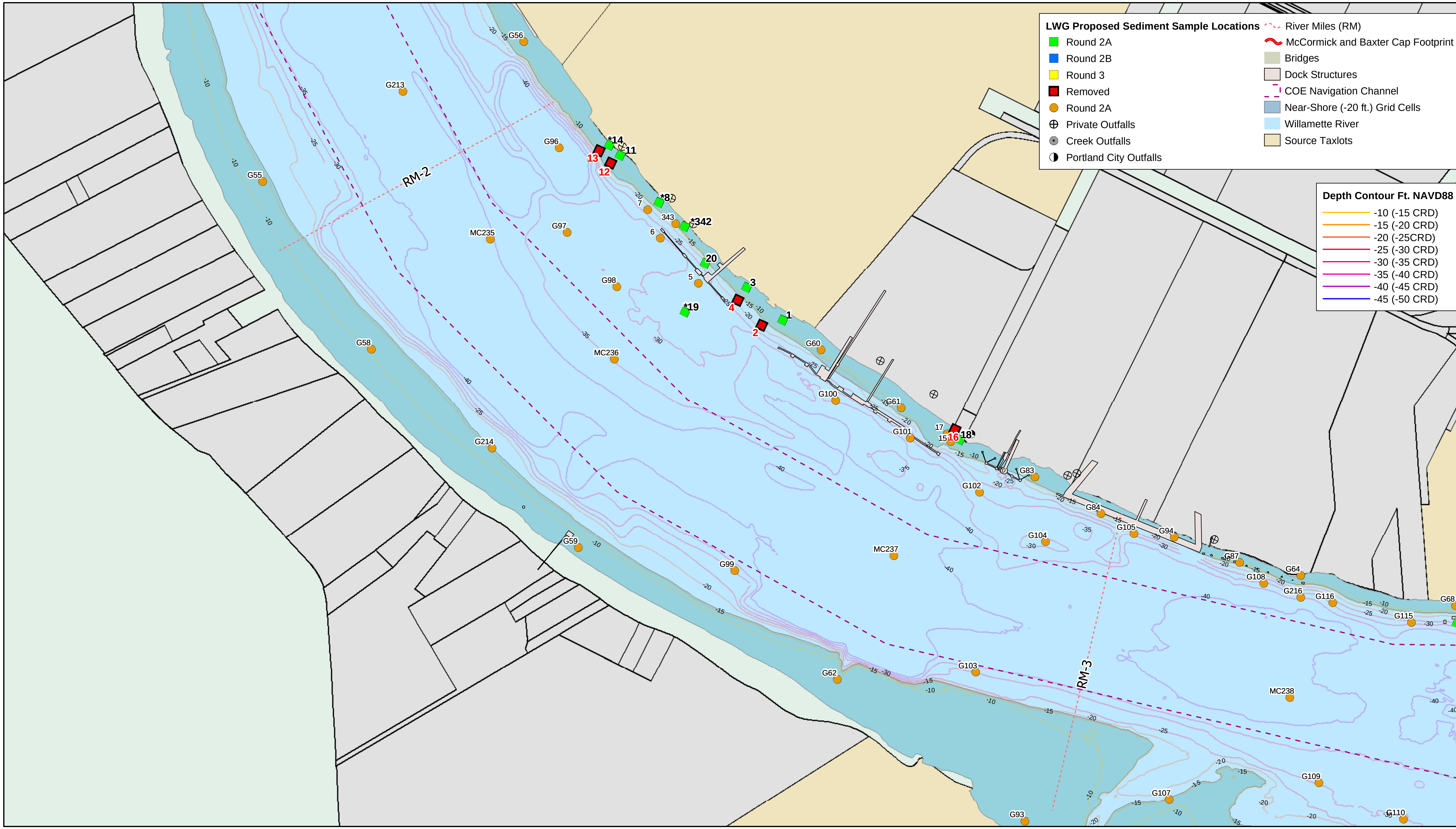
We also placed bioassays in areas where little is known about the sediment chemistry. These samples will help build the predictive model database and will meet our goal of having minimum coverage across the site.

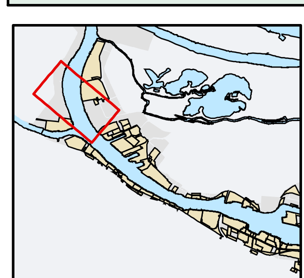
EPA and its partners selected a total of 223 bioassay sampling stations. The majority of these samples are placed within the nearshore zone, near contaminant sources, and in the river's most valuable habitat. We realize that collecting this many samples in one year will be a significant undertaking. However, we believe that at least 200 samples are required to develop a solid predictive approach. Gathering all of these samples in the next round of sampling provides the cost benefit of only having to gather sediment samples once and avoids any questions relating to varying conditions at different testing times.

Additional bioassays may be needed in the future depending on whether or not the predictive approach appears to work and if areas are determined to have conditions that are not appropriate for the application of such an approach.

This approach does not identify test interpretation rules, nor does it identify locations of reference and/or background samples. These issues will require further discussion with the LWG.

Finally, this approach does not cover all objectives related to a complete characterization of toxicity to the benthic community. For example, this approach does not address risk from bioaccumulative chemicals. Nor does it address risks posed by the discharge of contaminated groundwater into shallow porewater.





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Bathymetry: DEA 2003, from Striplin

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Plot Date: 02.15.2004 B. Shorr NOAA CPRD

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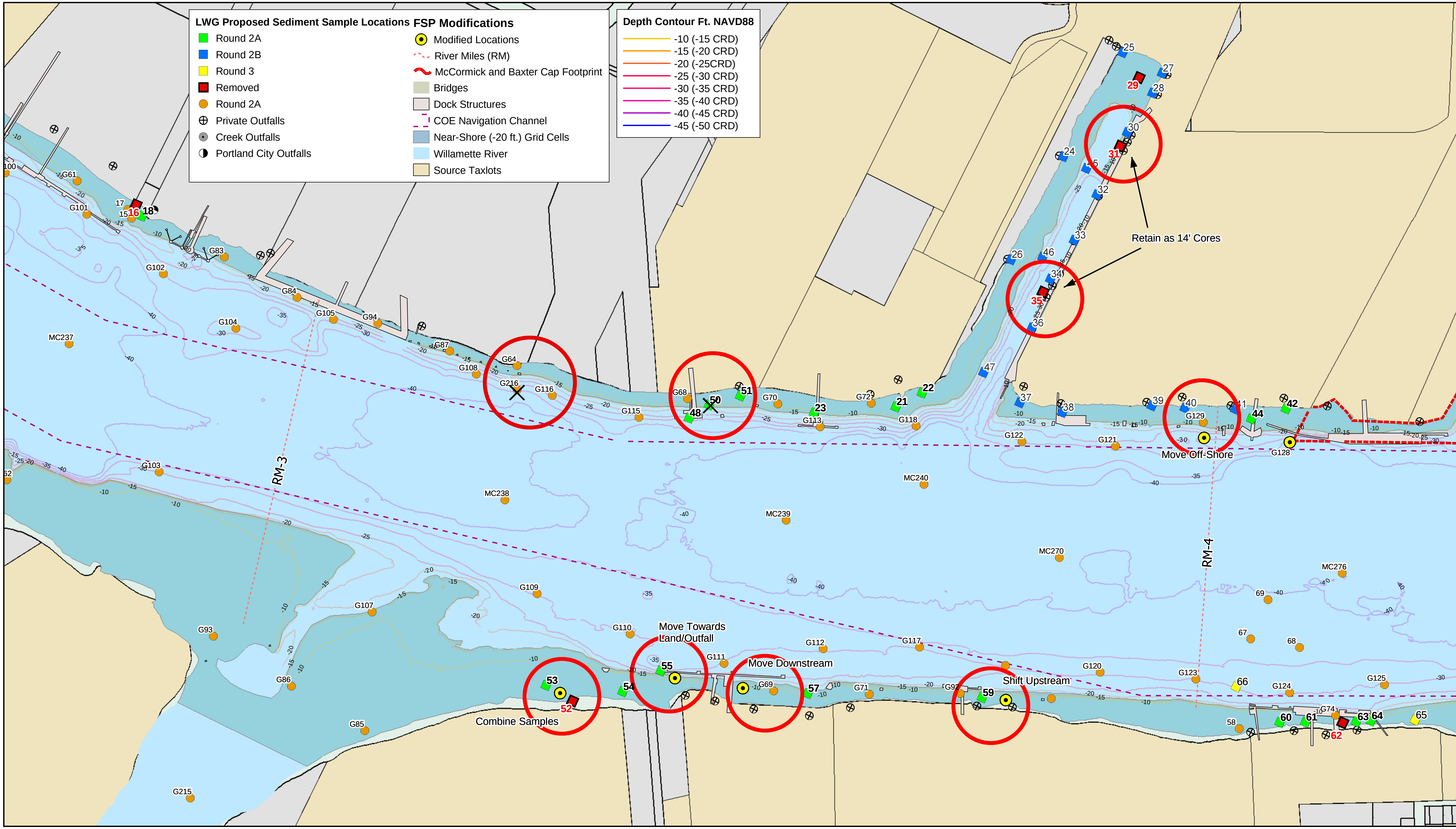
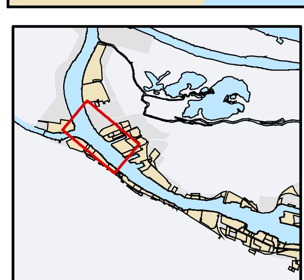
Figure 1. River Miles 2-3

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications





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Contaminant Data from NOAA Query Manager (09.24.03)
Source: Striplin E.A. (Integral)

*Sample = Shifted From EPA Proposed Location

Bathymetry: DEA 2003, from Striplin

Map: c:\gis\projects\portlandharbor\ph_master_021504.mxd
Plot Date: 02.15.2004 B. Shorr NOAA CPRD

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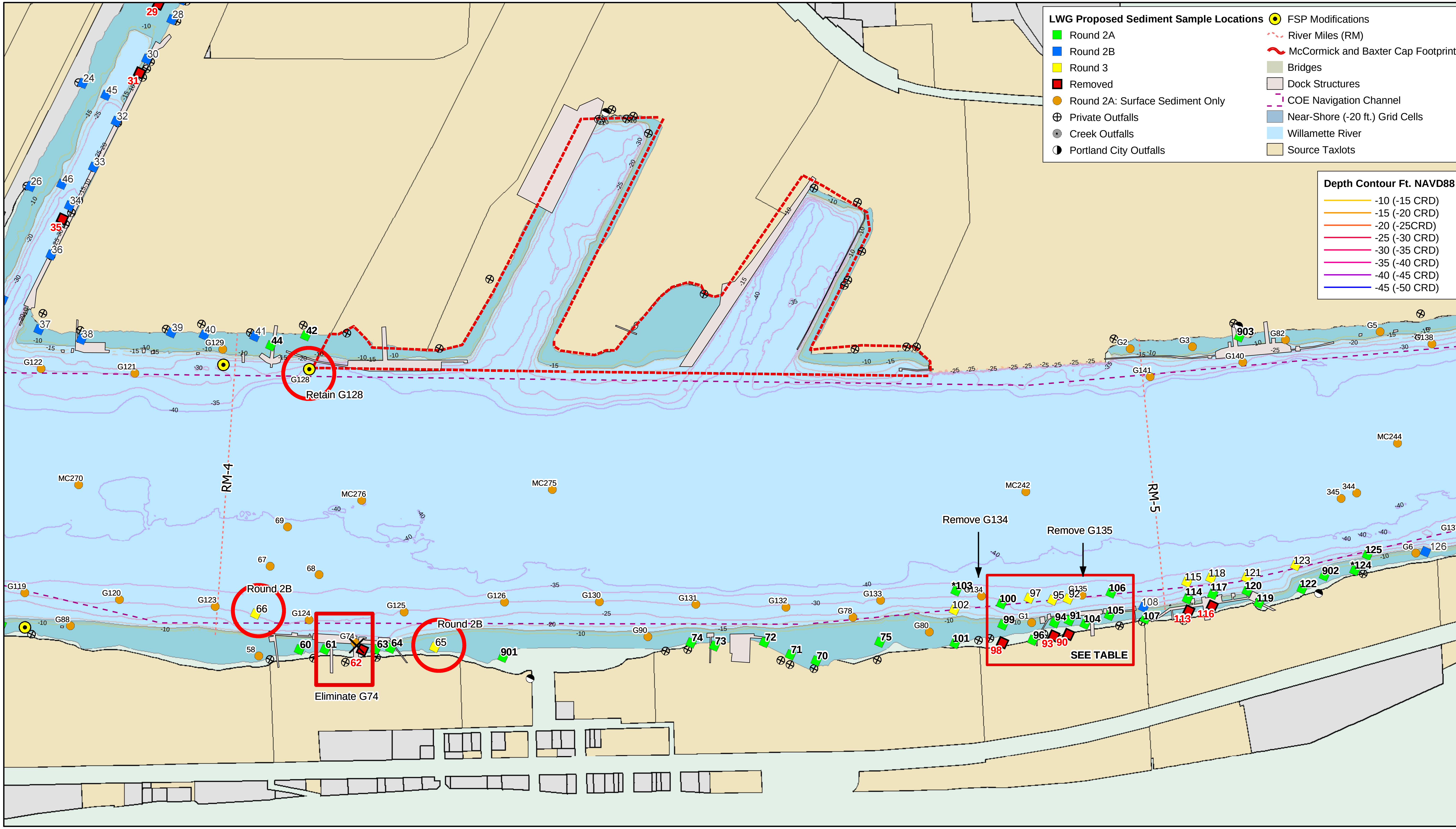
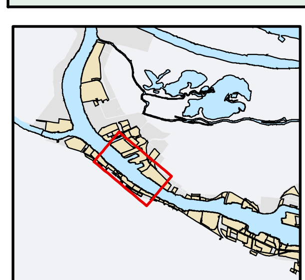
Figure 2. River Miles 3-4

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications





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Map: c:\gis\projects\portlandharbor\ph_master_021504.mxd
Plot Date: 02.17.2004 B. Shorr NOAA CPRD

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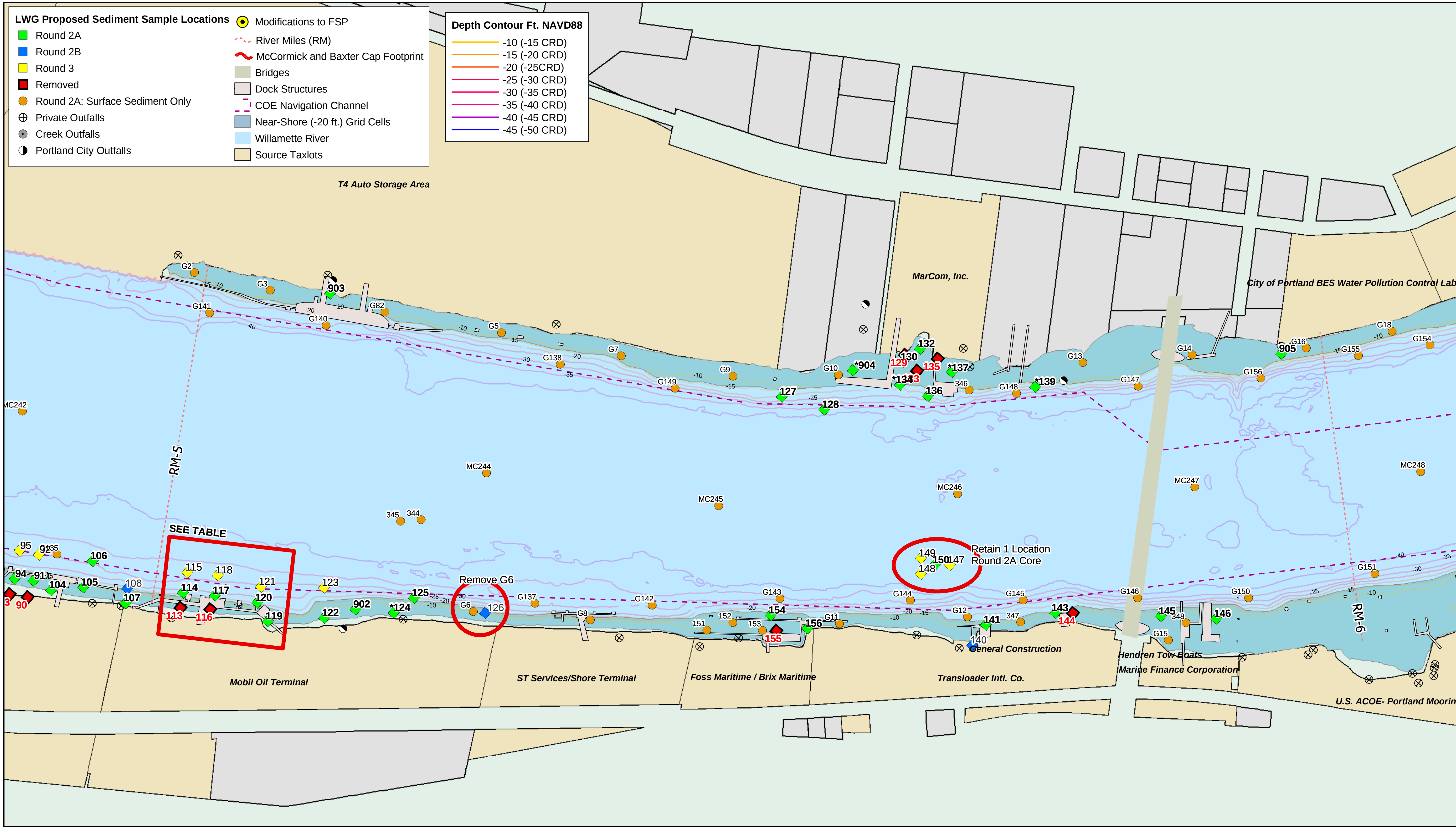
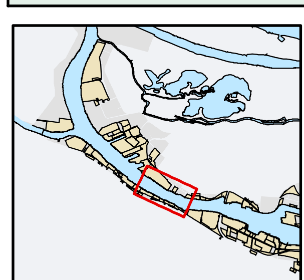
Figure 3. River Miles 4-5

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications





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Contaminant Data from NOAA Query Manager (09.24.03)
Source: Striplin E.A. (Integral)

Bathymetry: DEA 2003, from Striplin

* Sample Shifted From EPA Proposed Location

Map: c:\gis\projects\portlandharbor\ph_master_021504.mxd
Plot Date: 02.16.2004 B. Shorr NOAA CPRD

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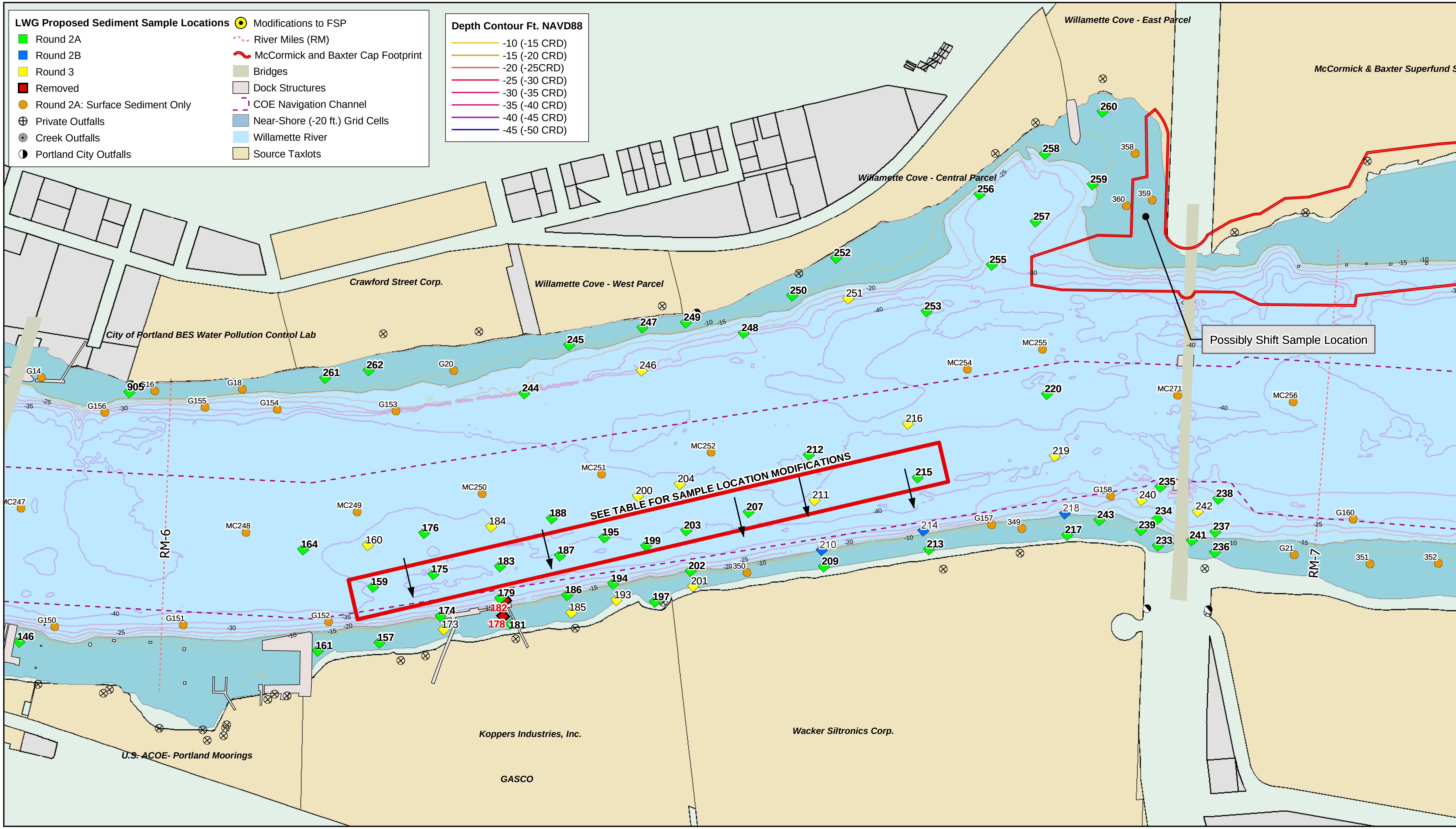
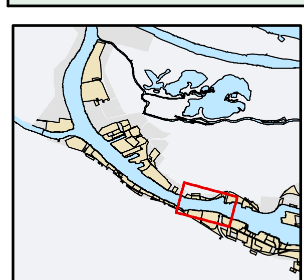
Figure 4. River Miles 5-6

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications





Coordinate System & Datum:
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Contaminant Data from NOAA Query Manager (09.24.03)
Source: Striplin E.A. (Integral)

Bathymetry: DEA 2003, from Striplin

* Sample Shifted

Map: c:\gis\projects\portlandharbor\ph_master_021504.mxd
Plot Date: 02.16.2004 B. Shorr NOAA CPRD

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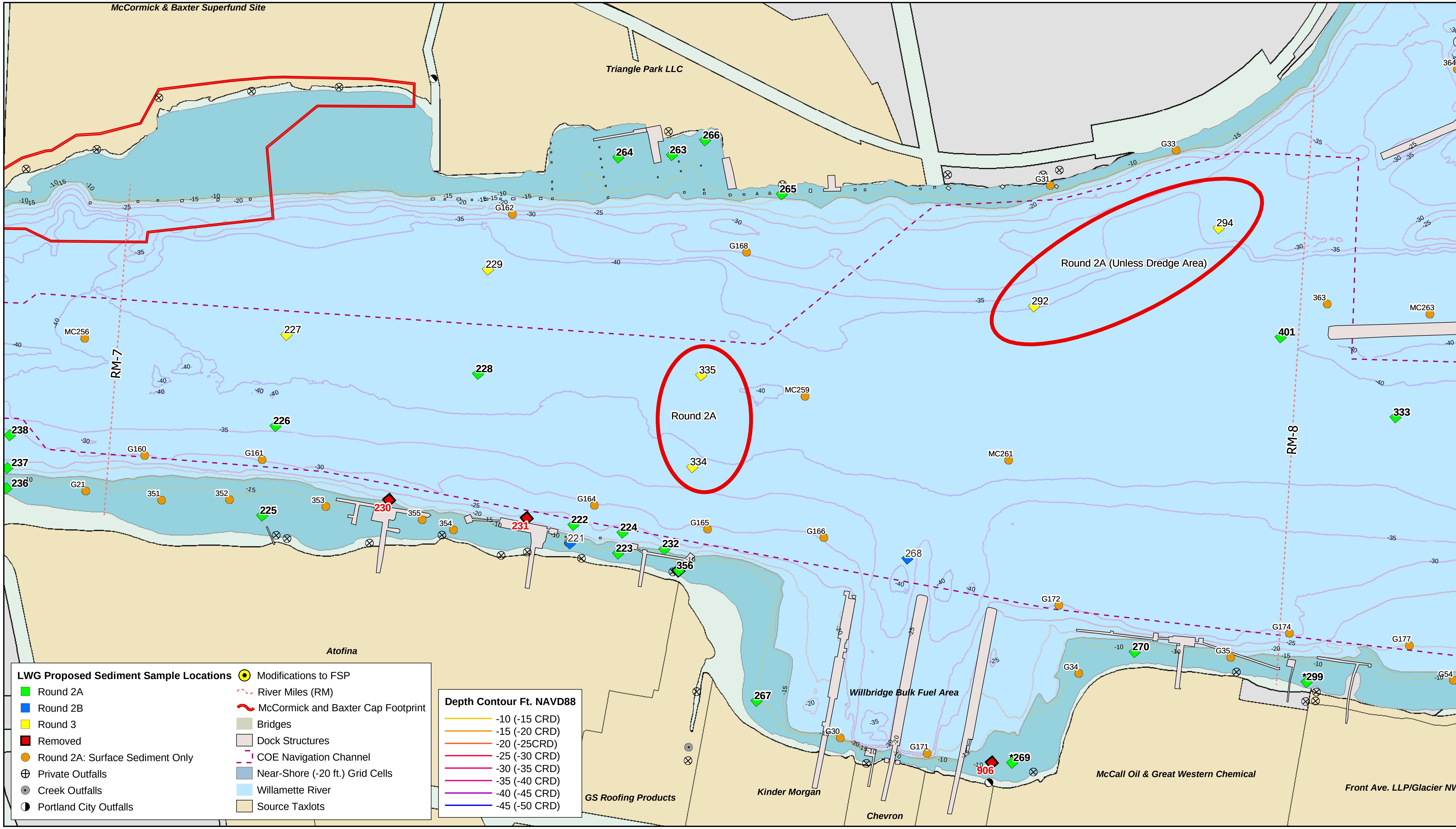
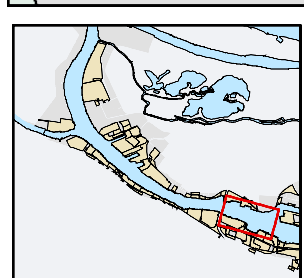
Figure 5. River Miles 6-7

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications





Coordinate System & Datum:
Oregon State Plane North, NAD83 Intl. Feet

Contaminant Data from NOAA Query Manager (09.24.03)
Source: Striplin E.A. (Integral)

Bathymetry: DEA 2003, from Striplin

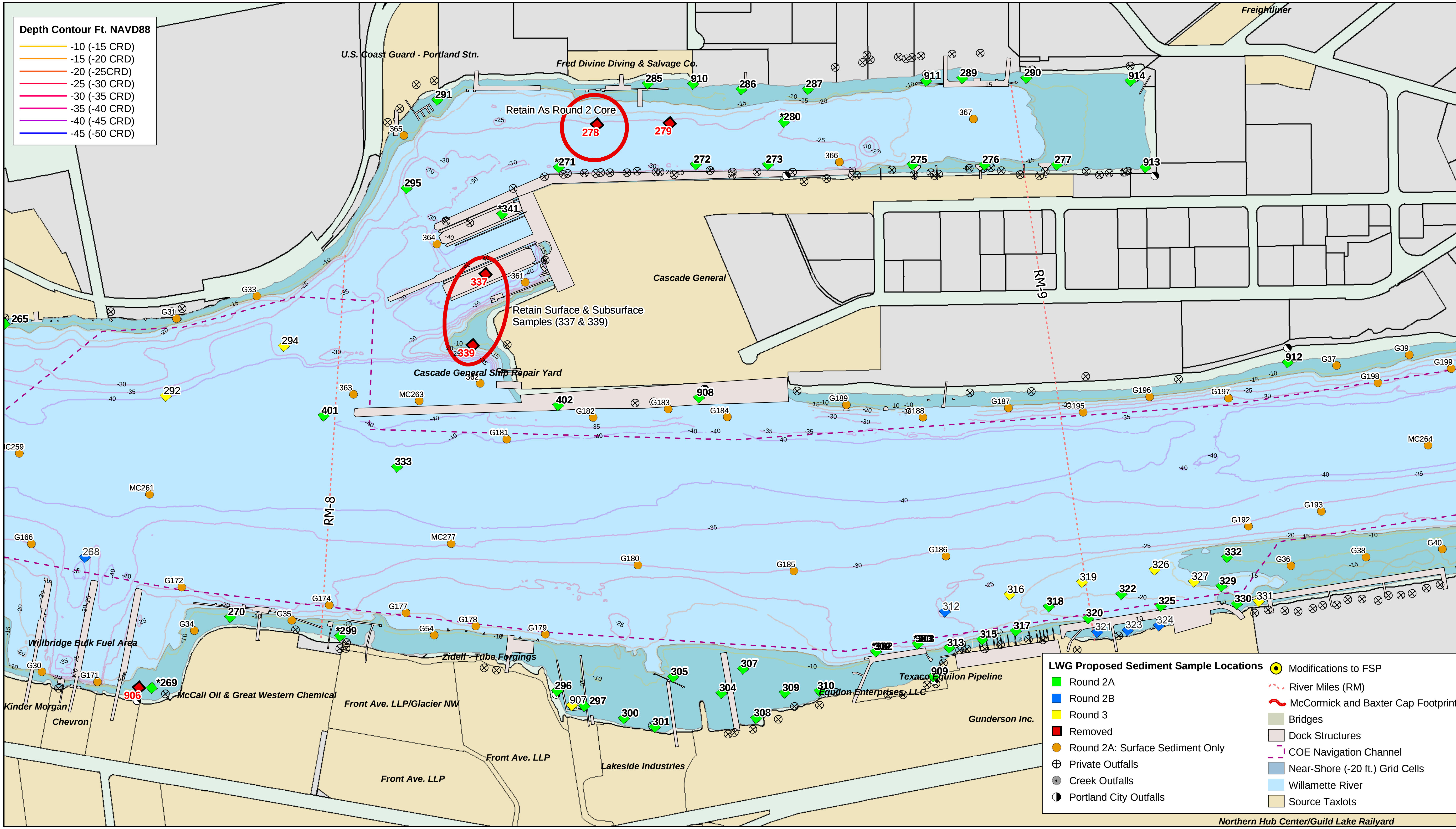
* Sample Shifted

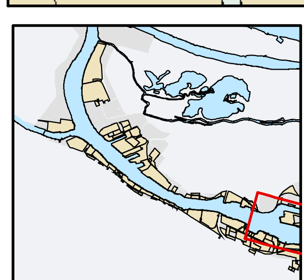
Map: c:\gis\projects\portlandharbor\ph_master_021504.mxd
Plot Date: 02.16.2004 B. Shorr NOAA CPRD

0 500 1,000 2,000 Feet

Figure 6. River Miles 7-8

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications





Coordinate System & Datum:
Oregon State Plane North, NAD83 Intl. Feet

Contaminant Data from NOAA Query Manager (09.24.03)
Source: Striplin E.A. (Integral)

Bathymetry: DEA 2003, from Striplin

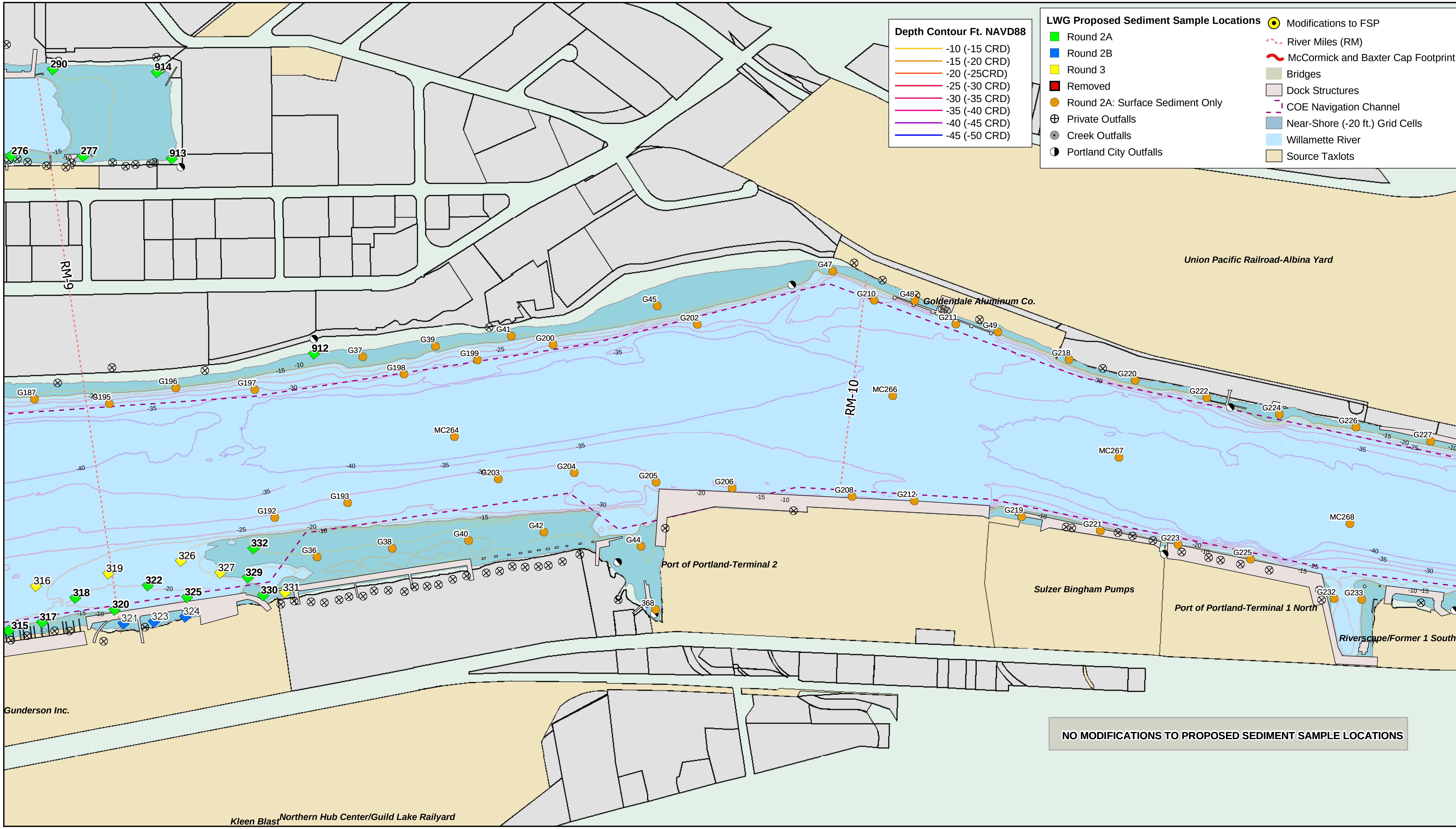
* Sample Shifted

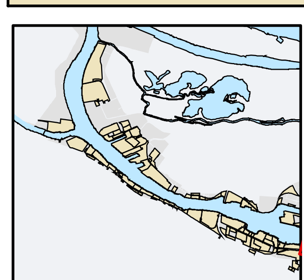
Map: c:\gis\projects\portlandharbor\ph_master_021504.mxd
Plot Date: 02.16.2004 B. Shorr NOAA CPRD

0 500 1,000 2,000 3,000 Feet

Figure 7. River Miles 8-9

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications





Coordinate System & Datum:
Oregon State Plane North, NAD83 Intl. Feet

Contaminant Data from NOAA Query Manager (09.24.03)
Source: Striplin E.A. (Integral)

Bathymetry: DEA 2003, from Striplin

* Sample Shifted

Map: c:\gis\projects\portlandharbor\ph_master_021504.mxd
Plot Date: 02.16.2004 B. Shorr NOAA CPRD

0 500 1,000 2,000 3,000 Feet

Figure 8. River Miles 9-11

Portland Harbor:
Field Sampling Plan
Sediment Sample
Location Modifications

ID	X	Y	SITE_NAME	LOCATION	DEPTH	SVOC	VOCS	TBT	METALS	PEST	PCB	DIOXFUR	CHLORHERB	HEXCHROM	ANALYTES	BENTHIC
-9	7617426.10721	713857.63999	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7619753.90804	709931.63883	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7620752.27491	710917.23631	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7622063.44306	708917.85456	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7623254.74963	707519.54217	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7629044.84962	700149.30684	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	N
-9	7631200.64610	698129.95167	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	N
-9	7633308.81421	699197.27189	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7633310.73339	696673.56407	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7634673.85553	700887.29259	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7635923.93297	699864.50197	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7636588.74130	696762.36467	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7636701.95319	698430.84672	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
-9	7637007.91620	698955.35474	City Outfalls	Near Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, pest,PCBs	Y
1	7617070.10508	723075.91981	Oregon Steel Mills	Abandoned outfall, south		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
2	7616987.69174	723178.93648	Oregon Steel Mills	Abandoned outfall, south	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
3	7617157.66925	723359.21566	Oregon Steel Mills	Abandoned outfall-hist dock loc		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
4	7617064.95424	723374.66817	Oregon Steel Mills	Abandoned outfall-hist dock loc	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
5	7617056.45808	723636.64727	Oregon Steel Mills	Dock - middle		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	N
6	7617206.69654	723963.51725	Oregon Steel Mills	Dock - north end, submerged out		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	N
7	7617332.79760	724106.08656	Oregon Steel Mills	Abandoned outfall, north		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	N
8	7617446.11594	724039.12572	Oregon Steel Mills	Abandoned outfall, north		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
11	7617561.39460	724397.59375	Oregon Steel Mills	North current outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
12	7617494.45377	724429.16886	Oregon Steel Mills	North current outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
13	7617533.70012	724526.04454	Oregon Steel Mills	North current outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
14	7617594.80001	724505.89128	Oregon Steel Mills	North current outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
15	7616831.74016	721836.52014	Consolidated Metco	Adjacent to city outfall-53A		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
16	7616909.39471	721842.79711	Consolidated Metco	Adjacent to city outfall-53A	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
17	7616865.64899	721874.76513	Consolidated Metco	Adjacent to city outfall-53A		1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
18	7616865.64899	721788.95622	Consolidated Metco	Adjacent to city outfall-53A	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
19	7616622.08366	723536.04900	Oregon Steel Mills	LWG-specified location	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	N
20	7617183.95032	723649.61779	Oregon Steel Mills	LWG-specified location, inside	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs	Y
21	7617673.06056	717559.80801	Premier Edible Oil	West of outfall	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pest, PCBs	Y
22	7617803.67315	717460.68711	Premier Edible Oil	South of outfalls	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pest, PCBs	Y
23	7617451.30525	717956.05465	Premier Edible Oil	Off dock	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pest, PCBs	Y
24	7619319.86749	717305.21168	International Slip	Off outfall	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
25	7619980.17189	717250.83367	International Slip	Two outfalls	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
26	7618680.92589	717326.57446	International Slip	Off outfall	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
27	7619969.24773	717003.94780	Northwest Pipe	Outfall 18	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
28	7619847.86825	717006.37539	International Slip	Outfall 17	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
29	7619893.99245	717108.33415	International Slip	Proposed by LWG	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
30	7619590.54374	717040.36164	International Slip	Outfalls 14, 15, 16	X	1	1	1	1	0	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT	N
31	7619505.57811	717042.78923	International Slip	Outfalls 14, 15, 16	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
32	7619206.98457	717047.64441	International Slip	Outfall 13	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
33	7618925.38417	717054.92718	International Slip	Outfall 12	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
34	7618675.34243	717084.05826	International Slip	Outfalls 11, 10	X	1	1	1	1	0	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT	N
35	7618592.80439	717088.91343	International Slip	Outfall 9	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
36	7618386.45926	717062.20995	International Slip	Outfall 8	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
37	7617983.47938	716948.11323	Schnitzer Steel	Outfall 7	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
38	7618034.45876	716712.63703	Schnitzer Steel	Outfall 6	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
39	7618277.21773	716278.09848	Schnitzer Steel	Outfall 5	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
40	7618342.76265	716108.16720	Schnitzer Steel	Outfall 4	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
41	7618454.43177	715850.84270	Schnitzer Steel	Outfall 3	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
42	7618575.81126	715598.37337	Schnitzer Steel	Outfall 2	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
44	7618444.72141	715748.88393	Schnitzer Steel	Dock with Conveyer	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
45	7619314.25317	717160.94313	International Slip	Channel Far inside Slip	X	1	1	1	1	0	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT	N
46	7618765.59218	717174.24400	International Slip	Mid Slip	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
47	7618050.67030	717200.84575	International Slip	Slip close to river	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, PCBs, TBT, Pest	Y
48	7617132.88942	718571.24414	Time Oil	North end of dock	X	1	1	0	1	0	0	1	0	0	TPH, SVOCs, metals, VOCs, dioxin/furan	N
50	7617244.54570	718501.43849	Time Oil	At outfall	X	1	1	0	1	1	1	1	0	0	TPH, SVOCs, metals, VOCs, dioxin/furan, Pest, PCBs	Y
51	7617364.20774	718365.28936	Time Oil	Another outfall	X	1	1	0	1	1	1	1	0	0	SVOCs, metals, VOCs, dioxin/furan, Pest, PCBs	Y
52	7615440.80098	718491.45863	Linnton Oil Fire Training Grounds	Adj to discharge disperse on be	X	1	1	0	1	1	1	1	0	0	SVOCs, metals, VOCs, PCBs, dioxin/furan, Pest	Y
53	7615457.24976	718663.72460	Linnton Oil Fire Training Grounds	Downstream of discharge point	X	1	1	0	0	0	1	1	0	0	SVOCs, metals, VOCs, PCBs, dioxin/furan	N
54	7615604.85313	718263.98388	Linnton Oil Fire Training Grounds	Adjacent to middle tower	X	1	1	0	1	1	1	1	0	0	SVOCs, metals, VOCs, PCBs, dioxin/furan, Pest	Y
55	7615798.16236	718121.56362	Georgia Pacific Linnton Site	North end of dock	X	1	0	0	1	1	1	1	0	0	SVOCs, metals, dioxin/furan, Pest, PCBs	Y
57	7616028.89149	717332.36612	Georgia Pacific Linnton Site	Outfall 4, LWG sample	X	1	0	0	1	1	1	1	0	0	SVOCs, metals, dioxin/furan, Pest, PCBs	Y
58	7616861.62231	715084.83523	Owens Corning - Linnton	Address PAHs at south end of si		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
59	7616415.22877	716446.86740	Owens Corning - Linnton	Outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
60	7616987.53126	714895.91177	Kinder-Morgan	Outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
61	7617048.97408	714767.68327	Kinder-Morgan	Seep-1, Sediment 1	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
62	7617134.45974	714578.01195	Kinder-Morgan	Seep 2, SS-24	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
63	7617169.18829	714513.89770	Kinder-Morgan	Seep 4, Outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
64	7617209.25970	714441.76917	Kinder-Morgan	Seep 3, Sediment 3	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
65	7617316.11678	714222.71215	Kinder-Morgan	South end of dock	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
66	7617065.25309	715198.36740	Kinder-Morgan	North end of dock, on -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
67	7617338.00649	715238.08923	Kinder-Morgan	East of 66		1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
68	7617409.74443	714972.59063	Kinder-Morgan	East of site on -36		1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
69	7617575.62319	715242.14362	Kinder-Morgan	East of 67 on -40		1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
70	7618139.74092	712279.95621	Linnton Plywood Association	Outfall 2	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, PCBs, Pest	Y
71	7618109.92930	712423.05198	Linnton Plywood Association	Outfalls 3 and 4	X	1	0	0	1	0	1	0	0	0	TPH, SVOCs, metals, PCBs	N

* Easting/Northing Coordinates
are in Oregon State Plane North NAD83, Feet

ID	X	Y	SITE_NAME	LOCATION	DEPTH	SVOC	VOCS	TBT	METALS	PEST	PCB	DIOXFUR	CHLORHERB	HEXCHROM	ANALYTES	BENTHIC
72	7618111.91674	712582.04728	Linnton Plywood Association	Green Wood	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, PCBs, Pest	Y
73	7617976.77073	712824.51512	Linnton Plywood Association	Outfall 5, steam cleaning, shop	X	1	0	0	1	0	1	0	0	0	TPH, SVOCs, metals, PCBs	N
74	7617937.27034	712948.97863	Linnton Plywood Association	Outfall 6	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, PCBs, Pest	Y
75	7618382.50632	712004.67546	Linnton Plywood Association	Columbia Sand and Gravel outfal	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, PCBs, Pest	Y
90	7618862.57679	711075.81375	Arco/BP	SD039C southern, Transect 1	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
91	7618933.62647	711105.30960	Arco/BP	Middle transect 1	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
92	7619038.49073	711161.36281	Arco/BP	Transect 1, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
93	7618820.40220	711145.59737	Arco/BP	Transect 2, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
94	7618887.24589	711174.79375	Arco/BP	Middle transect 2	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
95	7618996.44957	711237.56241	Arco/BP	Transect 2, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
96	7618749.45774	711242.81756	Arco/BP	Transect 3, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
97	7618951.78083	711358.43075	Arco/BP	Transect 3, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
98	7618667.23306	711386.49566	Arco/BP	Transect 4, nearshore and outfa	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
99	7618756.57053	711428.53683	Arco/BP	Transect 4, middle	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
100	7618859.04586	711483.71585	Arco/BP	Transect 4, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
101	7618550.97530	711624.99176	Arco/BP	Transect 5, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
102	7618717.88723	711706.59315	Arco/BP	Transect 5, middle	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
103	7618884.79916	711769.64877	Arco/BP	Transect 5, -40	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
104	7618952.95144	711018.53942	Arco/BP	north of dock	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
105	7619053.26894	710917.30000	Arco/BP	south of dock	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
106	7619169.11324	710960.97900	Arco/BP	south of dock, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
107	7619119.73698	710729.29039	Arco/BP	south end property, outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
108	7619174.00638	710764.58849	Mobil Oil Terminal	outfall transect -20/nearshore/	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
113	7619260.99163	710527.35599	Mobil Oil Terminal	Transect 2, nearshore/beach	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
114	7619318.98179	710564.25882	Mobil Oil Terminal	middle transect 2	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
115	7619400.69521	710606.43349	Mobil Oil Terminal	Transect 2, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
116	7619340.06913	710421.91933	Mobil Oil Terminal	Transect 3, nearshore/beach	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
117	7619400.69521	710448.27849	Mobil Oil Terminal	Middle transect 3	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
118	7619477.13679	710495.72499	Mobil Oil Terminal	Transect 3, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
119	7619463.95721	710195.23049	Mobil Oil Terminal	Transect 4, nearshore/beach	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
120	7619497.14479	710283.79712	Mobil Oil Terminal	Middle transect 4	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
121	7619561.68712	710317.13522	Mobil Oil Terminal	Transect 4, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
122	7619635.29179	710013.35225	Mobil Oil Terminal	Transect 5, nearshore/beach	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
123	7619738.09254	710100.33749	Mobil Oil Terminal	Transect 5, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
124	7619875.22797	709721.37535	Mobil Oil Terminal	Transect 6, nearshore outfall	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
125	7619959.50954	709765.57608	Mobil Oil Terminal	Transect 6, -20	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
126	7620110.22434	709481.77120	Mobil Oil Terminal	south end of property	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
127	7621687.96495	709091.43642	MarCom Shipyard	Downstream end of dry dock	X	1	1	1	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs, TBT	N
128	7621764.92270	708910.53309	MarCom Shipyard	Adjacent to drydock	X	1	1	1	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs, TBT	N
129	7622180.20460	708790.53413	MarCom Shipyard	transect 1, nearshore	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
130	7622112.88454	708748.01620	MarCom Shipyard	middle Transect 1	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
132	7622243.98150	708758.64568	MarCom Shipyard	Transect 2, nearshore	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
133	7622160.71722	708703.72669	MarCom Shipyard	middle transect 2	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
134	7622088.08242	708654.12243	MarCom Shipyard	Transect 2, -20	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
135	7622259.92573	708668.29508	MarCom Shipyard	Barge wreck nearshore	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
136	7622105.79822	708597.43185	MarCom Shipyard	Barge wreck -20	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
137	7622340.62781	708567.79814	MarCom Shipyard	outfall at south property line	X	1	1	1	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
139	7622170.38038	708446.83287	MarCom Shipyard	outfall -30	X	1	1	1	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs, TBT	N
140	7621385.88956	707737.79752	Marine Finance	Seeps north end of property	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, TBT, Pest, PCBs	Y
141	7621494.72722	707751.03454	Marine Finance	Houseboat construction	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, TBT, Pest, PCBs	Y
143	7621732.67553	707548.54871	Marine Finance	north of dock	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, TBT, Pest, PCBs	Y
144	7621782.41227	707486.37778	Marine Finance	south of dock	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, TBT, Pest, PCBs	Y
145	7622021.77034	707181.74024	Marine Finance	south of St. Johns bridge	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, TBT, Pest, PCBs	Y
146	7622170.98056	706985.90182	Marine Finance	south of tow boat dock	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, TBT, Pest, PCBs	Y
147	7621595.62472	708042.23258	rm5-6 oily extents	upstream of oily extent	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
148	7621482.42057	708116.35050	rm5-6 oily extents	downstream west of oily extent	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
149	7621535.88378	708159.30519	rm5-6 oily extents	downstream east of oily extent	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
150	7621551.93603	708094.14294	rm5-6 oily extents	on oily extent	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
151	7620682.27697	708681.68503	Brix Maritime	North outfall		1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
152	7620782.04391	708614.94335	Brix Maritime	end of dock		1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
153	7620840.09033	708492.10805	Brix Maritime	In slip middle		1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
154	7620915.41586	708506.83087	Brix Maritime	outside slip middle	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
155	7620878.11363	708441.55198	Brix Maritime	in slip south	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
156	7620974.86627	708344.79934	Brix Maritime	South outfall	X	1	1	1	1	1	1	0	0	0	SVOCs, metals, VOCs, TBT, Pest, PCBs	Y
157	7623389.70556	705958.37399	Gasco	transect 1, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
159	7623527.25274	706165.67657	Gasco	Transect 1, -30	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
160	7623627.85541	706322.63228	Gasco	Transect 1, -40	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
161	7623157.57081	706106.51798	Gasco	Transect 2, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
164	7623395.72065	706491.49893	Gasco	Transect 2, -40	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, pest, PCBs	N
173	7623645.20921	705819.64930	Gasco	Transect 5, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
174	7623672.83944	705874.45567	Gasco	Transect 5, -5	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
175	7623767.21439	706037.31322	Gasco	Transect 5, -30	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
176	7623854.00195	706202.90337	Gasco	Transect 5, -40	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	N
178	7623884.27564	705694.55755	Gasco	Transect 6, -5	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
179	7623925.72098	705765.35999	Gasco	Transect 6, -30	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
181	7623888.98284	705646.25020	Gasco	Transect 7, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
182	7623937.27611	705743.68528	Gasco	Transect 7, -5	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	N
183	7624016.16868	705874.27545	Gasco	Transect 7, -30	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
184	7624099.50246	706034.68493	Gasco	Transect 7, -40	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
185	7624126.10082	705514.51799	Gasco	Transect 8, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y

* Easting/Northing Coordinates
are in Oregon State Plane North NAD83, Feet

ID	X	Y	SITE_NAME	LOCATION	DEPTH	SVOC	VOCS	TBT	METALS	PEST	PCB	DIOXFUR	CHLORHERB	HEXCHROM	ANALYTES	BENTHIC
186	7624161.91141	705585.71489	Gasco	Transect 8, -5	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
187	7624249.83289	705740.81635	Gasco	Transect 8, -30	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
188	7624327.98600	705889.13761	Gasco	Transect 8, -40	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	N
193	7624314.27099	705428.61665	Gasco	Transect 10, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
194	7624350.53565	705494.23843	Gasco	Transect 10, -5	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
195	7624451.81817	705675.63768	Gasco	Transect 10, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
197	7624440.33388	705312.91509	Wacker	Transect 11, nearshore	X	1	0	0	1	1	1	0	0	0	TPH, SVOCs, metals, Pest, PCBs	Y
199	7624569.70163	705528.19258	Wacker	Transect 11, -30	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
200	7624683.63607	705721.23786	Wacker	Transect 11, -40	X	1	0	0	1	0	0	0	0	0	TPH, SVOCs, metals	N
201	7624614.74966	705257.65465	Wacker	Transect 12, nearshore	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pest, PCBs	Y
202	7624649.28744	705316.36887	Wacker	Transect 12, -5	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pest, PCBs	Y
203	7624749.29808	705466.02457	Wacker	Transect 12, -30	X	1	1	0	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs	N
204	7624859.77875	705641.80097	Wacker	Transect 12, -40	X	1	1	0	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs	N
207	7625013.51209	705350.32301	Wacker	Transect 13, -30	X	1	1	0	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs	N
209	7625113.82057	704951.99530	Wacker	Transect 14, nearshore	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pest, PCBs	Y
210	7625153.53901	705014.16331	Wacker	Transect 14, -5	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pest, PCBs	Y
211	7625270.81854	705203.53745	Wacker	Transect 14, -30	X	1	1	0	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs	N
212	7625379.57232	705374.13319	Wacker	Transect 14, -40	X	1	1	0	1	0	0	0	0	0	TPH, SVOCs, metals, VOCs	N
213	7625518.75092	704711.00537	Wacker	Transect 15, nearshore	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	Y
214	7625552.76941	704790.38184	Wacker	Transect 15, -5	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	Y
215	7625685.20447	704987.15863	Wacker	Transect 15, -30	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	N
216	7625805.33394	705197.12253	Wacker	Transect 15, -40	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	N
217	7626029.02826	704367.04064	Wacker	Transect 16, nearshore	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	Y
218	7626081.94591	704446.41712	Wacker	Transect 16, -5	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	Y
219	7626210.60114	704669.65272	Wacker	Transect 16, -35	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	N
220	7626360.96927	704902.29562	Wacker	Transect 16, -40	X	1	1	0	1	1	1	1	1	0	TPH, SVOCs, metals, VOCs, Pest,PCBs, chlorinated herbicides, dioxin/furan	N
221	7628237.07545	702096.11694	Atofina	North metal transect, nearshore	X	1	0	0	1	1	1	0	0	1	SVOCs, metals, pesticides, hexavalent chromium, PCBs	Y
222	7628301.11400	702149.48239	Atofina	North metal transect -20	X	1	0	0	1	1	1	0	0	1	SVOCs, metals, pesticides, hexavalent chromium, PCBs	Y
223	7628371.36750	701925.34747	Atofina	South metal transect, nearshore	X	1	0	0	1	1	1	0	0	1	SVOCs, metals, pesticides, hexavalent chromium, PCBs	Y
224	7628446.07914	701983.17107	Atofina	South metal transect, -20	X	1	0	0	1	1	1	0	0	1	SVOCs, metals, pesticides, hexavalent chromium, PCBs	Y
225	7627271.16068	703067.36826	Atofina	transect 1, nearshore	X	1	0	0	1	1	1	0	0	1	SVOCs, metals, pesticides, hexavalent chromium, PCBs	Y
226	7627571.60820	703333.66189	Atofina	Middle transect 1	X	1	0	0	1	1	0	0	0	1	SVOCs, metals, pesticides, hexavalent chromium	N
227	7627868.85380	703611.69592	Atofina	Transect 1, channel	X	1	0	0	1	1	0	0	0	1	SVOCs, metals, pesticides, hexavalent chromium	N
228	7628407.84491	702933.95461	Atofina	Transect 2, channel	X	1	0	0	1	1	0	0	0	1	SVOCs, metals, pesticides, hexavalent chromium	N
229	7628738.71075	703259.48390	Atofina	Transect 2, across river from s	X	1	0	0	1	1	0	0	0	1	SVOCs, metals, pesticides, hexavalent chromium	N
230	7627746.11324	702757.84860	Atofina	Northern dock	X	1	0	0	1	1	1	0	0	1	SVOCs, metals, pesticides, hexavalent chromium, PCBs	Y
231	7628162.36381	702304.24222	Atofina	Middle dock	X	1	0	0	1	1	0	0	0	1	SVOCs, metals, pesticides, hexavalent chromium	N
232	7628541.25856	701807.94347	Atofina	Southern dock	X	1	0	0	1	1	1	0	0	1	SVOCs, metals, pesticides, hexavalent chromium, PCBs	Y
233	7626305.92477	704072.39212	Rhone Poulenc	transect 1, nearshore	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	Y
234	7626379.14592	704163.96060	Rhone Poulenc	Transect 1, -20	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	Y
235	7626482.47687	704265.11871	Rhone Poulenc	Transect 1, -30	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	N
236	7626480.23766	703888.93212	Rhone Poulenc	Transect 2, nearshore	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	Y
237	7626540.69622	703956.10830	Rhone Poulenc	Transect 2, -20	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	Y
238	7626643.69969	704059.11177	Rhone Poulenc	Transect 2, -30	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	N
239	7626292.14437	704173.31127	Rhone Poulenc	Southeast boundary of Wacker	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	Y
240	7626379.47340	704274.07554	Rhone Poulenc	Farther in river from 239	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	N
241	7626435.45354	703994.17480	Rhone Poulenc	South of bridge, nearshore	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	Y
242	7626538.45702	704074.78621	Rhone Poulenc	Farther in river from 241	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	N
243	7626180.46397	704325.29737	Rhone Poulenc	Farthest north	X	1	1	0	1	1	1	1	1	0	SVOCs, metals, VOCs, pest,PCBs, chlorinated herbicides, dioxin/furan	Y
244	7624590.52811	706391.47744	Willamette Cove	Most northwest	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	N
245	7624880.25393	706427.88092	Willamette Cove	Nearshore of 244	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
246	7625053.88154	706135.27025	Willamette Cove	outfall -30	X	1	0	0	1	0	0	0	0	0	SVOCs, metals	N
247	7625178.42075	706278.38361	Willamette Cove	north of outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	N
248	7625506.33255	705971.73374	Willamette Cove	south of outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	N
249	7625339.71305	706172.62229	Willamette Cove	west of outfall -30	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
250	7625777.45737	705961.31809	Willamette Cove	Another outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
251	7625958.78355	705791.84358	Willamette Cove	south of outfall, -30	X	1	0	1	1	0	0	0	0	0	SVOCs, metals, TBT	N
252	7626033.29944	705963.14709	Willamette Cove	east of outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
253	7626188.24621	705525.02176	Willamette Cove	mouth of WC -40	X	1	0	1	1	0	0	0	0	0	SVOCs, metals, TBT	N
255	7626542.06377	705497.47787	Willamette Cove	mouth of WC -30	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, TBT, Pest, PCBs	N
256	7626700.51837	705771.50178	Willamette Cove	north side of WC, -20	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, TBT, Pest, PCBs	Y
257	7626813.37625	705519.67877	Willamette Cove	center of WC	X	1	0	1	1	0	0	0	0	0	SVOCs, metals, TBT	N
258	7627037.78191	705722.71246	Willamette Cove	next to outfall -20	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, TBT, Pest, PCBs	Y
259	7627112.16424	705483.74690	Willamette Cove	center of WC, -20	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
260	7627353.01843	705701.34049	Willamette Cove	nearshore, next to outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
261	7623959.11483	707010.83396	Crawford Street	Nearshore, downstream end of be	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, TBT, Pest, PCBs	Y
262	7624128.68423	706913.00546	Crawford Street	Nearshore downstream of outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, TBT, Pest, PCBs	Y
263	7629689.14576	703123.72663	Triangle Park	outfall in cove	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs, TBT	Y
264	7629500.21682	703269.05658	Triangle Park	downstream edge of cove	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs, TBT	Y
265	7629950.73968	702678.04809	Triangle Park	upstream outfall	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs, TBT	Y
266	7629844.16438	703080.12764	Triangle Park	high concs in cove	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, pest,PCBs, TBT	Y
267	7628421.60767	701030.65394	Willbridge	NW corner Willbridge cove	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pesticides, PCBs	Y
268	7629339.25128	701083.35645	Willbridge	Off Chevron Pier	X	1	1	0	1	1	0	0	0	0	TPH, SVOCs, metals, VOCs, Pesticides	N
269	7629240.04657	700023.10606	Willbridge	SW corner Willbridge cove	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pesticides, PCBs	Y
270	7629844.57530	700119.21063	Willbridge	McCall Pier	X	1	1	0	1	1	1	0	0	0	TPH, SVOCs, metals, VOCs, Pesticides, PCBs	Y
271	7633947.10232	700769.31239	Portland Shipyard	Swan Island Lagoon PSY shorelin	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
272	7634329.77027	700447.49684	Portland Shipyard	Swan Island Lagoon PSY shorelin	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
273	7634712.43821	700125.68129	Portland Shipyard	Swan Island Lagoon PSY shorelin	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
275	7635477.77409	699482.05020	Portland Shipyard	Swan Island Lagoon PSY shorelin	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
276	7635860.44203	699160.23465	Portland Shipyard	Swan Island Lagoon PSY shorelin	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N

* Easting/Northing Coordinates
are in Oregon State Plane North NAD83, Feet

ID	X	Y	SITE_NAME	LOCATION	DEPTH	SVOC	VOCS	TBT	METALS	PEST	PCB	DIOXFUR	CHLORHERB	HEXCHROM	ANALYTES	BENTHIC
277	7636243.10997	698838.41911	Portland Shipyard	Swan Island Lagoon PSY shorelin	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
278	7633981.95149	701096.62546	Portland Shipyard	Swan Island Lagoon Center Trans	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
279	7634373.90384	700779.00890	Portland Shipyard	Swan Island Lagoon Center Trans	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
280	7634752.34059	700461.39234	Portland Shipyard	Swan Island Lagoon Center Trans	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
285	7634433.72288	701090.22522	Portland Shipyard	SI Lagoon mainland shoreline	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
286	7634905.73190	700642.70874	Portland Shipyard	SI Lagoon mainland shoreline	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
287	7635259.56884	700348.29753	Portland Shipyard	SI Lagoon mainland shoreline	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
289	7636126.71246	699718.92833	Portland Shipyard	SI Lagoon mainland shoreline	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
290	7636468.82157	699434.20687	Portland Shipyard	SI Lagoon mainland shoreline	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
291	7633246.31678	701940.77826	Portland Shipyard	Coast Guard	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
292	7630486.98845	701579.51002	Portland Shipyard	downstream of shipyard	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
294	7631337.02558	701318.70317	Portland Shipyard	downstream of shipyard	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
295	7632689.35737	701608.48855	Portland Shipyard	downstream of shipyard	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
296	7631249.77993	698272.88645	Shaver Transportation	near shoreline seep / outfall	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
297	7631326.75207	698070.67337	Shaver Transportation	inside dock	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
299	7630378.95408	699449.93142	Front Avenue LLP	near Front Avenue outfall	X	1	0	0	1	1	1	0	0	0	SVOCs, metals, PCBs, Pest	Y
300	7631482.24499	697829.50727	Lakeside Industries	In front of Lakeside Industries	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, pest,PCBs, TBT	Y
301	7631607.93987	697644.82921	Lakeside Industries	Off of private outfall	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, pest,PCBs, TBT	N
302	7633136.42162	697103.53308	Shell/ Texaco	At dock	X	1	0	1	1	0	1	0	0	0	TPH, SVOCs, metals, TBT, PCBs	N
303	7633386.26849	696940.84210	Shell/ Texaco	At dock	X	1	0	1	1	1	1	0	0	0	TPH, SVOCs, metals, TBT, PCBs, Pest	Y
304	7632111.95506	697528.56248	Gunderson	Adjacent to southern dock	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
305	7631929.10535	697829.82735	Gunderson	at end of northern dock	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
307	7632335.09472	697561.87437	Gunderson	ds of southern dock	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
308	7632184.87865	697241.14277	Gunderson	off Gunderson	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
309	7632448.77174	697249.26255	Gunderson	off Gunderson	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
310	7632643.64664	697103.10638	Gunderson	off Gunderson	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
312	7633660.75365	696966.67823	Gunderson	Gunderson box	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
313	7633522.75301	696754.86328	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
315	7633734.56795	696652.16512	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
316	7634078.85839	696768.46124	Gunderson	Gunderson box	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
317	7633950.58519	696548.30441	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
318	7634234.87862	696530.10963	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
319	7634519.17204	696511.91485	Gunderson	Gunderson box	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
320	7634390.89885	696291.75803	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
321	7634377.47868	696178.54930	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
322	7634675.19227	696273.56325	Gunderson	Gunderson box	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
323	7634546.91908	696053.40642	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
324	7634734.32597	695939.38570	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
325	7634831.21250	696035.21164	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
326	7634959.48569	696255.36847	Gunderson	Gunderson box	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
327	7635115.50592	696017.01686	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
329	7635241.15617	695869.77520	Gunderson		X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
330	7635243.02317	695707.81458	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
331	7635372.09559	695624.29713	Gunderson	Gunderson box	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
332	7635399.79935	695998.82209	Gunderson	Gunderson box	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
333	7631398.60497	700172.84347	Portland Shipyard	PSY-downstream	X	1	0	1	1	0	1	0	0	0	SVOCs, metals, PCBs, TBT	N
334	7628869.28812	702007.25136	Atofina	Transect 3- Channel	X	1	0	0	1	1	0	0	0	1	SVOCs, metals, pesticides, hexavalent chromium	N
335	7629161.70949	702293.58062	Atofina	Transect 3- Channel	X	1	0	0	1	1	0	0	0	1	SVOCs, metals, pesticides, hexavalent chromium	N
337	7632724.92415	700799.44546	Portland Shipyard	PSY-downstream	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
339	7632340.54687	700479.13107	Portland Shipyard	PSY-downstream	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
341	7633062.08000	700903.08000	Portland Shipyard	PSY-downstream	X	1	0	1	1	1	1	0	0	0	SVOCs, metals, PCBs, TBT, Pest	Y
342	7617333.76328	723858.00013	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
343	7617327.39990	723915.20933	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
344	7620244.39136	709964.44682	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
345	7620180.32496	710029.49578	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
346	7622242.98296	708474.66538	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
347	7621602.08596	707639.86959	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
348	7622071.06799	707077.28446	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
349	7625892.85357	704517.31884	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
350	7624835.69568	705150.50985	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
351	7626973.30483	703406.25386	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
352	7627205.91257	703213.96479	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
353	7627512.95478	702916.22688	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
354	7627880.17344	702473.71844	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
355	7627802.48907	702597.59351	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
356	7628515.77407	701690.46799	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
357	7628233.63501	702103.55428	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
358	7627344.83477	705467.34295	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
359	7627269.49871	705260.24352	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
360	7627166.29590	705314.42767	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
361	7632899.52579	700580.46617	Benthic Samples	lwg location		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
362	7632210.09540	700245.23855	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
363	7631489.03976	700751.24251	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
364	7632600.53101	701177.65506	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
365	7632909.55526	701900.45753	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
366	7635101.99206	699821.43666	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
367	7636004.42041	699452.26143	Benthic Samples	benthic located added		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y
368	7637261.45221	693883.48980	Benthic Samples	stormwater		1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs	Y

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ID_STRING	X	Y	ZONE	BENTHIC_KEEP	SVOC	VOCS	TBT	METALS	PEST	PCB	DIOXFUR	CHLORHERB	HEXCHROM	ANALYTES
G1	7618835.29213	711289.69703	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G2	7620437.54093	711436.21081	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G3	7620592.88199	711128.91225	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G5	7621107.02172	710223.76031	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G6	7620081.15614	709526.58725	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G7	7621369.56035	709751.80354	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G8	7620386.04245	709105.46283	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G9	7621617.96180	709315.59816	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G10	7621923.22272	708961.49540	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G11	7621082.18120	708250.37043	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G12	7621469.28482	707834.70452	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G13	7622659.78093	708167.90484	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G14	7622997.91105	707819.20453	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G15	7621962.13236	707087.65374	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G16	7623344.75445	707451.17599	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G18	7623646.11693	707207.52919	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G20	7624416.14487	706669.36093	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G21	7626742.01384	703653.22763	River miles 6-7	Y	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G30	7628600.89507	700666.25203	River miles 7-8	Y	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G31	7630887.53839	701942.45306	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G33	7631414.36670	701703.37331	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G34	7629593.80418	700205.98474	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G35	7630156.04275	699827.20628	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G36	7635700.21545	695669.21023	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G37	7636833.29653	696528.12473	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G38	7636137.49016	695379.90239	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G39	7637266.73961	696261.11834	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G40	7636577.58858	695082.42370	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G41	7637714.81104	695977.55575	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G42	7637014.51839	694792.33190	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G44	7637466.31277	694283.21792	River miles 9-10	Y	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G45	7638622.78238	695487.33892	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G47	7639709.00904	694890.34026	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G48	7640012.87499	694368.26684	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G49	7640313.64271	693833.00862	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G51	7632527.45042	699783.30750	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G54	7630845.68600	699114.44094	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G55	7616495.53375	726306.09860	River miles 1-2	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G56	7617940.36324	725223.51064	River miles 1-2	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G58	7615849.84679	725273.16172	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G59	7615287.30215	723619.03851	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G60	7617005.14823	722787.72469	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G61	7616890.36962	722195.62107	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G62	7615226.68799	721849.86400	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G64	7616993.47155	719558.28126	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G68	7617226.43446	718624.84035	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G69	7615962.22100	717509.14695	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G70	7617410.91564	718159.49343	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G71	7616169.15138	717022.09073	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G72	7617633.60413	717692.56584	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G74	7617153.86451	714633.46764	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G75	7618634.63597	715252.76545	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G76	7618805.61221	714859.87358	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G78	7618444.35668	712197.51413	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G80	7618549.27569	711781.20162	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G81	7619881.23877	712534.92408	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G82	7620845.55774	710678.50974	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G83	7616853.39442	721279.87367	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G84	7616820.63624	720820.57781	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G85	7614805.82207	719467.55627	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G86	7614857.76530	719939.48793	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G87	7616908.36418	719929.43305	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G88	7616572.77143	716099.14204	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G90	7617867.98341	713179.79796	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G92	7616385.31665	716566.77368	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G93	7614925.81697	720447.69466	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G94	7616879.17977	720354.84449	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G95	7613203.91754	720326.71819	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G96	7617445.23474	724754.14705	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G97	7616998.78064	724492.65250	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G98	7616826.57691	724078.08797	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G99	7615563.31288	722696.06726	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G100	7616762.58060	722576.14049	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G101	7616746.22695	722069.17731	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G102	7616626.30018	721545.86049	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G103	7615623.27627	721104.31192	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs

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ID_STRING	X	Y	ZONE	BENTHIC_KEEP	SVOC	VOCS	TBT	METALS	PEST	PCB	DIOXFUR	CHLORHERB	HEXCHROM	ANALYTES
G104	7616522.72706	721055.25097	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G105	7616795.28791	720586.44631	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G107	7615418.15956	719708.58010	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G108	7616855.25129	719741.50769	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G109	7615895.83711	718923.82515	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G110	7615912.19076	718362.34981	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G111	7615983.05658	717822.67933	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G112	7616288.32473	717359.32589	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G113	7617394.92177	717893.54515	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G115	7617018.78780	718825.70324	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G116	7616926.11711	719310.86155	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G117	7616522.72706	716879.61880	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G118	7617623.87288	717413.83806	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G119	7616631.75140	716405.36293	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G120	7616818.75644	715914.75341	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G121	7617989.10441	716367.20441	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G122	7617792.86060	716846.91150	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G123	7617007.88537	715418.69267	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G124	7617160.51944	714917.18071	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G125	7617422.17785	714459.27849	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G126	7617705.64113	713979.57140	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G127	7618675.95774	714998.94896	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G128	7618490.61637	715445.94875	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G129	7618314.56665	715982.80501	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G130	7617929.14103	713505.31553	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G131	7618141.73849	713014.70600	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G132	7618337.98229	712556.80378	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G133	7618594.18949	712098.90156	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G134	7618850.39669	711602.84082	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G135	7619090.25023	711101.32886	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G137	7620284.06674	709340.58580	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G138	7621167.16388	709934.76844	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G140	7620632.94462	710839.67045	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G141	7620344.03012	711270.31659	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G142	7620611.13975	708937.19574	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G143	7620998.17615	708522.90326	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G144	7621363.40769	708075.90347	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G145	7621685.02949	707694.31829	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G146	7622017.55372	707312.73310	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G147	7622737.11435	707912.36696	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G148	7622366.43160	708304.85458	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G149	7621412.46864	709476.86622	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G150	7622333.72430	706936.59913	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G151	7622775.27287	706576.81882	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G152	7623276.78483	706173.42876	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G153	7624105.36980	706696.74559	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G154	7623707.43096	707040.17226	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G155	7623467.57742	707252.76972	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G156	7623113.24832	707519.87934	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G157	7625801.27391	704616.05485	River miles 6-7	Y	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G158	7626285.85657	704374.52718	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G160	7627043.57572	703605.90559	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G161	7627430.61212	703257.02771	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G162	7628978.75773	703376.95448	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G164	7628428.18482	702155.88189	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G165	7628744.35540	701752.49184	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G166	7629115.03815	701392.71152	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G168	7629665.61106	702581.07681	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G171	7628851.67391	700365.84318	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G172	7629720.12323	700493.26073	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G174	7630423.33022	699740.99279	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G177	7630795.69577	699358.24461	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G178	7631107.26666	698978.20177	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G179	7631438.86110	698624.35155	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G180	7632238.58545	698579.88359	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G181	7632102.79318	699830.75073	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G182	7632658.32915	699561.10264	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G183	7633094.42651	699272.18814	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G184	7633372.43857	698966.91999	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G185	7633039.91434	697854.87174	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G186	7633912.10905	697255.23788	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G187	7634903.89618	697764.42514	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G188	7634408.16979	698094.72528	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G189	7634058.95756	698501.61864	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G192	7635651.04725	696066.87259	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G193	7636103.49825	695821.56783	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs

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ID_STRING	X	Y	ZONE	BENTHIC_KEEP	SVOC	VOCS	TBT	METALS	PEST	PCB	DIOXFUR	CHLORHERB	HEXCHROM	ANALYTES
G195	7635280.36449	697407.87195	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G196	7635702.66663	697194.94014	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G197	7636114.40068	696835.49417	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G198	7636975.69296	696252.21396	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G199	7637428.14396	696001.45798	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G200	7637896.94862	695745.25079	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G202	7638752.78968	695211.03153	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G203	7637008.40026	695276.44613	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G204	7637439.04640	694971.17799	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G205	7637831.53401	694556.88550	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G206	7638207.66798	694186.20275	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G208	7638807.30184	693608.37375	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G210	7639799.42332	694551.43428	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G211	7640126.49634	694060.82476	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G212	7639118.02121	693308.55682	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G213	7617354.98740	725762.67250	River miles 1-2	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G214	7615615.05585	724351.93825	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G215	7614060.08086	720185.58660	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G216	7616873.01857	719500.92045	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G218	7640569.37316	693370.72829	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G219	7639617.71982	692746.59312	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G220	7640826.83505	692965.73709	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G221	7639972.87497	692321.71749	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G222	7641129.90890	692553.84556	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G223	7640324.78556	691901.89103	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G224	7641441.51359	692142.30248	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G225	7640642.84664	691501.74047	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G226	7641790.70746	691733.35079	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G227	7642123.29831	691326.07765	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G228	7642430.02158	690922.38199	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G230	7642737.61752	690551.86864	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G231	7642006.38149	689895.61339	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G232	7640911.08433	690921.05686	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
G233	7641053.65226	690794.01167	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC235	7616763.52319	724899.85848	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC236	7616420.35522	723905.50943	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC237	7616054.97241	721855.43443	River miles 2-3	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC238	7616291.48619	719304.31289	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC239	7616847.58270	717845.74526	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC240	7617349.82408	717238.51054	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC242	7619476.95044	711625.29618	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC244	7620588.97230	709875.96915	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC245	7621137.96172	708995.27470	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC246	7621858.52999	708218.94708	River miles 5-6	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC247	7622556.41393	707433.85940	River miles 5-6	Y	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC248	7623251.09645	706711.58404	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC249	7623686.38118	706464.95806	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC250	7624162.87221	706171.36952	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC251	7624622.41063	705897.54564	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC252	7625056.38646	705659.98470	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC254	7626161.72307	705211.94877	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC255	7626472.86276	705066.34482	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC256	7627173.80164	704174.91741	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC259	7629453.97291	701925.65556	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC261	7629962.70275	701128.97826	River miles 7-8	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC263	7631809.55000	700424.31000	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC264	7636964.14027	695696.59636	River miles 9-10	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC266	7639470.93553	693961.59572	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC267	7640398.78452	692628.03397	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC268	7641327.93906	691248.35612	River miles 10-11	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC270	7617298.82300	716388.30932	River miles 3-4	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC271	7626800.74460	704525.82056	River miles 6-7	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC275	7618381.70835	714002.60627	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC276	7617881.95672	714932.87307	River miles 4-5	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs
MC277	7631343.66886	699524.15165	River miles 8-9	N	1	0	0	1	1	1	0	0	0	SVOCs, metals, Pest, PCBs

* Easting/Northing Coordinates
are in Oregon State Plane North NAD83, Feet

Table 1 - Sediment Sample Location Modifications
EPA Comments on Round 2 Field Sampling Plan
Sediment Sampling and Benthic Toxicity Testing

River Mile	Sample Number	Required Change	Rationale
3 - 4	G-216	Eliminate surface sediment sample	Nearby sediment samples are adequate
3 - 4	52/53	Combine samples into one surface/subsurface sample location halfway between samples 52 and 53	Sample 52 is on shore; shift sample 53 to better characterize potential releases from LOFTG
3 - 4	50	Eliminate surface sediment sample	Nearby sediment samples are adequate
3 - 4	G-69	Move approximately 150' downstream (down stream of outfall).	Better source characterization
3 - 4	59	Move approximately 150' upstream (down stream of outfall).	Better source characterization
3 - 4	55	Move to point just landward of dock	Better source characterization
3 - 4 (International Slip)	31 and 35	Retain as 14' subsurface core	Characterize outfalls
3 - 4	G-129	Move off-shore to 30' contour line	Consistent with samples G-122 and G-121

Table 1 - Sediment Sample Location Modifications
EPA Comments on Round 2 Field Sampling Plan
Sediment Sampling and Benthic Toxicity Testing

River Mile	Sample Number	Required Change	Rationale
4 - 5	65, 66	Change from round 3 to round 2B	Characterize nature and extent of contamination and potential groundwater discharges off shore of Kinder Morgan
4 - 5	G-128	Retain sample	Characterize sediment off shore of dock; outside T-4 removal area.
4 - 5	G-74	Eliminate surface sediment sample	Nearby sediment samples are adequate
4 - 5	G-134 and 135	Eliminate surface sediment sample	Nearby sediment samples are adequate
4 - 5	Arco Transects (Samples 98, 99, 100, 96, G-1, 97, 93, 94, 95, 90, 91 and 92).	Samples should be collected in manner analogous to samples 101 (Round 2A subsurface sample with bioassay), 102 (Round 3) and 103 (Round 2A).	As agreed to during December 12, 2003 meeting.
5 - 6	Mobile Transects (Samples 113, 114, 115, 116, 117, 118 119, 120 and 121).	Samples should be collected in manner analogous to samples 101 (Round 2A subsurface sample with bioassay), 102 (Round 3) and 103 (Round	As agreed to during December 12, 2003 meeting.

Table 1 - Sediment Sample Location Modifications
EPA Comments on Round 2 Field Sampling Plan
Sediment Sampling and Benthic Toxicity Testing

River Mile	Sample Number	Required Change	Rationale
		2A).	
5 - 6	G-6	Eliminate surface sediment sample	Nearby sediment samples are adequate
5 - 6	147, 148 or 149	One of these samples needs to be a Round 2A sediment core	Characterize unexpected petroleum related contamination
6 - 7	159, 175, 183, 187, 195, 199, 203, 207, 211, and 215	Move samples to 35' contour line (toe of slope).	As agreed to during December 12, 2003 meeting
7 - 8	334 and 335	Samples should be collected during round 2A	Sediment samples G-165, 334, 335 and G-168 represent transect that must be collected during the same time-frame.
7 - 8	292 and 294	Collect during round 2A unless in area planned for dredging	More information regarding dredging activities required.
8 - 9	337 and 339	Subsurface sediment samples must be retained	Historic data does not include PAH anslysis.
8 - 9 (Swan Island Lagoon)	278	Retain as subsurface sample location	Characterize subsurface sediment within Swan Island Lagoon; no nearby subsurface

Table 1 - Sediment Sample Location Modifications
EPA Comments on Round 2 Field Sampling Plan
Sediment Sampling and Benthic Toxicity Testing

River Mile	Sample Number	Required Change	Rationale
			sediment shipyard da

APPENDIX B
SURFACE SEDIMENT SAMPLE DEPTH EVALUATION

PORTLAND HARBOR RI/FS

ROUND 2 FIELD SAMPLING PLAN SEDIMENT SAMPLING AND BENTHIC TOXICITY TESTING

APPENDIX B
SURFACE SEDIMENT SAMPLE DEPTH EVALUATION

June 21, 2004

Prepared for:
Lower Willamette Group

Prepared by:
Integral Consulting, Inc.

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1.0 INTRODUCTION

As part of the Portland Harbor Remedial Investigation (RI), three bathymetric surveys of the Lower Willamette River (LWR) have been conducted between December 2001 and May 2003. Integral previously presented a comparison of data from the first two surveys, completed in January 2002 and September 2002, which indicated that riverbed elevations were changeable in some parts of the river over that time period (SEA et al. 2003). A detailed review of the bathymetric changes revealed trends in the magnitude, direction (i.e., shallowing versus deepening), and spatial distribution of river bed elevation changes in the LWR. This information was used to establish an appropriate surface sediment sampling interval for the Round 2 nature and extent sediment sampling program that will effectively characterize “surface sediments” in the system (i.e., capture the surface mixed layer throughout most of the system).

The third bathymetric survey was conducted on the LWR in May 2003. With the completion of this third survey, changes along the LWR may be observed over three time intervals: the eight months between the January 2002 and September 2002 (T1T2) surveys; the eight months between the September 2002 and May 2003 (T2T3) surveys; and the entire 16-month study period (T1T3). The purposes of this evaluation are to present the results of a comparison between the January 2002 and May 2003 data sets (T1T3) and discuss the net changes observed over the 16-month period, to discuss and compare patterns seen during the two component 8-month periods, and define a surface sampling interval or intervals that can be used in the Round 2 (2004) nature and extent sediment sampling program to effectively characterize “surface sediments” in the system.

2.0 TECHNICAL APPROACH

2.1 BATHYMETRIC CHANGE DERIVATION

The technical approach used in this analysis follows that used for the previous (T1T2) bathymetric change analysis (SEA et al. 2003). Two sets of maps showing bathymetric change were generated by comparing 1) the January 2002 and May 2003 data sets, and 2) the September 2002 and May 2003 data sets (see Figures 3 and 4 in SEA 2003). The bathymetric change maps were created by gridding the bathymetric sounding data from each survey into 1-square-meter cells (approximately 10.8 ft^2). The average depth within each cell was then compared between surveys, and a direction and magnitude of change for each cell was tabulated (Tables 1a, 1b, 2a, and 2b). The vertical resolution of the multibeam survey is +/- 0.25 foot, so cell comparisons that show positive or negative change less than or equal to 0.25 foot are considered to represent no change in riverbed elevation. In the analysis, the early data are subtracted from the later data so negative elevation changes indicate shallowing and positive elevation changes indicate deepening.

Tables 1a and 1b show the total cell counts by river mile (RM) for nearshore and channel zones, respectively, for the January 2002 to May 2003 data comparison (T1T3). Similarly, Tables 2a and 2b show the total cell counts for the nearshore and channel areas for the September 2002 to May 2003 (T2T3) data comparison. Tables for the T1T2 comparison were presented in SEA et al. (2003). The cell counts presented in the tables are grouped into *No Change*, *Shallowing*, and *Deepening* categories. The no-change category is defined as $\pm$0.25 foot. The percentage of the area within each river mile that falls within each of these three categories is shown at the bottom of each table.

The definition of the nearshore and channel areas is based on the results of the December 2001 LWR sediment-profile imaging (SPI) (SEA 2002a). In that survey, the sediment transport regimes inferred from the SPI results in the deeper portions of the LWR (channel and lower channel slopes) differed notably from those inferred for the nearshore areas (upper channel slope, off-channel benches and beaches). The division between these “channel” and “nearshore” areas was delineated by the –15 foot North American Vertical Datum of 1988 (NAVD88) contour, which equates approximately to the –20 foot Columbia River Datum (CRD) contour in the survey area. Figure 1 illustrates the nearshore and channel areas defined by the NAVD88 –15-foot contour, as well as sediment transport regimes identified along the channel that will be referred to below (SEA 2002b).

T1T3 Data Refinement

The original T1T3 data set was reexamined to identify dredged areas and data considered likely to be erroneous due to survey noise. Erroneous bathymetric data typically resulted in survey areas where in-water or over water structures affected navigational accuracy leading to offsets in the time-series data sets that were artifactual (see SEA 2003). These "bad" data segments were identified and removed during data processing for this evaluation. Tables 3a and 3b present the T1T3 data with the survey noise removed, and with dredged area data presented separately. A revised T1T3 data set was generated that represents the removal of both erroneous and dredged area data. This revised data set is presented in Tables 4a and 4b and herein is the data referred to regarding T1T3 bathymetric changes.

A summary comparison of the original and revised T1T3 data is presented in Tables 5 and 6. As shown in Table 5, removing the dredged area and erroneous data generally resulted in changes of only 1 to 2 points in the percentages of no change, shallowing, and deepening cells. The relative proportion of cell types per river mile generally remain consistent across the two data sets. Exceptions are seen in the nearshore data, where changes from 3 to 9 percentage points are noted in RMs 4-6 (due primarily to the removal of erroneous data), and up to 5 percentage points in RM 13-14 due to the removal of dredged area data. In each case, the revised data increases the apparent stability of the nearshore segments through a decrease in the percentage of deepening cells and an increase in the percentage of no-change cells (Table 5). Table 6 presents the breakdown of change increments in the original and revised T1T3 data sets. All observed differences are approximately 2 to 3 percentage points or less.

It is important to note that no attempt was made to filter out large-scale change data from dredging or survey errors for the T1T2 or T2T3 data analyses. Consequently, the change data compiled for these time intervals represent worst-case riverbed elevation change scenarios, especially at the higher magnitudes. As shown by the revised T1T3 data, impacts of these artifactual effects are small, and, given the large surveyed area with very accurate x, y, z data, the trends described here are representative of natural riverbed sediment deposition and erosion patterns overall.

3.0 DATA EVALUATION AND DISCUSSION OF BATHYMETRIC CHANGES

3.1 CHANGE DATA

16-month period from January 2002 to May 2003 (T1T3)

Data presented in Tables 4a and 4b show that areas of shallowing and deepening generally make up a larger percentage of the total area in the shallow, nearshore portion of the site than in the main navigation channel. The numbers of cells showing change account for 59% of the total cells in the nearshore zone and 47% of the cells in the channel zone. Figures 2a and 2b show the percentages of cells in nearshore and channel zones, respectively, within each river mile segment that account for no change, shallowing, and deepening in the T1T3 comparison.

Discharge data are unavailable for the period over which these bathymetric surveys were conducted. Plots of available stage data measured at the USGS gage at Portland (#14211720) from 1973 through mid-August 2003 were provided in Section 2 of the Work Plan (SEA et al. 2003). Stages in 2002 and 2003 appear relatively typical compared to those of the other 27 years on the U.S. Army Corps of Engineers website (SEA et al. 2003). 2002 and 2003 stages were either greater than or similar to river stages observed in other years 56% of the time (15 years), and were less than the river stages observed in other years 44% of the time (12 years). A discussion of the factors that influence stage height is also provided in the Work Plan (SEA et al. 2003).

Nearshore Areas. Across all nearshore areas combined, approximately 41% of the riverbed shows no change in elevation between the two surveys, while 41% of the area deepened measurably and 18% shallowed. The cumulative percent of the nearshore area shallowing and deepening by vertical change interval is shown in Table 4a. The magnitude and the extent of vertical change are relatively greater in nearshore areas than in the channel. Still, over 77% of the cells that exhibit vertical change show change that is less than or equal to 1 foot (shaded rows), and over 94% of the cells that show vertical change show change that is less than or equal to 2 feet. When the no-change cells are included in the calculation, the percentage of the total area of the nearshore riverbed that shows vertical change (either shallowing or deepening) greater than 1 foot is approximately 12.9%. This represents a total nearshore area of about 210,000 m^2.

Channel Areas. Across all channel segments combined, 53% of the riverbed shows no change in elevation between the two surveys, while 26% of the area deepened measurably and 21% shallowed. The cumulative percent of the channel area that is shallowing and deepening by vertical change interval is also provided in Table 4b. Over 85% of shallowing cells and over 93% of deepening cells exhibit vertical change less than or equal to 1 foot (see shaded row). Over 99% of the cells show vertical change that is less than or equal to 2 feet. When the no-change cells are included in this calculation, only 4.6% of the total area of the channel riverbed shows vertical change (either shallowing or deepening) greater than 1 foot. This represents a total channel area of about 429,000 m^2.

8-month period from September 2002 to May 2003 (T2T3)

A similar examination of the change data presented in Tables 2a and b show that the numbers of cells showing change account for only 37% of the total cells in the nearshore zone and 33% of the cells in the channel zone. Figures 3a and 3b show the percentages of cells in nearshore and channel zones, respectively, within each river mile segment that account for no change, shallowing, and deepening in the T2T3 comparison.

Nearshore Areas. Across all nearshore areas combined, approximately 63% of the riverbed shows no change in elevation between the two surveys, while 20% of the area deepened measurably and 17% shallowed. The cumulative percent of the nearshore area shallowing and deepening by vertical change interval is shown in Table 2a. Over 81% of the cells that exhibit vertical change show change that is less than or equal to 1 foot (shaded rows), and over 92% of the cells that show vertical change show change that is less than or equal to 2 feet. In total, approximately 5.5% of the nearshore riverbed shows vertical change (either shallowing or deepening) greater than 1 foot. This is equivalent to a total nearshore area of about 96,000 m^2.

Channel Areas. Across all channel segments combined, 67% of the riverbed shows no change in elevation between the two surveys, while 12% of the area deepened measurably and 21% shallowed. The cumulative percent of the channel area that is shallowing and deepening by vertical change interval is also provided in Table 2b. Over 89% of shallowing cells and over 95% of deepening cells exhibit vertical change less than or equal to 1 foot (shaded rows), and over 99% of the cells show vertical change that is less than or equal to 2 feet. In total, only 2.6% of the total area of the channel riverbed shows vertical change (either shallowing or deepening) greater than 1 foot, which represents a total channel area of about 249,000 m^2.

Study Area Trends

The summary statistics for the nearshore and channel zones from the three time interval comparisons are presented in Tables 7a and 7b.

In the nearshore zones (Table 7a), the area calculated to represent changes greater than 1 foot decreased from 214,410 m^2over the T1T2 period to 96,269 m^2over the T2T3 period. The area of changes greater than 1 foot calculated for the overall study (209,844 m^2), is actually slightly less than that of the T1T2 period. Also, since the percentage of shallowing cells remained consistent (16% to 17%) over the two periods, the increase in apparent stability (i.e., no-change area) in T2T3 is best explained by the reduction in deepening cells from 40% over the T1T2 interval to 20% over the T2T3 interval.

In the channel zones (Table 7b), the area calculated to represent changes greater than 1 foot over the T1T2 period (262,173 m^2) stayed relatively constant (249,451 m^2) during the T2T3 period. The percentages of shallowing and deepening cells from T1T2 and T2T3 are near mirror-images of each other, while the percentage of no-change cells remained consistent.

Trends by River Mile

To show trends over the study period in each river mile segment, the breakdown of cell classifications (no change, shallowing, or deepening) per mile over the T1T2 and T2T3 time periods is presented in Table 8. For the sake of comparison, only differences greater than or equal to 20 percentage points between the two time periods are considered noteworthy. Differences of 20 percentage points or more are shaded in Table 8 to highlight changes in river 'behavior;' with increases greater than 20 percent differentiated by bold type.

Using a change of ≥ 20 percentage points as the threshold for noteworthy change between the two time periods, the trends observed in both nearshore and channel areas (Table 8) are described below.

Nearshore Areas

- RMs 0-4 showed a dramatic decrease in deepening cells with a corresponding increase in cells showing no change.
- RMs 4-8 showed a notable increase in the percentage of no-change cells, as both deepening and shallowing cells decreased.
- RMs 8-10 showed generally the same percentage of no-change cells, with minor variations in deepening and shallowing percentages.
- RM 10-11 showed a marked decrease in the percentage of shallowing cells, while minor increases occurred in the percentages of no-change and deepening cells.
- RMs 11-13 showed dramatic changes of behavior over the two time periods as the percentages of shallowing cells markedly increased and deepening cells markedly decreased. The percentages of no-change cells remained approximately the same in RM 11-12 but increased markedly in RM 12-13.
- The percentages of cell types remained approximately the same over the two time periods in RMs 13-15.7. Only relatively minor changes were exhibited in this segment, with

increases in no-change and shallowing cells and decreases in deepening cells.

<u>Channel Areas</u>

- The percentages of no-change cells increased dramatically in RMs 0-2 during the T2T3 period.
- RMs 2-4, classified as part of a transitional/depositional zone (SEA 2002b), showed a marked increase in the percentages of shallowing cells. The percentage of deepening cells decreased dramatically in RM 2-3, but less so in RM 3-4.
- The channel behavior through RM 4-5 remained relatively consistent through the period of study, with no marked changes in the proportions of cell types.
- RMs 5-7, classified as a sediment transport/non-depositional zone (SEA 2002b), showed a marked increase in the percentages of no-change cells, while the percentages shallowing cells remained consistent. The percentage of deepening cells decreased dramatically in RM 6-7.
- The channel behavior through RMs 7-9 remained relatively consistent through the period of study, showing no marked changes in the proportions of cell types.
- Shallowing cells increased dramatically in RM 9-10, with a corresponding decrease in the percentage of no-change cells. The percentages of deepening cells remained consistent over the two time periods. Shallowing in RM 9-10 is consistent with its classification as a depositional zone (SEA 2002b).
- The channel behavior through RM 10-12 remained relatively consistent through the period of study, with no marked changes in the proportions of cell types.
- In RM 12-13, part of the river segment classified as a dominantly erosional, relatively high energy ‘chute’ (SEA 2002b), no-change cells increased dramatically, with a corresponding decrease in the percentage of deepening cells. The percentages of shallowing cells remained consistent over the two time periods.
- The percentages of cell types remained approximately the same over the two time periods in RMs 13-15.7.

Change Maps Description

Detailed T1T3 and T2T3 change maps are presented in SEA (2003). T1T2 change maps were presented previously in SEA et al. (2003). To assess the extent and spatial distribution of the LWR areas where the 2003 elevation changes exceeded the +/- 1-foot change, cells exhibiting shallowing and deepening greater than 1 foot were placed into two categories, and the no-change category was expanded to include all changes up to +/- 1 foot. Using this classification scheme, a simplified series of bathymetric change maps were generated and are shown in Figures 4a-g. A summary of the percentages of cells in each RM segment that represent changes of +/- 1 foot or less is included as Table 9. For the purposes of discussion, river mile segments were grouped according to observations of similar characteristics shown on the T1T3 change maps.

RM 15.7 to RM 14

This segment includes the channels to the east and west of Ross Island. Approximately 87% of the channel and 86% of the nearshore areas exhibited changes of 1 foot or less over the T1T3 period (Table 9). Nearshore deepening (generally up to 5 feet) occurred throughout the study period at the cutbanks of the western channel near the toe of Ross Island and the eastern channel across from the Ross Island quarry, although the majority of the deepening appears to have occurred over T1T2. A large area of deepening visible in the eastern channel near the toe of Ross Island is the result of dredging that progressed during the survey period. Shoaling up to approximately 5 feet along western margin and nearshore zone of the main channel northwest of Ross Island occurred throughout the study period but is mostly attributable to T1T2.

RM 14 to RM 11

Areas of change totaling 1 foot or less throughout the study period account for 95% to 98% of the channel zones and 54% to 91% of the nearshore zones in this segment (Table 9). Changes in the channel are primarily the localized effects of bridge foundations, and also sand waves occurring between RM 11 and the Broadway Bridge, which were seen throughout the study period. The eastern channel margin and nearshore zones show large areas of deepening along the 'cutbank' side of the river. This deepening is generally on the order of 2 to 5 feet, though small patches of deep scouring near the shoreline just upstream of the river bend appears to show deepening of 10 or more feet. The majority of these changes occurred during T1T2.

RM 11 to RM 10

Approximately 94% of the channel and 78% of the nearshore zones within this RM showed changes of 1 foot or less (Table 9). Changes observed include prominent areas of both deepening (up to 5 feet or less) and shallowing (between 5 to 10 feet) in the nearshore zone, the infilling of dredged holes in the channel, and some dredging in the western channel margin near RM 10. The changes in the channel occurred throughout the period but became more significant in T2T3.

RM 10 to RM 8

In this segment, 78% to 96% of the channel area and 87% to 91% of the nearshore area showed changes of 1 foot or less throughout the study period (Table 9). In agreement with its earlier classification as part of a depositional area (SEA 2002b; Figure 1), large portions of the channel have shoaled (generally up to 5 feet) between RM 10 and approximately RM 8.5. The shoaling along the edges of a dredged area near eastern channel margin occurred during T1T2, and the majority of the shoaling along the central and western portions of the channel occurred over T2T3. Dredging that occurred during T1T2 is evident along the Port of Portland Terminal 2 dock.

RM 8 to RM 7

This segment is characterized by little overall change in the channel area, with 99% of the channel and 87% of the nearshore showing changes of 1 foot or less (Table 9). Deepening generally up to 2 feet occurred along the western nearshore areas including near Atofina, and dredging is evident at the Willbridge Terminal docks. Shallowing (approximately 5 feet) is noted in some eastern nearshore areas. These changes occurred primarily over the T1T2 interval.

RM 7 to RM 5

This segment has been described as a sediment transport zone (SEA 2002b; Figure 1). Approximately 98% to 99% of the channel and 87% to 90% of the nearshore showed changes of 1 foot or less (Table 9). Changes in channel are seen primarily in the vicinity of the bridge footings and as sand waves in the center of the river between RM 6 and RM 5, which occurred throughout the study period. Numerous areas of change are seen in the nearshore zones, primarily deepening (up to 5 feet), though up to approximately 5 feet of shallowing is seen near the eastern end of St. John's Bridge. The majority of change appears to have occurred over T1T2.

RM 5 to RM 3

Approximately 98% to 99% of the channel and 79% to 93% of the nearshore showed changes of 1 foot or less during the study period (Table 9). The degree of change in this segment of the river is in keeping with its characterization as a depositional and transitional zone (SEA 2002b; Figure 1). Net change in this segment is seen primarily as shallowing (up to approximately 2 feet) along the western nearshore and channel margins, which occurred almost exclusively over the T1T2 time period. Nearshore zones show both shallowing and deepening (up to 5 - 10 feet), particularly in the industrial slips on the eastern shoreline.

RM 3 to RM 0

Within this segment, 97% to 98% of the channel, and 72% to 95% of the nearshore exhibited changes of 1 foot or less (Table 9). Changes occurring over the study period in this segment generally consist of deepening (generally up to 5 feet) of the western channel margin and nearshore zone and shallowing (generally up to 2 feet) of the eastern channel margin and nearshore zones. Most of the observed change occurred primarily during the T1T2 period, especially downstream of RM 1.5. The shallowing in the eastern nearshore and eastern portion of the navigation channel from approximately RM 1.5 to RM 2.1 occurred throughout the study period.

3.2 SURFACE LAYER SAMPLE INTERVAL

Based on the T1T3 data presented in Tables 4a and 4b, a surface sediment sample of 1 foot (approximately 30 cm) will capture the riverbed elevation change observed in 2003 across 95% of the channel and 87% of the nearshore areas, which is consistent with the previous analysis (SEA et al. 2003). A high-quality, 1-foot surface sample can be obtained with a large power grab, such as the one used for some of the LWR co-located sediment sampling in 2002. This sampling device also has the advantage of taking a large volume of undisturbed, surface sediment in all sediment textures. It is recommended that a 1-foot sample be used as the standard surface sampling depth.

Information presented in Figures 4a-g will be used in planning future sediment nature and extent sampling, along with the historical sediment quality data and the source evaluation information, to develop a rationale for the sampling approach at each station. This overlay of areas with depositional sediment changes greater than the 1-foot sampling depth may lead to sampling subsurface (> 1 foot) sediments at a subset of stations (e.g., if a proposed station falls in an area of greater than 1 foot shallowing, and the historical data indicate past elevated surface sediment concentrations).

Historical surface sediment data to be used in the RI/FS were collected from the 0 to 15 cm interval (approximately 6 inches). Based on the data in Tables 4a and 4b, changes within 6 inches account for approximately 81% of the channel and 68% of the nearshore areas. As noted, the period of study during which the bathymetric change data was collected was characterized by typical stages in the Willamette River; therefore, the 0- to-6 inch sample interval appears representative of the majority of surface changes under normal conditions.

4.0 CONCLUSION

Stages recorded on the Willamette River during the period over which the three bathymetric surveys were conducted appear to represent relatively typical conditions on the river; therefore, the changes observed through comparison of the surveys are also considered representative of typical conditions.

Dredged areas identified from the T1T3 data comprised from <0.01% to 19.6% of the deepening cells of their respective RM segments. Removing dredged area and suspected erroneous data appears generally to have little effect on the apparent behavior of the riverbed and the representativeness of the proposed 1-foot surface sampling interval.

Comparing bathymetric data from the first and third surveys indicates that a major portion (53%) of the riverbed in the channel zones shows no change in elevation between the two surveys, and the sum of channel areas that deepened (26%) is slightly greater those that shallowed (21%). Within the nearshore areas, unchanged and deepened areas are equally dominant (each 41%) over areas that shallowed (18%).

A comparison of the percentages of total cells representing no change, shallowing, and deepening between the T1T2 and T2T3 time periods indicated that some segments of the river underwent changes that varied between the two time periods. While nearshore and channel zones both generally showed decreases in the areas of deepening cells, areas of no change or shallowing increased relative to the T1T2 period.

Direct measurements of riverbed elevation changes in 2003 are consistent with previous inferences on the LWR physical system and support the representativeness of historical surface sediment data collected from a 0- to 0.5-foot interval in the majority of riverbed locations. A 1-foot (30-cm) surface sediment sampling interval is proposed as the standard representative surface sampling interval for the Portland Harbor RI/FS (SEA et al. 2003). A 1-foot interval will capture changes in riverbed elevations over the great majority of the potential sampling area, and, based on observations of benthic infauna (oligochaetes) as deep as 21 cm in SPI from the LWR (SEA 2002a), this interval also includes the biologically active zone.

Relatively small and localized subareas that exhibit deepening greater than 1 foot have been identified and will also be sampled to 1 foot to characterize the new surface sediment layer. Relatively small and localized subareas that exhibit shallowing greater than 1 foot have also been identified, and these areas may be approached differently. These shallowing areas greater than 1 foot will be included as an overlay during the placement of Round 2 nature and extent sediment station locations (SEA et al. 2003). This sampling approach is based on the considerable amount of information available on the LWR physical system.

This approach may be modified (for subareas of the site) in later phases of the RI, if warranted, based on information still to be gathered (e.g., modeling results). Based on the existing data, this represents a logical approach to evaluating surface sediment.

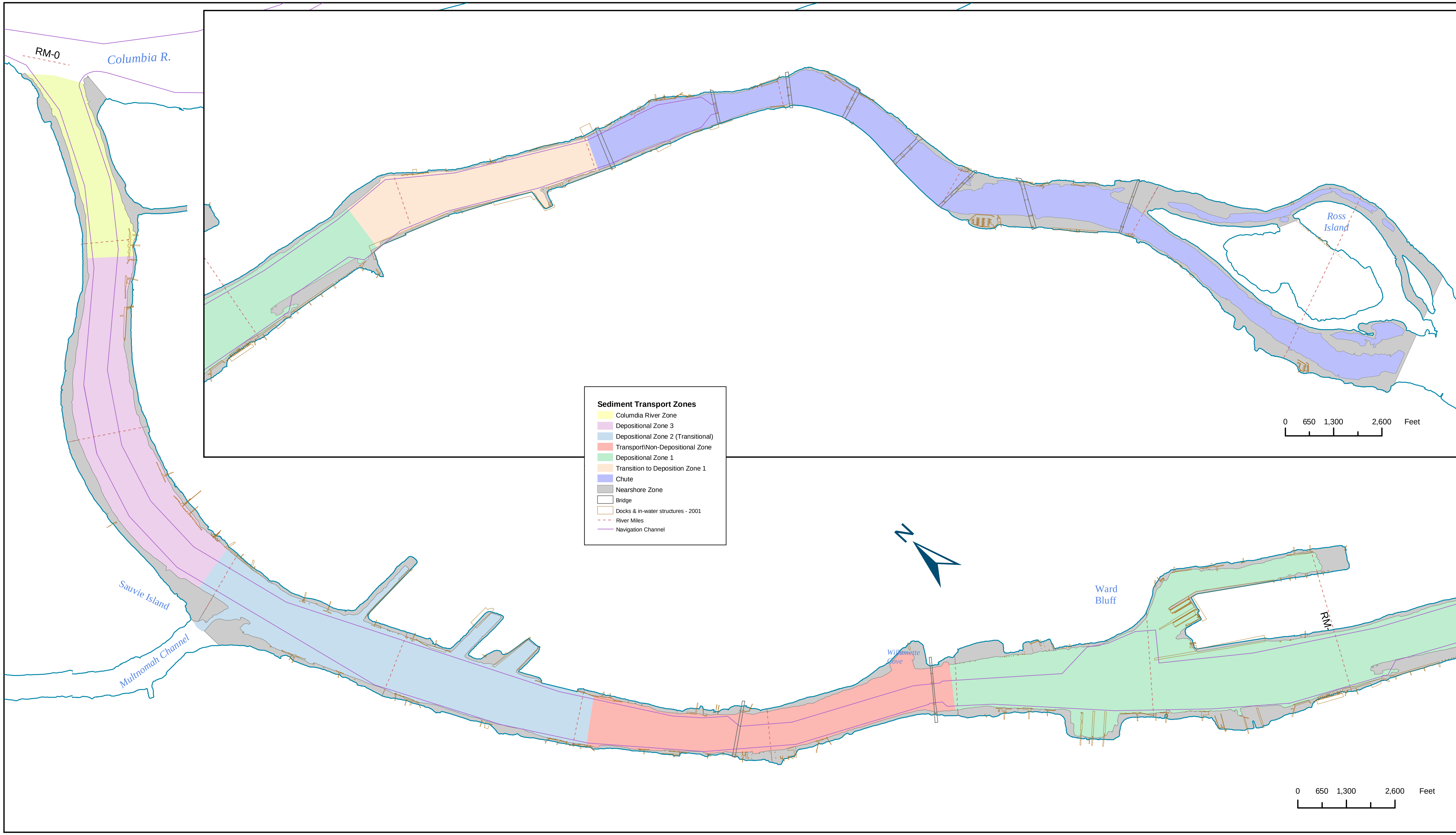
5.0 REFERENCES

SEA. 2002a. Sediment Profile Image Survey of Lower Willamette River. Prepared for Lower Willamette Group, Portland, OR. Striplin Environmental Associates, Inc., Olympia, WA. (April 26, 2002).

SEA. 2002b. Integration of Sediment Trend Analysis (STA) Survey Results with Historic Bathymetry in the Lower Willamette River. Prepared for Lower Willamette Group, Portland, OR. Striplin Environmental Associates, Inc., Olympia, WA. (April 26, 2002).

SEA. 2003. Lower Willamette River May 2003 Multibeam Bathymetric Survey Report. Draft. Prepared for Lower Willamette Group, Portland, OR. Striplin Environmental Associates, Inc., Olympia, WA. (October 8. 2003).

SEA, Windward, Kennedy/Jenks, Anchor Environmental, and Groundwater Solutions. 2003. Portland Harbor RI/FS Programmatic Work Plan. Revised Draft Final. Prepared for Lower Willamette Group, Portland, WA. Striplin Environmental Associates, Inc., Olympia, WA. (November 13, 2003).



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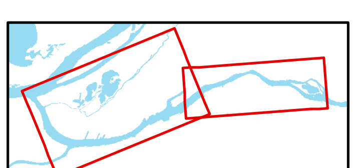

FEATURE SOURCES:
Transportation, Property, Zoning or Boundaries: Metro RLIS .
Channel & River miles: Developed from US Army Corps of Engineers information.
Nearshore: The area of river above the -15' 2001 bathymetry contour and below the waters edge.
River Edge: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
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PLOT DATE: 12/18/03

Figure 1
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Nearshore and Channel Areas and
Sediment Transport Zones

Figure 2a. Nearshore Area (<20' CRD) Bathymetry Changes (Dec 2001 to May 2003)

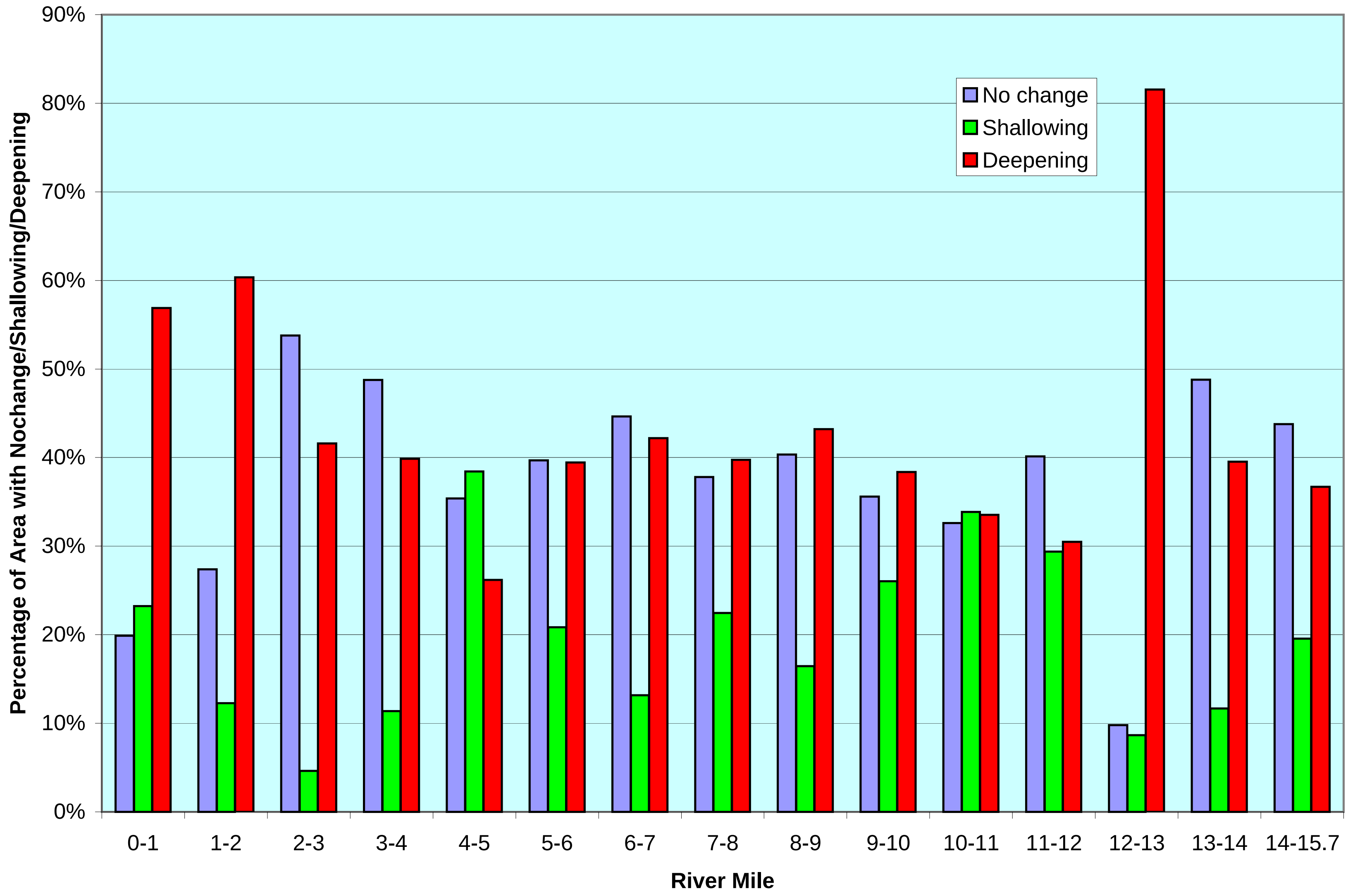


Figure 2b. Channel Area (> 20' CRD) Bathymetry Changes (Dec 2001 to May 2003)

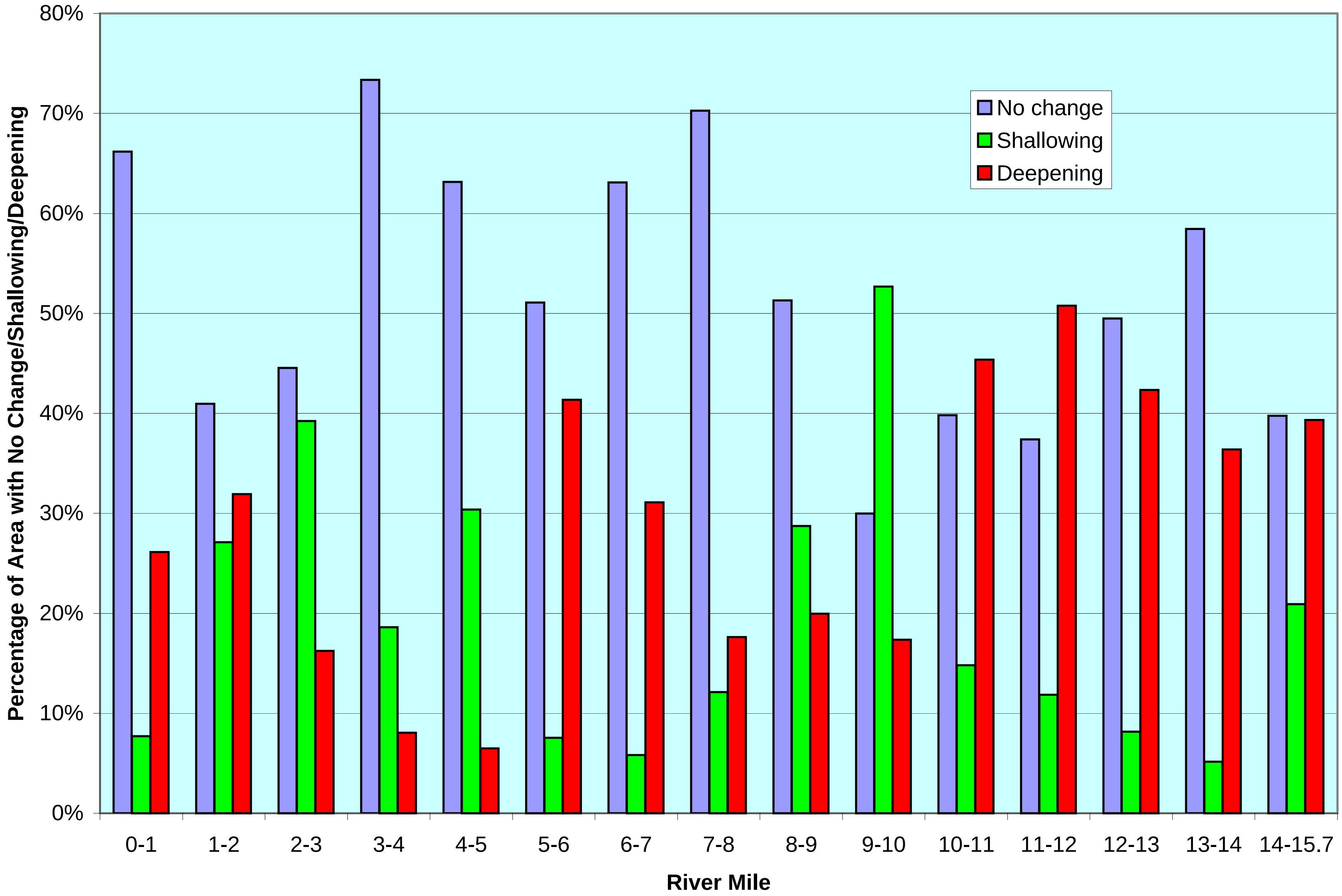


Figure 3a. Nearshore Area (<20' CRD) Bathymetry Changes (Sept 2002 to May 2003)

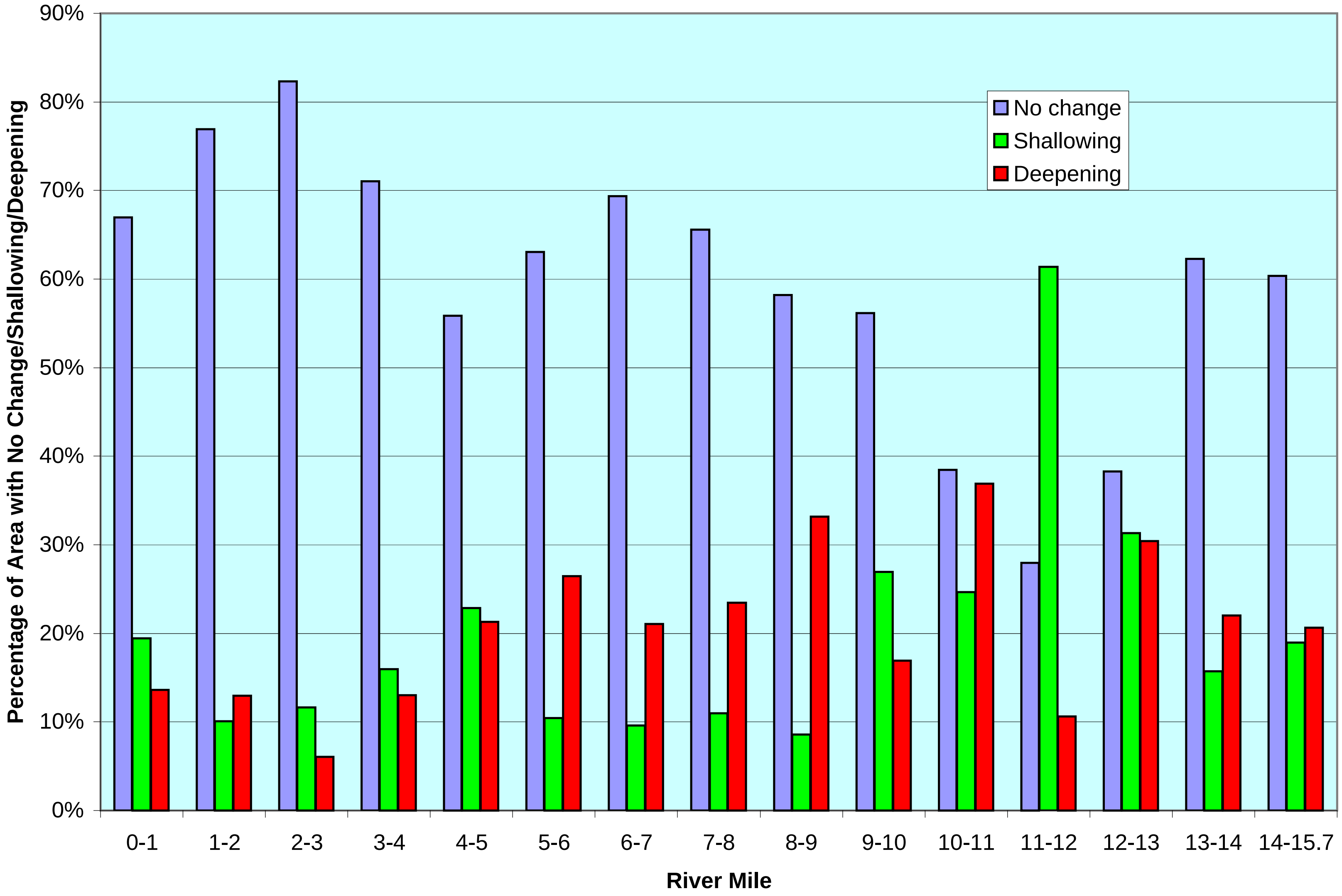
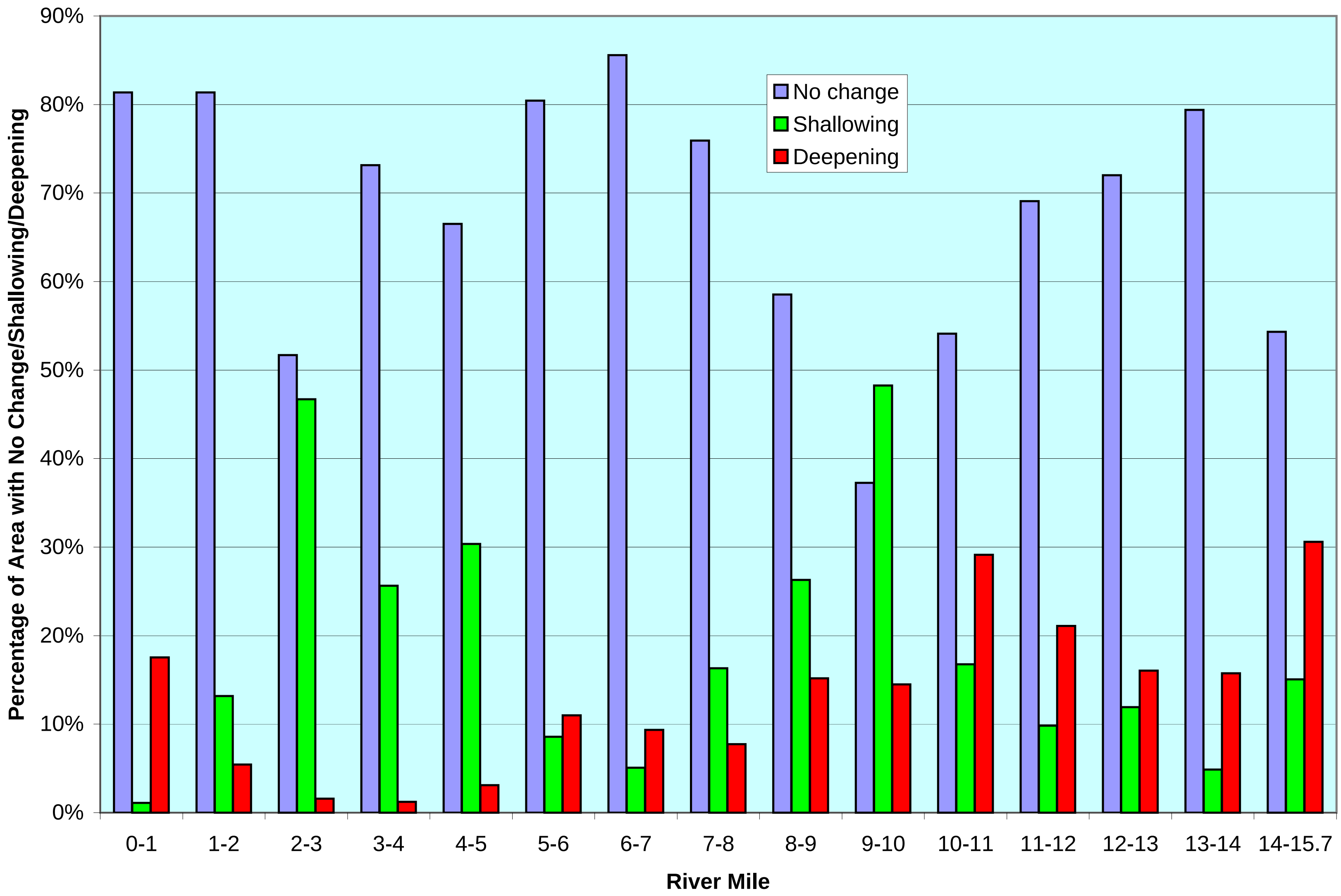
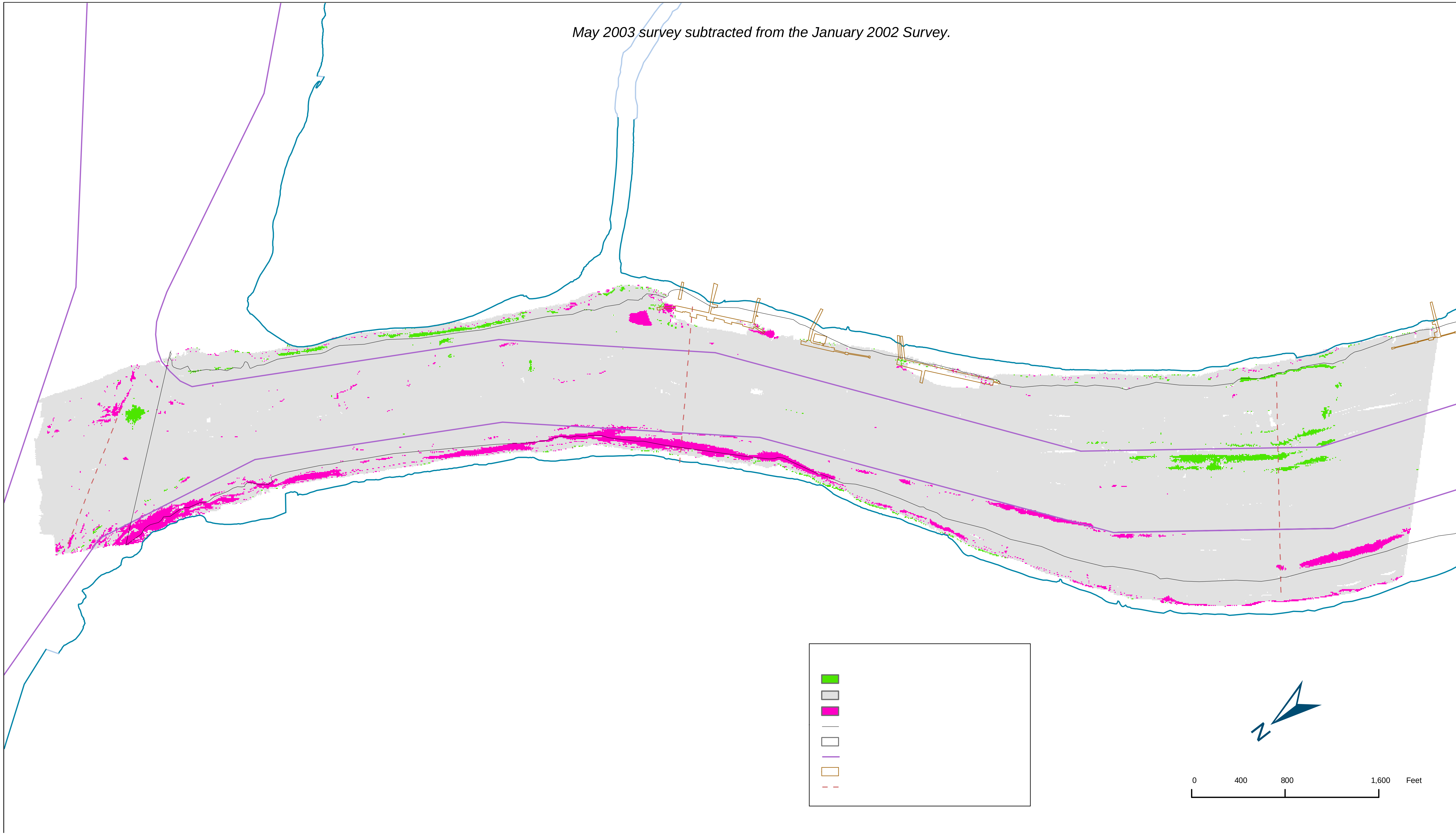
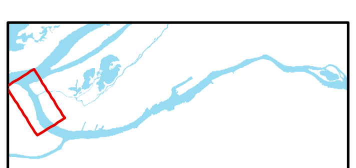


Figure 3b. Channel Area (>20' CRD) Bathymetry Changes (Sept 2002 to May 2003)







FEATURE SOURCES:
Bathymetric Information: Multibeam bathymetric surveys conducted by
David Evans and Associates, Inc. Dec, 2001/Jan, 2002, July/Sept 2002, and May 2003.
Difference in bathymetry: 1 Meter grid values of the May 2003 survey
were subtracted from the January 2002 survey to produce the difference grid.
Seven overlaping data files are shown in these data sheets.
Transportation, Water, Property, Zoning or Boundaries: Metro RLIS .
Channel & River miles: Developed from USACOE information.
River Edge, Docks & In-water Structures: created by digitizing on October 2001
0.33 ft. resolution color orthophotos.
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PLOT DATE: 12/12/03

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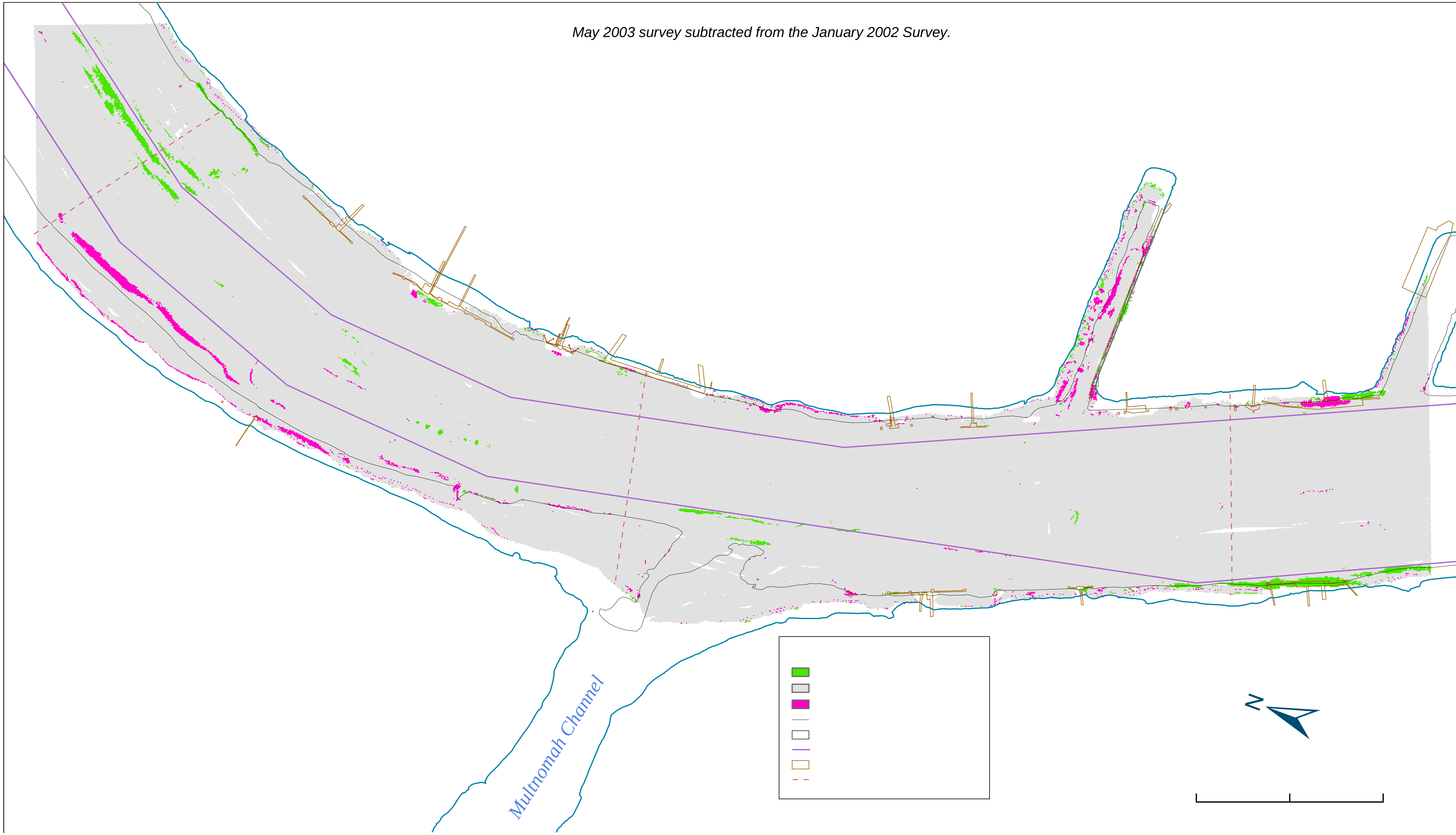
Figure 4a
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Generalized Bathymetric Change; T1 to T3



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FEATURE SOURCES:
Bathymetric Information: Multibeam bathymetric surveys conducted by
David Evans and Associates, Inc. Dec, 2001/Jan, 2002, July/Sept 2002, AND mAY 2003.
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0.33 ft. resolution color orthophotos.
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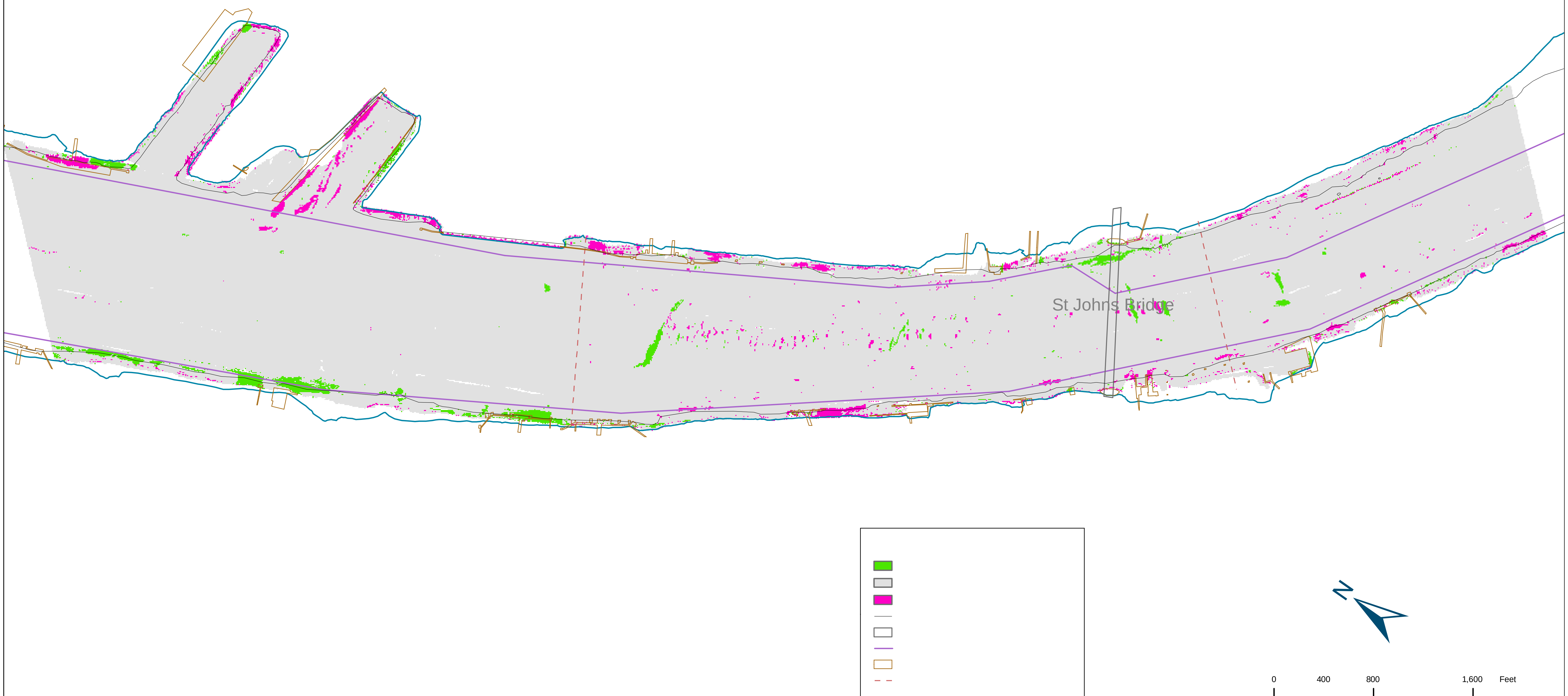
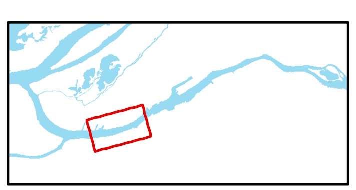
PLOT DATE: 09/11/03

Figure 4b
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Generalized Bathymetry Change; T1 -T3

May 2003 survey subtracted from the January 2002 Survey.





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Channel & River miles: Developed from USACOE information.
River Edge, Docks & In-water Structures: created by digitizing on October 2001
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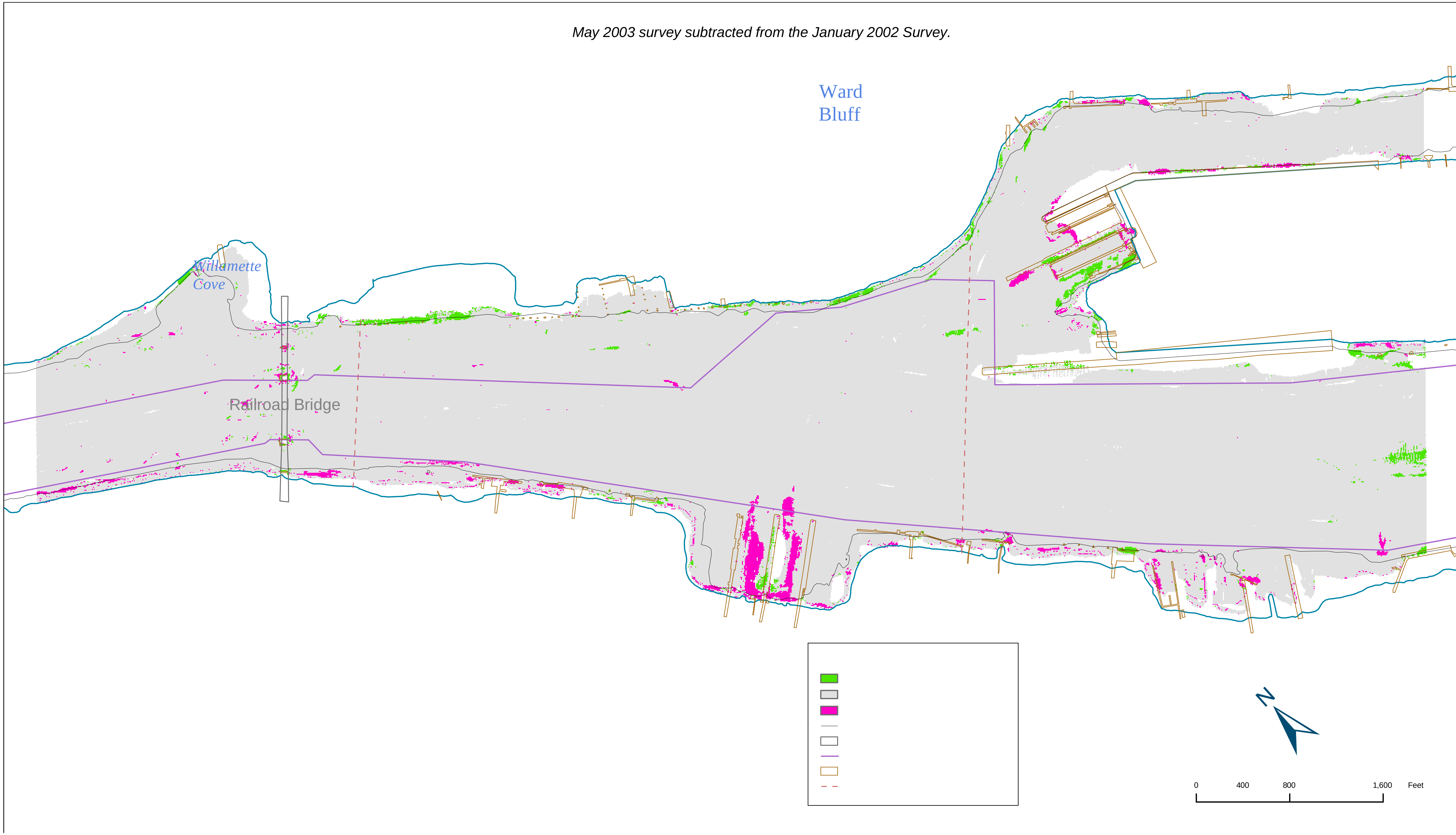
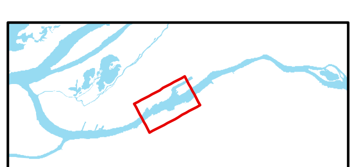
PLOT DATE: 09/11/03

Figure 4c
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Generalized Bathymetry Change; T1 -T3

May 2003 survey subtracted from the January 2002 Survey.





FEATURE SOURCES:
Bathymetric Information: Multibeam bathymetric surveys conducted by
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Channel & River miles: Developed from USACOE information.
River Edge, Docks & In-water Structures: created by digitizing on October 2001
0.33 ft. resolution color orthophotos.
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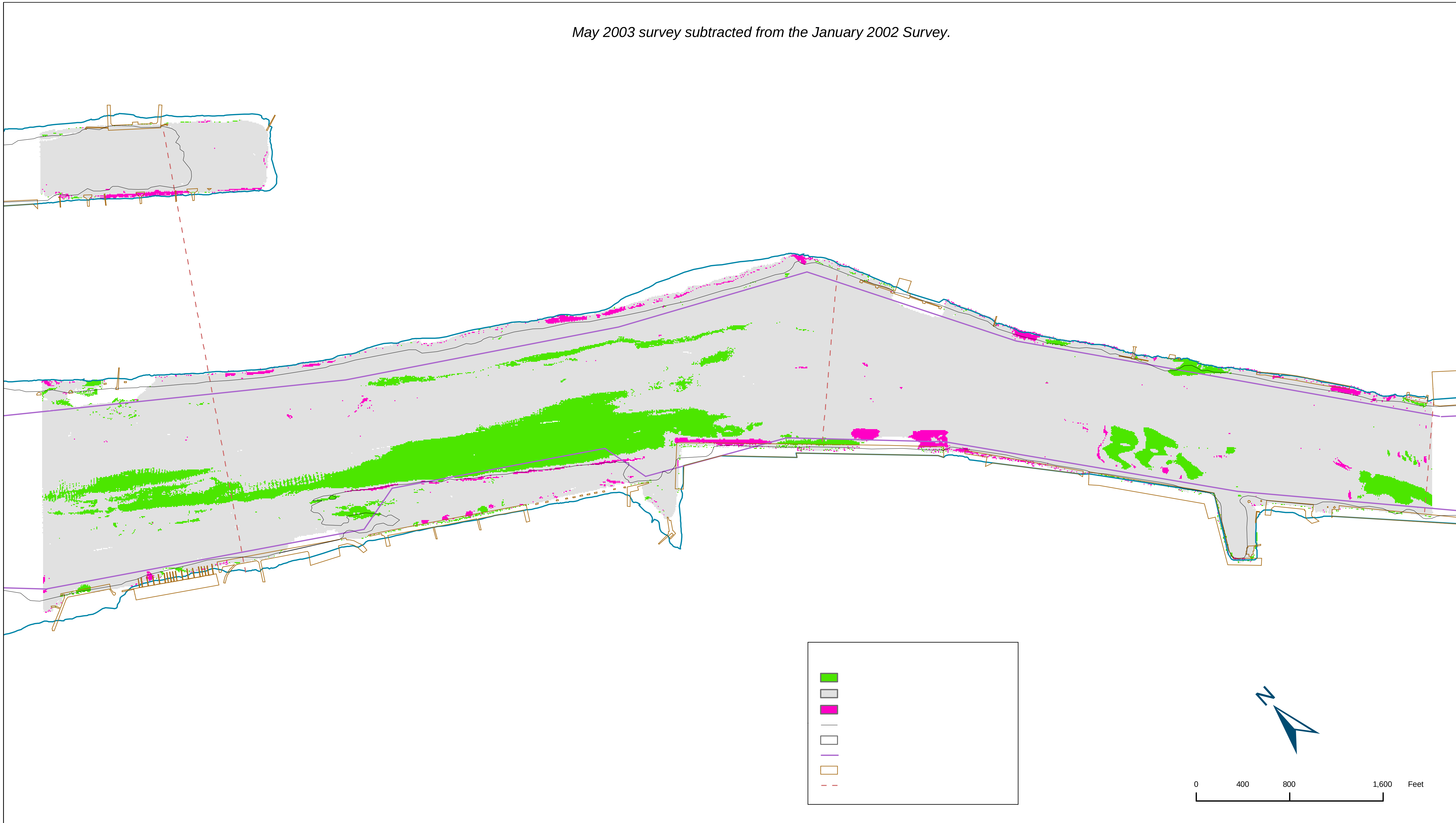
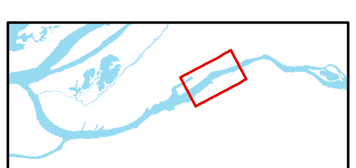
Figure 4d
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Generalized Bathymetry Change; T1 -T3

May 2003 survey subtracted from the January 2002 Survey.





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Channel & River miles: Developed from USACOE information.
River Edge, Docks & In-water Structures: created by digitizing on October 2001 0.33 ft. resolution color orthophotos.
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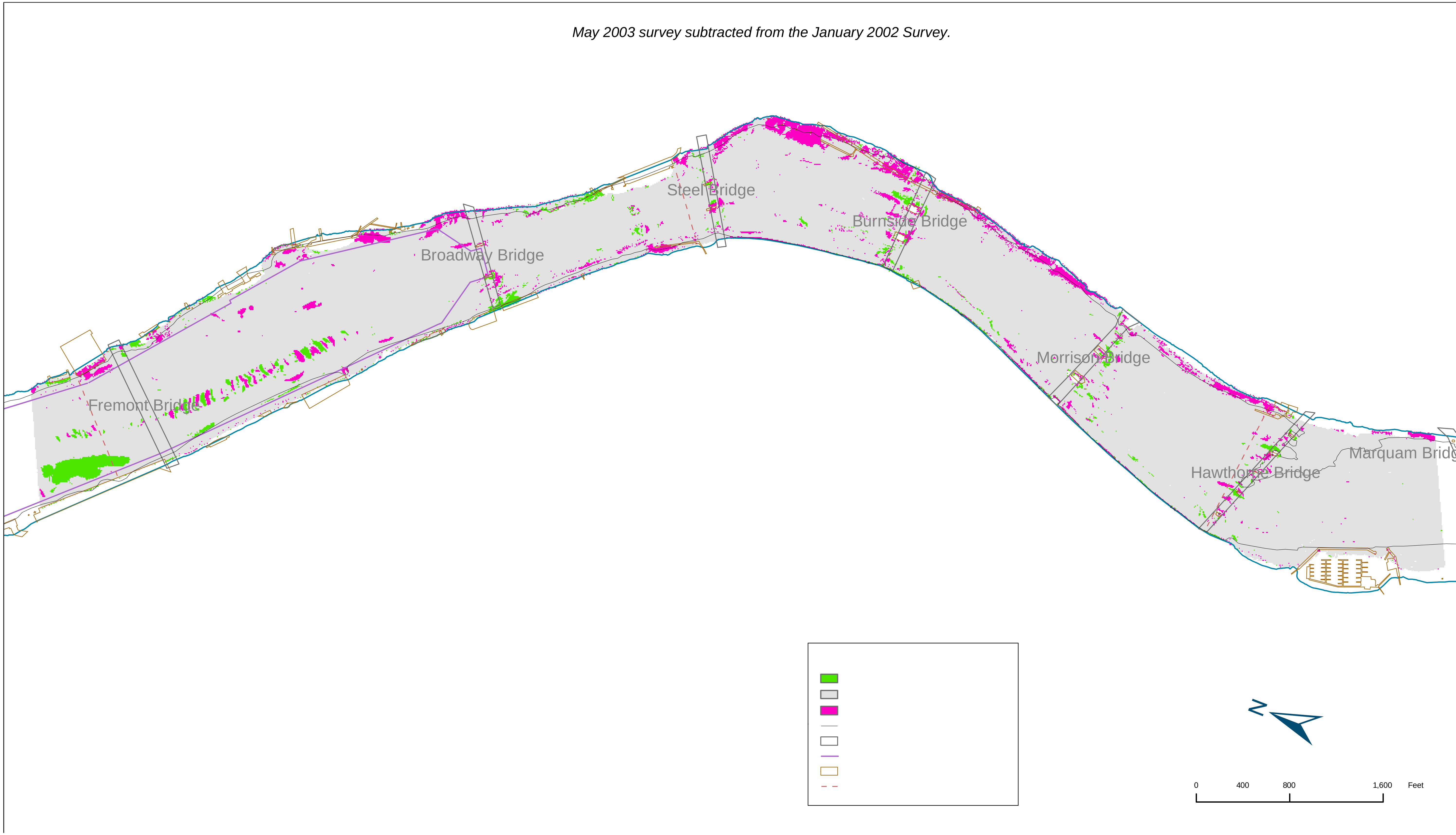
Figure 4e
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Generalized Bathymetry Change; T1 -T3

May 2003 survey subtracted from the January 2002 Survey.



FEATURE SOURCES:
Bathymetric Information: Multibeam bathymetric surveys conducted by
David Evans and Associates, Inc. Dec, 2001/Jan, 2002, July/Sept 2002, AND mAY 2003.
Difference in bathymetry: 1 Meter grid values of the May 2003 survey
were subtracted from the January 2002 survey to produce the difference grid.
Seven overlaping data files are shown in these data sheets.
Transportation, Water, Property, Zoning or Boundaries: Metro RLIS .
Channel & River miles: Developed from USACOE information.
River Edge, Docks & In-water Structures: created by digitizing on October 2001
0.33 ft. resolution color orthophotos.
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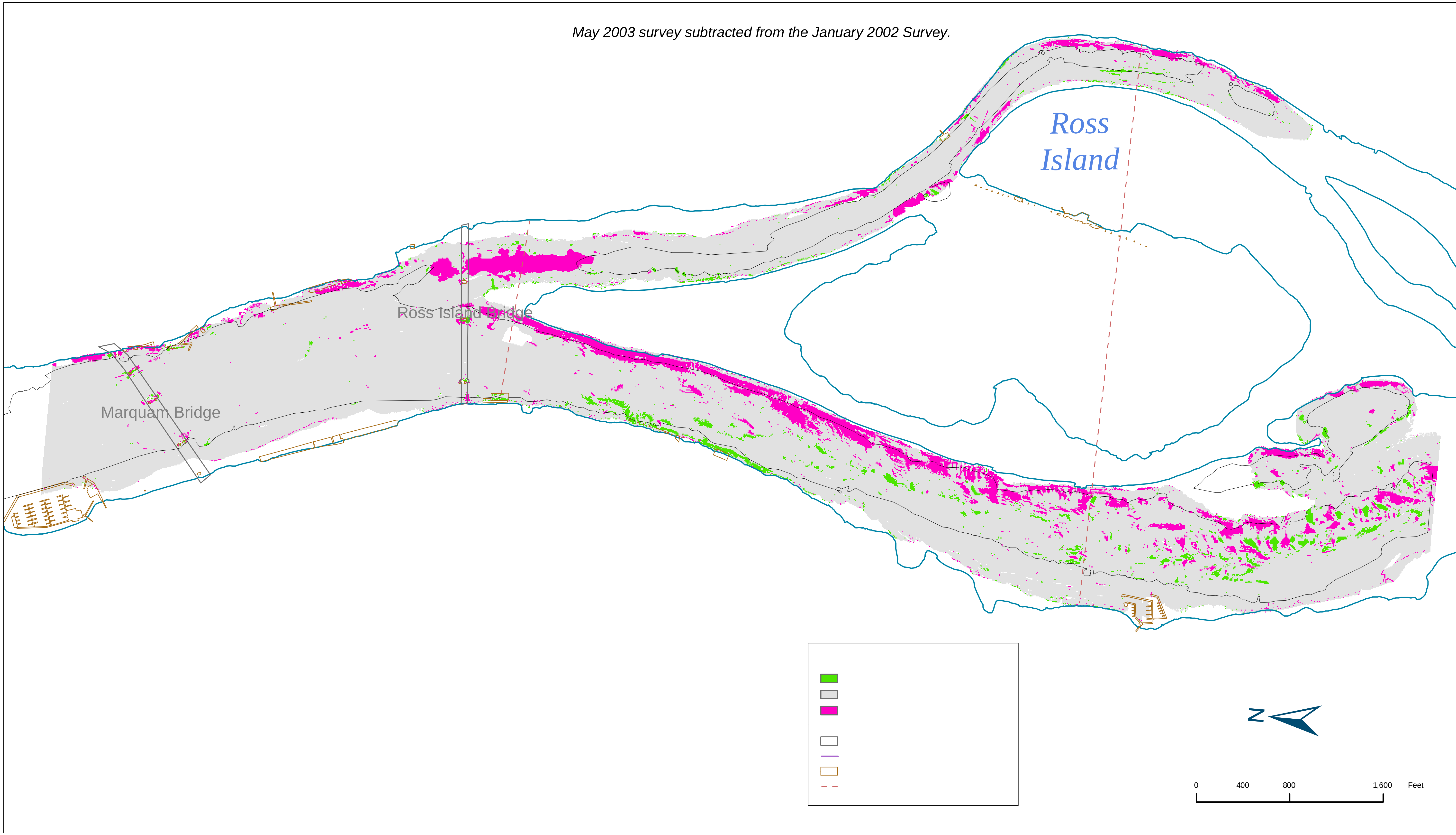
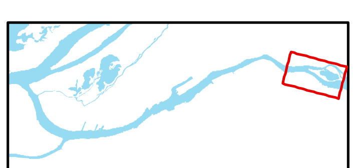
PLOT DATE: 09/11/03

Figure 4f
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Generalized Bathymetry Change; T1 -T3





FEATURE SOURCES:
Bathymetric Information: Multibeam bathymetric surveys conducted by
David Evans and Associates, Inc. Dec, 2001/Jan, 2002, July/Sept 2002, AND mAY 2003.
Difference in bathymetry: 1 Meter grid values of the May 2003 survey
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River Edge, Docks & In-water Structures: created by digitizing on October 2001
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File name: 3_Figure_3a-g_change-3classes-workmap.mxd
PLOT DATE: 09/11/03

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Figure 4g
Portland Harbor RI/FS
Round 2 Field Sampling Plan Appendix B
Generalized Bathymetry Change; T1 -T3

Table 1a. Evaluation of T1T3 Bathymetric Change in Nearshore (<20' CRD) Areas Based on 1 Square Mile Cell Counts.

	River Mile																
Bathymetric Change	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	16664	26293	71142	66295	21450	18996	40259	32334	51801	58267	13116	18190	2734	66756	162427	666,724	
Shallowing (# of cells)																	% Shallowing (cumulative)
-0.5 - -0.25	6561	6036	2795	8131	7392	4218	5753	6283	8691	18643	5781	5735	699	8543	33486	128,747	42.02
-1 - -0.5	8633	4152	2497	5847	8296	3695	3576	6351	6836	19396	4062	5431	839	5677	27968	113,256	78.98
-2 - -1	4160	1370	721	2573	8314	1219	1873	5140	4207	4087	2560	1866	513	1421	10108	50,132	95.34
-3 - -2	84	226	67	436	2100	244	459	1218	946	328	440	403	163	277	799	8,190	98.01
-4 - -3	14	1	10	130	1233	118	129	175	248	112	211	148	78	38	125	2,770	98.91
-5 - -4	1	0	5	68	633	21	69	27	79	13	215	103	46	20	41	1,341	99.35
-6 - -5	0	0	3	44	443	5	17	6	36	4	151	79	36	7	14	845	99.63
-7 - -6	1	0	4	25	276	2	2	0	18	1	113	57	18	13	14	544	99.80
-8 - -7	0	0	4	27	69	2	0	0	8	1	53	35	20	9	9	237	99.88
-9 - -8	0	0	6	31	32	1	1	0	11	0	17	12	6	4	8	129	99.92
-10 - -9	2	0	2	27	5	4	0	0	12	0	11	6	10	0	1	80	99.95
-30 - -10	1	0	3	79	3	2	0	0	31	8	2	5	19	0	3	156	100.00
-55 - -30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00
Total cells shallowing	19457	11785	6117	17418	28796	9531	11879	19200	21123	42593	13616	13880	2447	16009	72576	306,427	
Deepening (# of cells)																	% Deepening (cumulative)
0.5-0.25	7771	29020	36516	34691	5724	8511	16839	15795	25297	39749	3785	4261	2458	32472	55159	318,048	44.17
0.5-1	20825	20981	12658	11946	7904	9139	14455	13588	19637	13738	4835	4310	8471	14287	40769	217,543	74.38
1-2	13115	4754	4758	4772	5068	6752	5304	4114	7159	6907	3876	3713	10620	9320	33144	123,376	91.51
2 - 3	3552	1896	753	1376	1114	1166	1054	1098	2290	2034	798	1202	2332	2784	7472	30,921	95.80
3 - 4	1657	735	269	440	366	345	302	349	781	488	244	403	1024	1418	1911	10,732	97.29
4 - 5	494	252	43	115	162	104	60	65	425	43	66	135	520	910	1135	4,529	97.92
5 - 6	136	163	4	77	101	27	13	18	252	14	27	39	292	875	860	2,898	98.33
6 - 7	58	67	4	32	38	12	3	7	141	2	8	16	184	975	802	2,349	98.65
7 - 8	15	38	6	20	22	3	1	4	87	0	3	2	117	1173	1135	2,626	99.02
8 - 9	14	22	0	13	15	2	3	0	65	0	2	0	78	996	987	2,197	99.32
9 - 10	5	21	1	7	16	1	0	0	43	0	1	0	40	966	1004	2,105	99.61
10-45	6	26	0	48	22	0	6	0	105	0	0	3	10	1170	1383	2,779	100.00
Total cells deepening	47648	57975	55012	53537	20552	26062	38040	35038	56282	62975	13645	14084	26146	67346	145761	720,103	
TOTAL CELLS	83769	96053	132271	137250	70798	54589	90178	86572	129206	163835	40377	46154	31327	150111	380764	1,693,254	

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	20%	27%	54%	48%	30%	35%	45%	37%	40%	36%	32%	39%	9%	44%	43%	39%
Shallowing	23%	12%	5%	13%	41%	17%	13%	22%	16%	26%	34%	30%	8%	11%	19%	18%
Deepening	57%	60%	42%	39%	29%	48%	42%	40%	44%	38%	34%	31%	83%	45%	38%	43%

Total Shallowing, Deepening (> +/- 1ft)/Total	14.7%	
Total Nearshore Area with Shallowing, Deep	248,936	square meters

Table 1b. Evaluation of T1T3 Bathymetric Change in Channel (>20' CRD) Areas Based on 1 Square Mile Cell Counts.

	River Mile																
Bathymetric Change	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	335378	257284	321040	531479	481753	269890	348508	588033	551284	192254	204219	154848	214730	242357	226113	4,919,170	
Shallowing (# of cells)																	% Shallowing (cumulative)
-0.5 - -0.25	24699	82110	163614	114358	152660	20730	20702	75982	137703	73518	26656	23842	19651	13093	53070	1,002,388	50.57
-1 - -0.5	11432	80569	112159	17943	72232	12437	8898	20692	131677	121625	23527	17356	10306	6484	45440	692,777	85.53
-2 - -1	2836	7480	6496	3093	9511	5074	2119	4564	37498	117795	19847	6906	4412	1793	18600	248,024	98.04
-3 - -2	88	59	281	127	1073	1205	503	133	1458	18087	4854	2160	741	540	1642	32,951	99.70
-4 - -3	7	2	147	38	374	436	185	16	344	137	500	432	192	179	137	3,126	99.86
-5 - -4	1	0	53	28	191	63	61	5	60	41	153	169	85	94	37	1,041	99.91
-6 - -5	0	1	32	20	79	1	35	2	22	12	102	92	49	34	24	505	99.94
-7 - -6	0	1	33	22	56	2	34	1	5	4	108	55	29	23	6	379	99.96
-8 - -7	0	3	58	8	36	1	20	1	4	0	130	41	11	17	16	346	99.98
-9 - -8	0	1	11	5	14	0	12	0	1	0	25	26	9	15	14	133	99.98
-10 - -9	0	0	1	1	11	0	14	0	0	0	0	19	8	12	5	71	99.99
-30 - -10	0	5	0	5	6	0	89	4	1	0	0	86	3	61	22	282	100.00
-55 - -30	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	100.00
Total cells shallowing	39063	170231	282885	135649	236243	39949	32672	101400	308773	331219	75902	51184	35496	22345	119013	1,982,024	
Deepening (# of cells)																	% Deepening (cumulative)
0.5-0.25	70439	127467	80254	39020	32456	159525	133838	125725	167625	83692	176657	145940	117417	115054	90756	1,665,865	66.74
0.5-1	48486	62976	26495	15050	15234	54759	33829	34937	41085	28178	54707	50497	61281	31716	82264	641,494	92.45
1-2	12120	8982	9282	3248	6787	6674	3794	9461	5000	2489	5765	11939	16857	4616	46653	153,667	98.60
2 - 3	1702	643	701	712	2181	200	487	1585	669	1393	1927	1987	2261	409	4278	21,135	99.45
3 - 4	579	150	90	152	748	17	142	978	97	195	217	618	912	127	315	5,337	99.66
4 - 5	328	104	59	41	260	8	101	880	36	10	0	362	428	70	193	2,880	99.78
5 - 6	354	92	37	18	115	1	78	504	22	0	0	239	168	33	222	1,883	99.85
6 - 7	276	73	28	12	57	0	53	534	5	0	1	138	96	27	72	1,372	99.91
7 - 8	64	36	17	3	46	1	31	359	6	0	0	127	55	26	4	775	99.94
8 - 9	0	14	15	0	28	0	32	292	2	0	0	92	54	18	3	550	99.96
9 - 10	0	2	11	1	13	0	19	100	1	0	0	15	62	24	3	251	99.97
10-45	1	0	4	1	38	0	68	35	8	0	0	59	412	41	5	672	100.00
Total cells deepening	134349	200539	116993	58258	57963	221185	172472	175390	214556	115957	239274	212013	200003	152161	224768	2,495,881	
TOTAL CELLS	508790	628054	720918	725386	775959	531024	553652	864823	1074613	639430	519395	418045	450229	416863	569894	9,397,075	

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	66%	41%	45%	73%	62%	51%	63%	68%	51%	30%	39%	37%	48%	58%	40%	52%
Shallowing	8%	27%	39%	19%	30%	8%	6%	12%	29%	52%	15%	12%	8%	5%	21%	21%
Deepening	26%	32%	16%	8%	7%	42%	31%	20%	20%	18%	46%	51%	44%	37%	39%	27%

Total Shallowing, Deepening (> +/- 1ft)/Total 5.1%
Total Channel Area with Shallowing, Deepen 475,380 square meters

Table 2a. Evaluation of T2T3 Bathymetric Change in Nearshore (<20' CRD) Areas Based on 1 Square Mile Cell Counts.

	River Mile																
Bathymetric Change	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	49119	72343	122723	108495	47134	40003	77690	65662	84225	98015	15887	12227	10328	94031	208523	1,106,405	
Shallowing (# of cells)																	% Shallowing (cumulative)
-0.5 - -0.25	6804	6102	11560	15420	11639	4079	7151	7212	6387	21633	4562	11765	2895	14496	38559	170,264	55.40
-1 - -0.5	4893	2642	4273	5996	5567	1815	2572	2575	3651	22994	4253	11386	2651	6924	20618	102,810	88.85
-2 - -1	2401	629	1148	2099	1602	591	774	1072	1703	2027	942	2806	1646	1838	5638	26,916	97.61
-3 - -2	153	114	128	408	223	59	144	115	462	243	278	496	612	268	619	4,322	99.02
-4 - -3	14	2	43	152	74	24	41	13	158	111	98	190	341	80	77	1,418	99.48
-5 - -4	4	0	34	68	40	24	17	6	47	47	33	67	183	51	12	633	99.68
-6 - -5	0	0	49	60	34	15	6	2	16	19	14	30	42	18	3	308	99.78
-7 - -6	0	0	31	55	16	12	3	2	14	2	10	14	27	20	2	208	99.85
-8 - -7	0	0	16	25	21	8	4	0	5	0	1	13	15	8	3	119	99.89
-9 - -8	0	0	7	23	6	7	5	0	3	0	0	14	10	1	1	77	99.91
-10 - -9	0	0	11	10	7	3	2	0	2	1	0	4	4	0	0	44	99.93
-30 - -10	0	0	17	43	60	1	4	0	10	10	0	33	36	0	0	214	100.00
-55 - -30	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	100.00
Total cells shallowing	14269	9489	17317	24363	19289	6638	10723	10997	12458	47087	10191	26818	8462	23704	65532	307,337	
Deepening (# of cells)																	% Deepening (cumulative)
0.5-0.25	7288	10435	5408	9583	8214	10466	16379	13275	27122	16391	5148	1844	2826	13905	38389	186,673	54.38
0.5-1	2215	1285	2507	6479	5702	4632	5353	7474	13213	8724	4985	1452	3280	6965	20307	94,573	81.93
1-2	384	320	870	2902	3313	1371	1590	1973	5328	3454	3835	946	1833	3370	4523	36,012	92.43
2 - 3	51	98	207	583	499	247	175	393	959	679	957	241	200	1433	923	7,645	94.65
3 - 4	26	41	85	205	142	62	55	173	340	166	204	103	35	899	687	3,223	95.59
4 - 5	4	2	2	66	51	14	33	62	295	60	76	24	20	795	742	2,246	96.25
5 - 6	1	1	0	37	24	3	10	42	181	26	36	9	7	910	691	1,978	96.82
6 - 7	0	0	0	13	12	0	7	30	174	7	14	5	0	966	677	1,905	97.38
7 - 8	2	1	0	13	6	0	2	15	126	2	1	3	4	1169	953	2,297	98.05
8 9	0	0	0	9	3	1	2	8	95	1	0	4	2	969	998	2,092	98.66
9 - 10	0	0	0	0	0	0	0	9	75	0	0	4	0	986	1287	2,361	99.34
10-45	0	0	0	22	4	0	0	4	118	0	0	4	0	886	1213	2,251	100.00
Total cells deepening	9971	12183	9079	19912	17970	16796	23606	23458	48026	29510	15256	4639	8207	33253	71390	343,256	
TOTAL CELLS	73359	94015	149119	152770	84393	63437	112019	100117	144709	174612	41334	43684	26997	150988	345445	1,756,998	

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	67%	77%	82%	71%	56%	63%	69%	66%	58%	56%	38%	28%	38%	62%	60%	63%
Shallowing	19%	10%	12%	16%	23%	10%	10%	11%	9%	27%	25%	61%	31%	16%	19%	17%
Deepening	14%	13%	6%	13%	21%	26%	21%	23%	33%	17%	37%	11%	30%	22%	21%	20%

Total Shallowing, Deepening (> +/- 1ft)/To	5.5%	
Total Nearshore Area with Shallowing, De	96,273	square meters

Table 2b. Evaluation of T2T3 Bathymetric Change in Channel (>20' CRD) Areas Based on 1 Square Mile Cell Counts.

	River Mile															
Bathymetric Change	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	417207	520466	375908	525971	518300	426913	473260	657326	630943	239148	281065	291287	322733	330365	313145	6,324,037	
Shallowing (# of cells)																	% Shallowing (cumulative)
-0.5 - -0.25	3954	71645	233995	167977	219875	30406	22284	117282	158161	71559	35958	21954	36748	14115	50044	1,255,957	64.48
-1 - -0.5	1135	12155	104465	15887	16101	11128	3308	22493	105198	112018	30630	10349	12131	4334	29884	491,216	89.70
-2 - -1	468	525	1203	388	479	2834	1421	1412	19218	122721	19572	5790	3534	1144	6333	187,042	99.30
-3 - -2	77	20	22	95	76	729	390	110	569	3345	836	2233	635	309	354	9,800	99.81
-4 - -3	4	2	1	28	24	324	217	6	80	11	66	612	184	147	130	1,836	99.90
-5 - -4	1	0	0	12	18	39	79	7	21	0	2	145	92	114	60	590	99.93
-6 - -5	0	0	1	8	9	21	55	10	12	0	0	84	58	67	13	338	99.95
-7 - -6	0	0	0	3	17	2	54	4	12	0	0	53	45	29	9	228	99.96
-8 - -7	0	0	0	1	9	0	50	2	14	0	0	39	37	11	5	168	99.97
-9 - -8	1	0	0	0	11	0	42	0	15	0	0	33	14	13	4	133	99.98
-10 - -9	0	0	0	0	2	0	28	0	9	0	0	30	7	7	4	87	99.98
-30 - -10	0	0	0	0	6	0	212	0	20	0	0	104	5	12	5	364	100.00
-55 - -30	0	0	0	1	0	0	7	0	0	0	0	0	0	0	0	8	100.00
Total cells shallowin	5640	84347	339687	184400	236627	45483	28147	141326	283329	309654	87064	41426	53490	20302	86845	1,947,767	
Deepening (# of cells)																	% Deepening (cumulative)
0.5-0.25	80735	31347	9976	6221	13424	43511	40957	56841	140268	84126	114304	63833	52819	54769	107792	900,923	77.85
0.5-1	8539	2432	1284	1754	6851	12203	7563	9117	18460	7994	32977	16455	14042	9142	58601	207,414	95.78
1-2	536	769	246	592	2952	2557	2672	968	4403	637	3635	5792	4058	1251	9257	40,325	99.26
2 - 3	41	145	66	112	626	72	394	86	501	122	347	2284	638	159	554	6,147	99.79
3 - 4	9	42	42	47	280	18	43	19	107	46	14	349	188	83	70	1,357	99.91
4 - 5	0	29	9	24	129	2	13	5	19	12	1	66	61	33	15	418	99.95
5 - 6	0	16	0	8	43	0	4	7	8	2	0	32	45	16	9	190	99.96
6 - 7	0	2	0	6	6	0	0	8	8	0	0	19	31	16	9	105	99.97
7 - 8	0	0	0	5	4	0	0	0	2	0	0	24	21	5	5	66	99.98
8 - 9	0	0	0	1	5	0	0	0	1	0	0	32	12	4	3	58	99.98
9 - 10	0	0	0	0	2	0	0	0	3	0	0	27	8	3	3	46	99.99
10-45	0	0	0	2	1	0	0	0	19	0	0	101	11	3	16	153	100.00
Total cells deepenin	89860	34782	11623	8772	24323	58363	51646	67051	163799	92939	151278	89014	71934	65484	176334	1,157,202	
TOTAL CELLS	512707	639595	727218	719143	779250	530759	553053	865703	1078071	641741	519407	421727	448157	416151	576324	9,429,006	

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	81%	81%	52%	73%	67%	80%	86%	76%	59%	37%	54%	69%	72%	79%	54%	67%
Shallowing	1%	13%	47%	26%	30%	9%	5%	16%	26%	48%	17%	10%	12%	5%	15%	21%
Deepening	18%	5%	2%	1%	3%	11%	9%	8%	15%	14%	29%	21%	16%	16%	31%	12%

Total Shallowing, Deepening (> +/- 1ft)/Total 2.6%
Total Channel Area with Shallowing, Deeper 249,451 square meters

Table 3a. Evaluation of T1T3 Bathymetric Change and Dredged Area Deepening in Nearshore (<20' CRD) Areas Based on 1 Square Mile Cell Counts.

	River Mile																
Bathymetric Change	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	16664	26293	71142	64845	20729	17369	39884	32334	51801	58267	13116	18146	2420	66655	162427	662,092	
Shallowing (# of cells)																	% Shallowing (cumulative)
-0.5 - -0.25	6561	6036	2795	7455	6798	4021	5705	6283	8691	18643	5781	5674	626	8530	33486	127,085	42.88
-1 - -0.5	8633	4152	2497	5023	7204	3561	3542	6351	6836	19396	4062	5349	732	5657	27968	110,963	80.32
-2 - -1	4160	1370	721	1961	6923	1152	1852	5140	4207	4087	2560	1737	430	1404	10108	47,812	96.45
-3 - -2	84	226	67	312	1033	234	455	1218	946	328	440	320	138	277	799	6,877	98.77
-4 - -3	14	1	10	93	417	117	129	175	248	112	211	97	71	38	125	1,858	99.40
-5 - -4	1	0	5	56	104	19	69	27	79	13	215	37	43	20	41	729	99.64
-6 - -5	0	0	3	43	12	5	17	6	36	4	151	20	34	7	14	352	99.76
-7 - -6	1	0	4	25	15	2	2	0	18	1	113	20	15	13	14	243	99.84
-8 - -7	0	0	4	27	2	2	0	0	8	1	53	7	15	9	9	137	99.89
-9 - -8	0	0	6	31	2	1	1	0	11	0	17	7	6	4	8	94	99.92
-10 - -9	2	0	2	27	3	4	0	0	12	0	11	6	10	0	1	78	99.95
-30 - -10	1	0	3	79	3	2	0	0	31	8	2	5	19	0	3	156	100.00
-55 - -30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00
Total cells shallowing	19457	11785	6117	15132	22516	9120	11772	19200	21123	42593	13616	13279	2139	15959	72576	296,384	
Deepening (# of cells)																	% Deepening (cumulative)
0.5-0.25	7771	29020	36516	34473	5301	6966	16696	15795	25297	39749	3785	4247	2084	32414	55159	315,273	45.05
0.5-1	20825	20981	12658	11788	6289	5988	14396	13588	19637	13738	4835	4306	7574	14233	40769	211,605	75.29
1-2	13115	4754	4758	4681	3363	3412	5226	4114	7159	6907	3876	3711	8370	9290	33144	115,880	91.85
2 - 3	3552	1896	753	1324	803	604	996	1098	2290	2034	798	1202	1392	2780	7472	28,994	95.99
3 - 4	1657	735	269	435	235	214	288	349	781	488	244	403	447	1412	1911	9,868	97.40
4 - 5	494	252	43	115	49	47	60	65	425	43	66	135	179	905	1135	4,013	97.97
5 - 6	136	163	4	77	30	17	13	18	252	14	27	39	82	870	860	2,602	98.34
6 - 7	58	67	4	32	15	11	3	7	141	2	8	16	25	970	802	2,161	98.65
7 8	15	38	6	20	14	3	1	4	87	0	3	2	3	1170	1135	2,501	99.01
8 9	14	22	0	13	8	2	3	0	65	0	2	0	1	994	987	2,111	99.31
9 10	5	21	1	7	15	1	0	0	43	0	1	0	0	963	1004	2,061	99.61
10-45	6	26	0	48	17	0	6	0	105	0	0	3	1	1164	1383	2,759	100.00
Total cells deepening	47648	57975	55012	53013	16139	17265	37688	35038	56282	62975	13645	14064	20158	67165	145761	699,828	
TOTAL CELLS	83769	96053	132271	132990	59384	43754	89344	86572	129206	163835	40377	45489	24717	149779	380764	1,658,304	

Table 3a. Evaluation of T1T3 Bathymetric Change and Dredged Area Deepening in Nearshore (<20' CRD) Areas Based on 1 Square Mile Cell Counts.

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	20%	27%	54%	49%	35%	40%	45%	37%	40%	36%	32%	40%	10%	45%	43%	40%
Shallowing	23%	12%	5%	11%	38%	21%	13%	22%	16%	26%	34%	29%	9%	11%	19%	18%
Deepening	57%	60%	42%	40%	27%	39%	42%	40%	44%	38%	34%	31%	82%	45%	38%	42%

Total Shallowing, Deepening (> +/- 1ft)/Total cells 13.9%
Total Nearshore Area with Shallowing, Deepening (> +/- 1ft) 231,286 square meters

Dredged Deepening	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7
0.5-0.25					41			57	39	16	55	34		940	496
0.5-1					256			221	51	53	77	63		1591	651
1-2					433			447	88	101	28	72		1924	577
2 - 3					47			221	111	21	4	44		1084	535
3 - 4					15			68	159	6	0	39		871	537
4 - 5					2			21	153	0	0	19		738	760
5 - 6					1			8	95	0	0	12		806	772
6 - 7					0			3	41	0	0	3		953	775
7 - 8					0			2	23	0	0	0		1163	1128
8 - 9					0			0	14	0	0	0		992	986
9 - 10					0			0	7	0	0	0		961	1005
10-45					0			0	42	0	0	3		1140	1382
Total cells in dredged areas					795			1048	823	197	164	289		13163	9604
Dredged/Total Deepening Cells					4.9%			3.0%	1.5%	0.3%	1.2%	2.1%		19.6%	6.6%

Table 3b. Evaluation of T1T3 Bathymetric Change and Dredged Area Deepening in Channel (>20' CRD) Areas Based on 1 Square Mile Cell Counts.

	River Mile															
Bathymetric Change	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	335378	257284	321040	531419	480841	269175	348317	588033	551284	188467	204219	154352	211822	241435	226113	4,909,179	
																	% Shallowing (cumulative)
Shallowing (# of cells)																	
-0.5 - -0.25	24699	82110	163614	114282	152363	20670	20641	75982	137703	73516	26656	23521	19470	12892	53070	1,001,189	50.78
-1 - -0.5	11432	80569	112159	17368	70711	12388	8820	20692	131677	121625	23527	16694	10149	6248	45440	689,499	85.75
-2 - -1	2836	7480	6496	2904	7325	5068	2031	4564	37498	117795	19847	6120	4295	1584	18600	244,443	98.14
-3 - -2	88	59	281	127	465	1205	441	133	1458	18087	4854	1892	704	441	1642	31,877	99.76
-4 - -3	7	2	147	38	171	436	147	16	344	137	500	350	172	88	137	2,692	99.90
-5 - -4	1	0	53	28	98	63	39	5	60	41	153	112	62	30	37	782	99.94
-6 - -5	0	1	32	20	54	1	20	2	22	12	102	61	27	10	24	388	99.96
-7 - -6	0	1	33	22	50	2	15	1	5	4	108	32	22	2	6	303	99.97
-8 - -7	0	3	58	8	36	1	9	1	4	0	130	31	7	3	16	307	99.99
-9 - -8	0	1	11	5	14	0	1	0	1	0	25	20	6	2	14	100	99.99
-10 - -9	0	0	1	1	11	0	3	0	0	0	0	14	1	2	5	38	99.99
-30 - -10	0	5	0	5	5	0	1	4	1	0	0	51	0	25	22	119	100.00
-55 - -30	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	100.00
Total cells shallowing	39063	170231	282885	134809	231303	39834	32168	101400	308773	331217	75902	48898	34915	21327	119013	1,971,738	
																	% Deepening (cumulative)
Deepening (# of cells)																	
0.5-0.25	70439	127467	80254	39013	31269	158453	133718	125725	167625	81176	176657	145830	113909	114604	90756	1,656,895	67.20
0.5-1	48486	62976	26495	15048	14689	53196	33677	34937	41085	28167	54707	50398	54432	31198	82264	631,755	92.82
1-2	12120	8982	9282	3247	6535	6054	3637	9461	5000	2488	5765	11884	11187	4158	46653	146,453	98.76
2 - 3	1702	643	701	712	2116	150	386	1585	669	1393	1927	1961	1205	277	4278	19,705	99.56
3 - 4	579	150	90	152	694	14	87	978	97	195	217	593	242	67	315	4,470	99.74
4 - 5	328	104	59	41	185	3	54	880	36	10	0	340	107	34	193	2,374	99.83
5 - 6	354	92	37	18	44	1	33	504	22	0	0	226	48	14	222	1,615	99.90
6 - 7	276	73	28	12	2	0	14	534	5	0	1	126	31	10	72	1,184	99.95
7 - 8	64	36	17	3	0	1	10	359	6	0	0	116	18	2	4	636	99.97
8 - 9	0	14	15	0	0	0	6	292	2	0	0	80	15	0	3	427	99.99
9 - 10	0	2	11	1	0	0	0	100	1	0	0	7	10	1	3	136	100.00
10-45	1	0	4	1	0	0	0	35	8	0	0	40	1	0	5	95	100.00
Total cells deepening	134349	200539	116993	58248	55534	217872	171622	175390	214556	113429	239274	211601	181205	150365	224768	2,465,745	
TOTAL CELLS	508790	628054	720918	724476	767678	526881	552107	864823	1074613	633113	519395	414851	427942	413127	569894	9,346,662	

Table 3b. Evaluation of T1T3 Bathymetric Change and Dredged Area Deepening in Channel (>20' CRD) Areas Based on 1 Square Mile Cell Counts.

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	66%	41%	45%	73%	63%	51%	63%	68%	51%	30%	39%	37%	49%	58%	40%	53%
Shallowing	8%	27%	39%	19%	30%	8%	6%	12%	29%	52%	15%	12%	8%	5%	21%	21%
Deepening	26%	32%	16%	8%	7%	41%	31%	20%	20%	18%	46%	51%	42%	36%	39%	26%

Total Shallowing, Deepening (> +/- 1ft)/Total cells 4.9%
Total Channel Area with Shallowing, Deepening (> +/- 1ft) 458,144 square meters

Dredged Deepening	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7
0.5-0.25	107.00				841.00			3286		543	461	154		4	88
0.5-1	131.00				1920.00			11614		902	972	241		9	163
1-2	223.00				1838.00			7903		1438	3046	405		8	181
2 - 3	241.00				1129.00			1477		1280	1870	304		9	125
3 - 4	293.00				337.00			956		177	214	247		8	110
4 - 5	286.00				99.00			869		0	0	274		9	147
5 - 6	342.00				33.00			502		0	0	209		6	218
6 - 7	263.00				1.00			533		0	0	108		7	71
7 - 8	63.00				0.00			359		0	0	108		0	0
8 - 9	0.00				0.00			292		0	0	70		0	0
9 - 10	0.00				0.00			100		0	0	1		0	0
10-45	0.00				0.00			32		0	0	0		0	0
Total cells deepening	1949.00				6198.00			27923		4340	6563	2121		60	1103
Dredged/Total Deepenin	1.5%				11.2%			15.9%		3.8%	2.7%	1.0%		0.0%	0.5%

Table 4a. Evaluation of T1T3 Bathymetric Change in Nearshore (<20' CRD) Areas Based on 1 Square Mile Cell Counts, Revised Data*.

Bathymetric Change	River Mile 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	16664	26293	71142	64845	20729	17369	39884	32334	51801	58267	13116	18146	2420	66655	162427	662,092	
Shallowing (# of cells)																	% Shallowing (cumulative)
-0.5 - -0.25	6561	6036	2795	7455	6798	4021	5705	6283	8691	18643	5781	5674	626	8530	33486	127,085	42.88
-1 - -0.5	8633	4152	2497	5023	7204	3561	3542	6351	6836	19396	4062	5349	732	5657	27968	110,963	80.32
-2 - -1	4160	1370	721	1961	6923	1152	1852	5140	4207	4087	2560	1737	430	1404	10108	47,812	96.45
-3 - -2	84	226	67	312	1033	234	455	1218	946	328	440	320	138	277	799	6,877	98.77
-4 - -3	14	1	10	93	417	117	129	175	248	112	211	97	71	38	125	1,858	99.40
-5 - -4	1	0	5	56	104	19	69	27	79	13	215	37	43	20	41	729	99.64
-6 - -5	0	0	3	43	12	5	17	6	36	4	151	20	34	7	14	352	99.76
-7 - -6	1	0	4	25	15	2	2	0	18	1	113	20	15	13	14	243	99.84
-8 - -7	0	0	4	27	2	2	0	0	8	1	53	7	15	9	9	137	99.89
-9 - -8	0	0	6	31	2	1	1	0	11	0	17	7	6	4	8	94	99.92
-10 - -9	2	0	2	27	3	4	0	0	12	0	11	6	10	0	1	78	99.95
-30 - -10	1	0	3	79	3	2	0	0	31	8	2	5	19	0	3	156	100.00
-55 - -30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00
Total cells shallowing	19457	11785	6117	15132	22516	9120	11772	19200	21123	42593	13616	13279	2139	15959	72576	296,384	
Deepening (# of cells)																	% Deepening (cumulative)
0.5-0.25	7771	29020	36516	34473	5260	6966	16696	15738	25258	39733	3730	4213	2084	31474	54663	313,595	46.55
0.5-1	20825	20981	12658	11788	6033	5988	14396	13367	19586	13685	4758	4243	7574	12642	40118	208,642	77.51
1-2	13115	4754	4758	4681	2930	3412	5226	3667	7071	6806	3848	3639	8370	7366	32567	112,210	94.17
2 - 3	3552	1896	753	1324	756	604	996	877	2179	2013	794	1158	1392	1696	6937	26,927	98.16
3 - 4	1657	735	269	435	220	214	288	281	622	482	244	364	447	541	1374	8,173	99.38
4 - 5	494	252	43	115	47	47	60	44	272	43	66	116	179	167	375	2,320	99.72
5 - 6	136	163	4	77	29	17	13	10	157	14	27	27	82	64	88	908	99.86
6 - 7	58	67	4	32	15	11	3	4	100	2	8	13	25	17	27	386	99.91
7 8	15	38	6	20	14	3	1	2	64	0	3	2	3	7	7	185	99.94
8 9	14	22	0	13	8	2	3	0	51	0	2	0	1	2	1	119	99.96
9 - 10	5	21	1	7	15	1	0	0	36	0	1	0	0	2	-1	88	99.97
10-45	6	26	0	48	17	0	6	0	63	0	0	0	1	24	1	192	100.00
Total cells deepening	47648	57975	55012	53013	15344	17265	37688	33990	55459	62778	13481	13775	20158	54002	136157	673,745	
TOTAL CELLS	83769	96053	132271	132990	58589	43754	89344	85524	128383	163638	40213	45200	24717	136616	371160	1,632,221	

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	20%	27%	54%	49%	35%	40%	45%	38%	40%	36%	33%	40%	10%	49%	44%	41%
Shallowing	23%	12%	5%	11%	38%	21%	13%	22%	16%	26%	34%	29%	9%	12%	20%	18%
Deepening	57%	60%	42%	40%	26%	39%	42%	40%	43%	38%	34%	30%	82%	40%	37%	41%

Total Shallowing, Deepening (> +/- 1ft)/Total cells 12.9%

Total Nearshore Area with Shallowing, Deepening (> +/- 1ft) 209,844 square meters

* This dataset represents a revision of Table 1a to exclude dredged area and suspected erroneous data.

Table 4b. Evaluation of T1T3 Bathymetric Change in Channel (>20' CRD) Areas Based on 1 Square Mile Cell Counts, Revised Data*.

	River Mile																
Bathymetric Change	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	Totals	
No Change (# of cells)																	
+/- 0.25'	335378	257284	321040	531419	480841	269175	348317	588033	551284	188467	204219	154352	211822	241435	226113	4,909,179	
Shallowing (# of cells)																	% Shallowing (cumulative)
-0.5 - -0.25	24699	82110	163614	114282	152363	20670	20641	75982	137703	73516	26656	23521	19470	12892	53070	1,001,189	50.78
-1 - -0.5	11432	80569	112159	17368	70711	12388	8820	20692	131677	121625	23527	16694	10149	6248	45440	689,499	85.75
-2 - -1	2836	7480	6496	2904	7325	5068	2031	4564	37498	117795	19847	6120	4295	1584	18600	244,443	98.14
-3 - -2	88	59	281	127	465	1205	441	133	1458	18087	4854	1892	704	441	1642	31,877	99.76
-4 - -3	7	2	147	38	171	436	147	16	344	137	500	350	172	88	137	2,692	99.90
-5 - -4	1	0	53	28	98	63	39	5	60	41	153	112	62	30	37	782	99.94
-6 - -5	0	1	32	20	54	1	20	2	22	12	102	61	27	10	24	388	99.96
-7 - -6	0	1	33	22	50	2	15	1	5	4	108	32	22	2	6	303	99.97
-8 - -7	0	3	58	8	36	1	9	1	4	0	130	31	7	3	16	307	99.99
-9 - -8	0	1	11	5	14	0	1	0	1	0	25	20	6	2	14	100	99.99
-10 - -9	0	0	1	1	11	0	3	0	0	0	0	14	1	2	5	38	99.99
-30 - -10	0	5	0	5	5	0	1	4	1	0	0	51	0	25	22	119	100.00
-55 - -30	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	100.00
Total cells shallowing	39063	170231	282885	134809	231303	39834	32168	101400	308773	331217	75902	48898	34915	21327	119013	1,971,738	
Deepening (# of cells)																	% Deepening (cumulative)
0.5-0.25	70332	127467	80254	39013	30428	158453	133718	122439	167625	80633	176196	145676	113909	114600	90668	1,651,411	68.37
0.5-1	48355	62976	26495	15048	12769	53196	33677	23323	41085	27265	53735	50157	54432	31189	82101	615,803	93.86
1-2	11897	8982	9282	3247	4697	6054	3637	1558	5000	1050	2719	11479	11187	4150	46472	131,411	99.30
2 - 3	1461	643	701	712	987	150	386	108	669	113	57	1657	1205	268	4153	13,270	99.85
3 - 4	286	150	90	152	357	14	87	22	97	18	3	346	242	59	205	2,128	99.94
4 - 5	42	104	59	41	86	3	54	11	36	10	0	66	107	25	46	690	99.97
5 - 6	12	92	37	18	11	1	33	2	22	0	0	17	48	8	4	305	99.98
6 7	13	73	28	12	1	0	14	1	5	0	1	18	31	3	1	201	99.99
7 8	1	36	17	3	0	1	10	0	6	0	0	8	18	2	4	106	99.99
8 9	0	14	15	0	0	0	6	0	2	0	0	10	15	0	3	65	100.00
9 - 10 -	0	2	11	1	0	0	0	0	1	0	0	6	10	1	3	35	100.00
10-45 -	1	0	4	1	0	0	0	3	8	0	0	40	1	0	5	63	100.00
Total cells deepening	132400	200539	116993	58248	49336	217872	171622	147467	214556	109089	232711	209480	181205	150305	223665	2,415,488	
TOTAL CELLS	506841	628054	720918	724476	761480	526881	552107	836900	1074613	628773	512832	412730	427942	413067	568791	9,296,405	

Percentages	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	66%	41%	45%	73%	63%	51%	63%	70%	51%	30%	40%	37%	49%	58%	40%	53%
Shallowing	8%	27%	39%	19%	30%	8%	6%	12%	29%	53%	15%	12%	8%	5%	21%	21%
Deepening	26%	32%	16%	8%	6%	41%	31%	18%	20%	17%	45%	51%	42%	36%	39%	26%

Total Shallowing, Deepening (> +/- 1ft)/Total cells 4.6%
Total Channel Area with Shallowing, Deepening (> +/- 1ft) 429,323 square meters

* This dataset represents a revision of Table 1b to exclude dredged areas and suspected erroneous data.

Table 5. Comparison of Change Statistics per River Mile from Original and Revised T1T3 Data Sets, Nearshore and Channel Zones.

Nearshore

Original Dataset																
River Mile:	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	20%	27%	54%	48%	30%	35%	45%	37%	40%	36%	32%	39%	9%	44%	43%	39%
Shallowing	23%	12%	5%	13%	41%	17%	13%	22%	16%	26%	34%	30%	8%	11%	19%	18%
Deepening	57%	60%	42%	39%	29%	48%	42%	40%	44%	38%	34%	31%	83%	45%	38%	43%
Revised Dataset																
River Mile:	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	20%	27%	54%	**49%**	**35%**	**40%**	45%	**38%**	40%	36%	**33%**	**40%**	**10%**	**49%**	**44%**	**41%**
Shallowing	23%	12%	5%	**11%**	**38%**	**21%**	13%	22%	16%	26%	34%	**29%**	**9%**	**12%**	**20%**	18%
Deepening	57%	60%	42%	**40%**	**26%**	**39%**	42%	40%	**43%**	38%	34%	**30%**	**82%**	**40%**	**37%**	**41%**

Channel

Original Dataset																<u>Overall</u>
River Mile:	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	66%	41%	45%	73%	62%	51%	63%	68%	51%	30%	39%	37%	48%	58%	40%	52%
Shallowing	8%	27%	39%	19%	30%	8%	6%	12%	29%	52%	15%	12%	8%	5%	21%	21%
Deepening	26%	32%	16%	8%	7%	42%	31%	20%	20%	18%	46%	51%	44%	37%	39%	27%
Revised Dataset																
River Mile:	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15.7	
No change	66%	41%	45%	73%	**63%**	51%	63%	**70%**	51%	30%	**40%**	37%	**49%**	58%	40%	**53%**
Shallowing	8%	27%	39%	19%	30%	8%	6%	12%	29%	**53%**	15%	12%	8%	5%	21%	21%
Deepening	26%	32%	16%	8%	**6%**	**41%**	31%	**18%**	20%	**17%**	**45%**	51%	**42%**	**36%**	39%	**26%**

Bold type indicates differences between the original and the revised data sets.

Table 6. Comparison of Change Statistics per Depth Increment from Original and Revised T1T3 Data Sets, Nearshore and Channel Zones.

	Nearshore				Channel			
	Original		**Revised**		**Original**		**Revised**	
No Change	# of cells		# of cells		# of cells		# of cells	
+/- 0.25'	666724		662092		4919170		4909179	
Shallowing	# of cells	% Shallowing (cumulative)	# of cells	% Shallowing (cumulative)	# of cells	% Shallowing (cumulative)	# of cells	% Shallowing (cumulative)
-0.5 - -0.25	128747	42.02	127085	42.88	1002388	50.57	1001189	50.78
-1 - -0.5	113256	78.98	110963	80.32	692777	85.53	689499	85.75
-2 - -1	50132	95.34	47812	96.45	248024	98.04	244443	98.14
-3 - -2	8190	98.01	6877	98.77	32951	99.70	31877	99.76
-4 - -3	2770	98.91	1858	99.40	3126	99.86	2692	99.90
-5 - -4	1341	99.35	729	99.64	1041	99.91	782	99.94
-6 - -5	845	99.63	352	99.76	505	99.94	388	99.96
-7 - -6	544	99.80	243	99.84	379	99.96	303	99.97
-8 - -7	237	99.88	137	99.89	346	99.98	307	99.99
-9 - -8	129	99.92	94	99.92	133	99.98	100	99.99
-10 - -9	80	99.95	78	99.95	71	99.99	38	99.99
-30 - -10	156	100.00	156	100.00	282	100.00	119	100.00
-55 - -30	0	100.00	0	100.00	1	100.00	1	100.00
Total cells shallowing	306427		296384		1982024		1971738	
Deepening	# of cells	% Deepening (cumulative)	# of cells	% Deepening (cumulative)	# of cells	% Deepening (cumulative)	# of cells	% Deepening (cumulative)
0.5-0.25	318048	44.17	313595	46.55	1665865	66.74	1651411	68.37
0.5-1	217543	74.38	208642	77.51	641494	92.45	615803	93.86
1-2	123376	91.51	112210	94.17	153667	98.60	131411	99.30
2 - 3	30921	95.80	26927	98.16	21135	99.45	13270	99.85
3 - 4	10732	97.29	8173	99.38	5337	99.66	2128	99.94
4 - 5	4529	97.92	2320	99.72	2880	99.78	690	99.97
5 - 6	2898	98.33	908	99.86	1883	99.85	305	99.98
6 - 7	2349	98.65	386	99.91	1372	99.91	201	99.99
7 - 8	2626	99.02	185	99.94	775	99.94	106	99.99
8 - 9	2197	99.32	119	99.96	550	99.96	65	100.00
9 - 10	2105	99.61	88	99.97	251	99.97	35	100.00
10-45	2779	100.00	192	100.00	672	100.00	63	100.00
Total cells deepening	720103		673745		2495881		2415488	
TOTAL CELLS	1693254		1632221		9397075		9296405	
Total Shallowing, Deepening (> +/- 1ft)/Total cell	15%		13%		5%		5%	
Total Channel Area with Shallowing, Deepening (> +/- 1ft), m^2	248936		209844		475380		429323	

Table 7a. Comparison of Change Statistics, Nearshore Zones.

Percentages	T1T2	T2T3	T1T3	
No change	43%	63%	41%	
Shallowing	16%	17%	18%	
Deepening	40%	20%	41%	
Total Shallowing, Deepening (> +/- 1ft)/Total cells	13.4%	5.5%	12.9%	
Total Nearshore Area with Shallowing, Deepening (> +/- 1ft)	214,410	96,269	209,844	square meters

Table 7b. Comparison of Change Statistics, Channel Zones.

Percentages	T1T2	T2T3	T1T3	
No change	66%	67%	53%	
Shallowing	12%	21%	21%	
Deepening	23%	12%	26%	
Total Shallowing, Deepening (> +/- 1ft)/Total cells	2.8%	2.6%	4.6%	
Total Nearshore Area with Shallowing, Deepening (> +/- 1ft)	262,173	249,451	429,323	square meters

Table 8. Comparison of Change Percentages, T1T2 and T2T3.

	0-1		1-2		2-3		3-4		4-5		5-6		6-7		7-8		8-9		9-10		10-11		11-12		12-13		13-14		14-15.7	
	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3	T1T2	T2T3
Nearshore																														
No change	19%	**67%**	38%	**77%**	40%	**82%**	43%	**71%**	29%	**56%**	37%	**63%**	48%	**69%**	36%	**66%**	50%	58%	53%	56%	27%	38%	25%	28%	10%	**38%**	56%	62%	50%	60%
Shallowing	15%	19%	9%	10%	5%	12%	14%	16%	39%	23%	22%	10%	18%	10%	25%	11%	22%	9%	17%	27%	46%	25%	17%	**61%**	10%	**31%**	10%	16%	13%	19%
Deepening	67%	14%	53%	13%	56%	6%	42%	13%	32%	21%	41%	26%	34%	21%	39%	23%	28%	33%	30%	17%	27%	37%	58%	11%	81%	30%	34%	22%	37%	21%
Channel																														
No change	69%	**81%**	58%	**81%**	62%	52%	79%	73%	72%	67%	56%	**80%**	64%	**86%**	72%	76%	79%	59%	62%	37%	67%	54%	51%	69%	51%	**72%**	69%	79%	52%	54%
Shallowing	15%	1%	22%	13%	9%	**47%**	5%	**26%**	12%	30%	7%	9%	7%	5%	6%	16%	11%	26%	22%	**48%**	11%	17%	13%	10%	9%	12%	8%	5%	19%	15%
Deepening	17%	18%	20%	5%	29%	2%	16%	1%	16%	3%	37%	11%	29%	9%	22%	8%	10%	15%	15%	14%	22%	29%	37%	21%	40%	16%	23%	16%	29%	31%

Notes:
Shaded cells indicate a difference of more than 20 percent between the two time periods.
Bold percentage values indicate an increase of more than 20 percent between the two time periods.

Table 9. Percentages of Cells Showing 0 to +/- 1 Foot Change, T1T3, Per River Mile.

River Mile	Nearshore	Channel
0-1	72%	97%
1-2	90%	97%
2-3	95%	98%
3-4	93%	99%
4-5	79%	98%
5-6	87%	98%
6-7	90%	99%
7-8	87%	99%
8-9	87%	96%
9-10	91%	78%
10-11	78%	94%
11-12	83%	95%
12-13	54%	96%
13-14	91%	98%
14-15.7	86%	87%

APPENDIX C

QUALIFICATIONS OF KEY SAMPLING PERSONNEL

Integral Consulting, Inc.
1205 West Bay Drive NW
Olympia WA. 98502

telephone: 360-705-3534
facsimile: 360-705-3669
kpine@integral-corp.com

Keith A. Pine

Managing Scientist

PROFESSIONAL PROFILE

For the past 18 years, Mr. Keith Pine has managed and provided oversight of sediment, soil, and groundwater investigations and cleanups at dozens of hazardous waste sites, including CERCLA sites, RCRA sites, leaking UST sites, brownfields sites, and property transfers. As a Managing Scientist at Integral, Mr. Pine has directed several multimedia remedial investigations/feasibility studies (RI/FS) and RCRA facility investigations at several large facilities in the Pacific Northwest. He is currently the deputy RI/FS coordinator for the Lower Willamette Group at the Portland Harbor Superfund site in Portland, OR. As a contractor to U.S. EPA, he has performed technical oversight of PRP-led RI/FS and remedial designs at dozens of NPL sites in Washington, Oregon, and California. He has managed and participated in sediment investigations involving wood-treating chemicals in Elliott Bay, mining wastes in the upper Columbia and Sanpoil rivers, pulp mill wastes in the lower Columbia River, smelter wastes in Commencement Bay, and PCBs in the Duwamish Waterway.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Geology, Western Washington University, 1985
B.S., Geology, Humboldt State University, 1981

Licensed Professional Geologist and Hydrogeologist in State of Washington
Registered Professional Geologist in State of Oregon
Hazard Ranking System (HRS), EPA Training Course, 2001
Natural Attenuation, EPA Short Course, 1997
DNAPL Site Diagnosis and Remediation, Waterloo Short Course, 1995
Dissolved Organic Contaminants in Groundwater, Waterloo Short Course, 1994
Hazardous Waste Operations and Emergency Response 40-hour Certification

RELEVANT EXPERIENCE

CERCLA Remedial Investigations and Feasibility Studies

Portland Harbor CERCLA RI/FS, Portland, Oregon — Currently acting as Deputy Project Manager on behalf of the Lower Willamette potentially responsible party (PRP) Group for the Portland Harbor Superfund site. Tasks include coordinating the efforts of an RI/FS consultant team and leading the technical elements of the RI. Leading development of the revised Programmatic Work Plan. Overseeing preparation of Round 2A Field Sampling Plan.

Asarco Sediments CERCLA RI/FS, Tacoma, Washington — Provided technical oversight and cleanup plan (Proposed Plan and ROD) support to EPA for an RI/FS for sediment and groundwater at the former Asarco smelter on Commencement Bay. Participated in the Asarco Sediments/Groundwater Task Force, a multi-agency and stakeholder group formed to evaluate the potential for groundwater and surface water to impacted sediment at the site. Example task force participation efforts included developing statistical distributions of groundwater contaminant loading rates to the bay and calculating contaminant loading to sediment and bay water from municipal stormwater runoff. Provided technical comments on plans and reports prepared by Asarco related to issues such as sediment sampling, sediment remedy refinement, and pilot cap testing.

Gencorp Aerojet CERCLA RI/FS/RD, Rancho Cordova, California — Project manager for EPA oversight of the PRP-led RI/FS for the Perimeter Groundwater Operable Unit at the Aerojet Superfund site. Also served as project manager for EPA oversight of the PRP-lead RD for the Western Groundwater Operable Unit at the Aerojet NPL site. The 5,500-acre site has been used for manufacturing and testing of rocket engines and rocket fuel since 1953. Primary contaminants of concern in groundwater include trichloroethene, perchlorate, and nitrosodimethylamine. Several large groundwater contaminant plumes extend off-site and have impacted public and private drinking water supply wells. Interim actions including plume capturing groundwater extraction and treatment systems and water supply wellhead treatment systems have been conducted.

Frontier Hard Chrome RI/FS, Vancouver, Washington — Performed a site characterization and developed a focused feasibility study for chromate-contaminated groundwater at a former commercial plating facility after EPA determined that the previously selected remedy (pump and treat) was not cost- effective. Extensive flow and transport modeling was performed to understand historical changes in chromate plume configurations and to predict future plume behavior. Intensive soil and groundwater sampling using push-probes identified a previously unknown primary chromate source. The focused feasibility study recommended *in-situ* geochemical redox manipulation via injection of chemical reductants to treat the chromate source zone.

Tulalip Landfill CERCLA RI/FS/RD, Marysville, Washington — As project manager**,** provided scoping, work plan development, technical oversight, negotiation support, and risk assessment for a streamlined RI/FS/RD at the Tulalip Landfill Superfund site. Project included scoping, development, and oversight of site characterization tasks to support a comprehensive risk assessment and evaluation of presumptive remedial action alternatives under CERCLA municipal landfill RI/FS guidance and the Superfund Accelerated Cleanup Model (SACM). Technical issues included assessing risk at various levels of the food chain in wetland and estuarine environments, assessment of human health risks associated with subsistence hunting and fishing, characterization of hydrogeologic connections to surface water and off-site wells, and geotechnical assessment of the landfill for accelerated evaluation and design of containment remedies. A flexible membrane liner with passive surface drainage was selected as they interim remedial action by EPA. RD review focused on achieving a limited cost landfill cover that met the remedial action objectives stipulated in the ROD.

Northwest Pipe & Casing CERCLA RI/FS, Clackamas, Oregon —Responsible for client communication, project budget and schedule, and primary technical direction. Supervised scoping, work plan development, field investigations, data evaluation, remedial investigation reporting, risk assessment, treatability studies, and feasibility study. NWP&C is former industrial manufacturing site with extensive PCB- and PAH-contaminated soil and multiple PCE groundwater plumes. The baseline ecological risk assessment was the first for a major site conducted in accordance with the emerging Oregon Department of Environmental Quality risk assessment guidance. Provided post-RI/FS support to EPA during remedy selection and public participation.

Tulalip Landfill RI/FS and Remedial Design (RD), Marysville, Washington —Provided scoping, work plan development, technical oversight, negotiation support, and risk assessment for a streamlined RI/FS/RD at the 143-acre Tulalip Landfill Superfund site. Project included scoping, development, and oversight of site characterization tasks to support an extensive ecological risk assessment and screening of presumptive remedial action alternatives under CERCLA municipal landfill RI/FS guidance and the Superfund Accelerated Cleanup Model. A comprehensive baseline risk assessment was prepared to evaluate risks in the wetlands and estuary surrounding the landfill. Technical issues included assessment of risk at various levels of the food chain in wetland and estuarine environments, assessment of human health risks associated with subsistence hunting and fishing, characterization of geohydrologic connections to surface water and off-site wells, and geotechnical characterization of the landfill for accelerated evaluation and design of containment remedies. A flexible membrane liner with passive surface drainage was selected as the interim remedial action by EPA. The RD review focused on achieving a limited cost landfill cover that met the remedial action objectives stipulated in the ROD.

Oroville Landfill RI/FS, Oroville, WA — Responsible for preparation of an RI/FS at a closed municipal dump contaminated with pesticide waste. The 16-acre site, located along the Similkameen River in north-central Washington, was contaminated with chlorinated and organophosphate pesticides. In addition to the completion of the RI/FS as an independent RA under the early Washington State MTCA, the project involved extensive fate and transport modeling, a comprehensive ecological risk assessment, preparation of a NEPA EA, development of a proposed plan and record of decision, evaluations of existing engineering controls, and periodic monitoring of potential migration pathways. The selected remedial alternative was localized capping of the pesticide debris disposal area of the landfill.

Naval Air Station (NAS) RI/FS, Adak, Alaska — Managed the preparation of RI/FS work plans for three PCB-contaminated sites at NAS Adak in the Aleutian Islands of Alaska. The study sites included a large PCB spill, a former hazardous waste storage facility, and a fire-fighting training and burn pit area. Authored and coordinated preparation of the RI/FS work plan, field sampling plan, quality assurance project plan, health and safety plan, and community relations plan.

American Crossarm & Conduit CERCLA RI/FS, Chehalis, Washington —Responsible for a comprehensive remedial investigation at an inactive wood preserving facility and landfill site and a nearby contaminated residential area and wetlands. The phased project involved a complete characterization of the nature and extent of Target Compound List contaminants in soil, groundwater, surface water, and stream sediment, a determination of risks to human health and the environment, and development of Interim Remedial Measures

Harbor Island CERCLA RI/FS, Seattle, Washington — Responsible for scoping of surface and subsurface soil investigations for the entire site and preparation of associated sections of the RI/FS work plan and sampling and analysis plan. Project involved a multimillion-dollar RI/FS at a large industrial area with many individual facilities in Seattle, WA. The site was listed on the NPL primarily because of extensive lead contamination of soil.

CERCLA Site Assessments

Expanded Site Inspections (ESIs), Washington and Oregon — Managed investigation and reporting for three high-profile, controversial sites in the Pacific Northwest: Portland Harbor, OR; Lower Duwamish River, WA; and Bertrand Creek Area Properties, WA. The Portland Harbor and Lower Duwamish River ESIs involved extensive sediment and porewater sampling along several miles of these urban waterways. Analytical results were evaluated and presented using an ARC/Info GIS; final reports and data were made available for posting on EPA's public website. The Bertrand Creek site involved groundwater, soil, and surface water impacted by soil fumigants across a large agricultural area of Whatcom County. HRS PREscore was used to develop initial estimates of the HRS score for each site. The Portland Harbor and Lower Duwamish River sites were subsequently listed on the NPL.

CERCLA Site Assessments, Washington, Oregon, Idaho, and Alaska — Developed site assessment program for EPA, Region 10, Superfund Technical Assistance and Response Team (START) contract. Project manager for all CERCLA PAs, SIs, ESIs, and Targeted Brownfields Assessments under the START contract. Supervised and coordinated activities of site leaders for individual sites, provided senior review of all contract site assessment deliverables. Managed 32 task orders covering a wide variety of sites throughout Region 10, including mine sites, marine and river sediment sites, formerly used defense sites, groundwater plumes, and a hazardous waste landfill.

RCRA Investigations

The Boeing Company RCRA Facility Investigation, Seattle, Washington — Managed a RCRA facility investigation (RFI) at an aging 100-acre manufacturing complex on the Duwamish Waterway. The primary constituents of concern at the site include PCBs in soil and sediment, and chlorinated solvents and metals in groundwater. The project involved scoping, preliminary field investigations, work plan preparation, extensive agency negotiation, and execution of a multiphase, multiyear, $3M consent order-driven RFI. All three major phases of field investigation are complete; over 800 soil samples, 1000 groundwater samples, and 150 sediment samples were collected, analyzed, and loaded into the project database and GIS. A human health and environmental evaluation was developed and included proposed media cleanup levels and points of compliance for soil, groundwater and Duwamish Waterway sediment. Primary author of the comprehensive RFI report, which was approved by EPA. The overall project also included several interim cleanup actions in support of facility redevelopment.

The Boeing Company RCRA TSD Closure Support — Led projects that involved closing nine RCRA treatment, storage, and disposal (TSD) facilities at large industrial facilities in the Puget Sound area. Tasks included development of closure plans and closure cost estimates, agency negotiation, coordination and oversight of closure activities, confirmation sampling, and preparation of closure certification reports. Developed new comprehensive approach to determining closure performance standards for various media prior to promulgation of Washington State closure standards for interim facilities. Subject RCRA TSDs included container storage areas, plating waste treatment systems, and aboveground and underground hazardous waste storage tanks.

Remediation and Environmental Assessments

Federal Aviation Administration Site Characterizations, Neah Bay, Washington, and Klamath Falls, Oregon — Designed and managed environmental site characterizations at two remote air route surveillance radar sites. The characterizations included surface and subsurface soil sampling to assess the nature and extent of petroleum hydrocarbons, PCBs, and other constituents from past practices at the sites. Utilized risk-based corrective action approach at the Makah site to determine that existing soil conditions are acceptable.

Petroleum Cleanup, Anchorage, Alaska — Managed multi-phase project involving site characterization, and the design, installation, and ongoing operation, maintenance, and monitoring of a five-well soil vapor extraction (SVE) system for a leaking underground gasoline storage tank site. Site challenges included the occurrence of much of the contaminant mass in seasonally saturated soil beneath client's operating warehouse facility and negotiating/managing project scope and costs to maximize client reimbursement under an Alaska Department of Environmental Conservation financial assistance grant program.

The Boeing Company Soil Quality Assessment and Removal Action, Tukwila, Washington — Participated in the assessment (nature and extent) and removal of 300 yd^3 of soil contaminated with chlorinated solvents and heavy metals (plating wastes) located beneath an operating manufacturing facility. Designed health and safety protocols and a ventilated containment structure to facilitate the removal of contaminated soil inside buildings without disrupting manufacturing operations or exposing client's employees.

NEPA Environmental Assessment, Fort Lewis, Washington — Principal investigator and project manager for a NEPA Environmental Assessment regarding the implementation of a sand and gravel borrow source management plan at Fort Lewis.

Development of Air Quality Compliance Tools for Stationary Air Pollution Sources, Fort Lewis, Washington — Developed management tools to assist with the proper operation and management of air pollution sources at Headquarters I Corps and Fort Lewis that demonstrate and maintain compliance with applicable state and federal laws, such as Title V, Aerospace Coatings NESHAP, NSPS boiler requirements, and gasoline control regulations. Rewrote air compliance SOPs to reflect current operations, new regulatory requirements, and readability; created new SOPs for previously undocumented operations; developed internal compliance checklists for various commands and operations on fort; developed signage reminding operators of various regulatory requirements; created authorized use lists for aerospace coatings and solvents; and created a regulatory compliance outline for various regulations that concern Fort Lewis.

Defense Depot San Joaquin, California—Tracy and Sharpe facilities, Environmental Baseline Survey (EBS) — Performed and supervised facility inspections and records reviews, compiled summary information and authored sections of the EBS reports for the two Defense Distribution Depot San Joaquin facilities. The work was performed under the Corps' Rapid Response program. The EBS focused on both current and former storage, industrial, and maintenance areas at each facility, describing the environmental condition of the properties based on available information from numerous sources. The study was used to determine the suitability of land parcels, buildings, and/or utility systems located on the properties for potential easement, lease, or transfer to another owner.

PUBLICATIONS

Pine, K.A., R.E. Jensen, and R. McGinnis. 1997. Observations on the results of metal analysis of filtered and unfiltered groundwater samples. Abstracts from the 2nd Symposium on the Hydrogeology of Washington State, Olympia, WA.

Jensen, R.E., K.S. King, and K.A. Pine. 1997. Origin of saline ground water in the Duwamish Valley, King County, Washington. Abstracts from the 2nd Symposium on the Hydrogeology of Washington State, Olympia, WA.

King, S.K., R.E. Jensen, and K.A. Pine. 1997. Geochemical evolution of TCE plumes, Duwamish Valley, King County, Washington. Abstracts from the 2nd Symposium on the Hydrogeology of Washington State, Olympia, WA.

Pine, K.A. 1984. Late Pleistocene glacial stratigraphy of the North-Central Okanogan Valley, Washington. Abstracts. Geological Society of America, 17:(9)400.

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Eugene C. Revelas
Managing Scientist

PROFESSIONAL PROFILE

Mr. Gene Revelas, Managing Scientist at Integral, is a regional expert on contaminated sediment and dredged material management issues. He is one of the few North American experts in the use of sediment-profile image technology for characterizing dredged material disposal sites and benthic habitats and has applied this technology at freshwater, estuarine, and marine sites throughout the United States, Canada, and in Europe. His broad background managing complex contaminated sediment sites, combined with a sharp focus on both benthic habitat and physical environment issues, guides his sound, science-based evaluation and decision making. Mr. Revelas is also conversant in the regulatory aspects of contaminated sediment having once served as the manager of the Contaminated Sediments Section of the Washington State Department of Natural Resources. He is currently working on the development and verification of an accurate, physical conceptual site model for a sediment cleanup site situated in a large, hydrodynamically complex, urban/industrial river system.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Marine Environmental Sciences, State University of New York, Stony Brook, 1984
B.S., Geology and Geophysics, Yale University, 1981

Western Dredging Association
Society of Toxicology and Chemistry/Pacific Northwest Chapter
Hazardous Waste Operations and Emergency Response 40-hour Certification

RELEVANT EXPERIENCE

Portland Harbor CERCLA RI/FS, Portland, Oregon — Serves as assistant program manager responsible for coordinating the activities of a diverse RI/FS consultant team for this complex contaminated site, including overseeing all RI sampling activities and laboratory data analyses. Additional roles include budget preparation and tracking; planning and development of technical scopes of work; progress reporting, oversight and QA review of project deliverables; and preparation of technical products.

Slip 4 (Duwamish River) Sediment Quality Evaluation, Seattle, Washington — Serves as project manager for a multi-year task order contract investigating sediment quality in Slip 4 and potential upland sources of the contamination. Compiled existing Slip 4 data and upland source tracing related to SCL properties and historical operations along this stretch of the Duwamish. Provides technical and strategic support to the City of Seattle on the Lower Duwamish River CERCLA cleanup under this contract.

PacifiCorps Former Oil Gasification Plant Site Assessment, Astoria, Oregon — Managed the sediment and resource evaluation portion of a site assessment in Youngs Bay, Oregon. The project consisted of an environmental evaluation of an intertidal coal tar deposit under Oregon Department of Environmental Quality oversight. The assessment included physical mapping of the deposit, evaluation of chemical pathways and potential ecological (including threatened and endangered species) and human health impacts and evaluation of the potential environmental impacts associated with various remedial alternatives.

U.S. Army Corps of Engineers, Marine Sediment Sampling, Chemical and Biological Analyses in Western Washington — From 1995 to 2002, managed task order projects including numerous dredged material characterizations under the Dredged Material Management Program (DMMP) for sites in Puget Sound, Grays Harbor, and Willapa Bay; preparation of a Programmatic Environmental Impact Statement for the inter-agency Puget Sound Confined Disposal Study MUDS; a habitat restoration site sediment quality assessment in the Duwamish; multi-year crab population studies at the mouth of Grays Harbor; an extensive laboratory bioaccumulation study in the East Waterway; water quality monitoring during contaminated sediment dredging in the East Waterway; and an assessment of paralytic shellfish poisoning issues associated with dredging/disposal in Bellingham Bay.

Port of Portland, Oregon, Portland Harbor Environmental Consulting Contract — Managed this task order contract with the environmental division of the Port of Portland from 2000 to 2002. Tasks were focused on contaminated sediment issues in Portland Harbor (e.g., historic data compilation, source evaluation, work plan development) in anticipation of a CERCLA listing of the site.

Hylebos Waterway Pre-remedial Design, Tacoma, Washington — Major involvement in the comprehensive sediment characterization portion of the Hylebos Waterway pre-remedial design program from 1994 to 1997. Responsibilities included coordination and oversight of coring activities and core sample analyses; data analyses, including PSDDA and natural recovery assessments; and technical reporting. Also directed a sediment profile survey of entire waterway and synthesized this information with traditional chemical and biological data sets.

Salmon Net Pen Benthic Standards for Puget Sound, Washington — Under contract to the Washington Department of Ecology from 1994 to 1996, developed standard(s) for evaluating the benthic impacts of salmon aquaculture in Puget Sound. Work included analysis and synthesis of several years of net pen monitoring data and development of effects criteria that were incorporated into an industry-wide net pen regulatory framework.

Contaminated Sediments Section, Washington Department of Natural Resources (DNR), Washington — While employed at DNR in 1993, managed the Contaminated Sediments section in DNR's Division of Aquatic Lands. This section's responsibility is the environmental review/assessment of projects/programs affecting state-owned aquatic lands. Major tasks included technical review of RI/FS and remedial design documents for federal and state superfund sites, participation on inter-agency technical panels evaluating proposed sediment remediation activities, and the refinement/development of sediment quality assessment techniques.

Puget Sound Dredged Disposal Analysis (PSDDA), Washington — Managed the PSDDA program for the Washington Department of Natural Resources (DNR) from 1991 to 1994. PSDDA is federal/state interagency program for managing dredged material and disposal in the Puget Sound region. Responsibilities included sediment sampling plan and data report review, technical direction of biological and chemical monitoring studies at the open-water dredged material disposal sites, and evaluation procedures technical review. Also, as a consultant prior to joining DNR, directed PSDDA disposal site physical, chemical, and biological monitoring (1990/91) and participated in PSDDA disposal site baseline (1988/89) and zones of siting feasibility studies (1985).

U.S. Navy Homeport Project, Everett, Washington — From 1987 through 1989, acted as assistant program manager for the environmental monitoring/dredged material testing program associated with construction of the Everett Naval Base. Coordinated collection and analysis of baseline environmental data at a deep-water disposal site and directed the Element I dredged material sediment characterization.

Alcatraz Disposal Site Study, San Francisco, California — In 1986 and 1987, served as chief field scientist for a multi-year study designed to assess the behavior of dredged material disposed at the Alcatraz site as a function of dredging and disposal techniques. Field techniques included current measurements, bathymetric and acoustic subbottom profiling, side scan sonar, sediment-profile photography, and deep sediment coring. Participated in data analysis and co-authored project technical reports.

San Francisco Bay Sediment Quality Investigation, California — Conducted a San Francisco Bay sediment quality survey and analyses for the National Oceanic and Atmospheric Administration in 1986. Led field, data management, and report preparation efforts. Program involved conductivity-temperature-depth profiling, sediment profile imaging, and sediment analyses throughout the estuary.

Sediment-Profile Image (SPI) Surveys — Since 1984, technical lead on numerous sediment-profile surveys of coastal, estuarine, and riverine areas throughout the U.S., Canada, and Europe. These surveys delineated areas of benthic disturbance and potential degradation. The SPI results are used to monitor conditions at aquatic disposal sites such as the PSDDA sites, evaluate remedial efforts (in-place capping and confined aquatic disposal sites), map coastal enrichment gradients and benthic habitat quality, and to optimize follow-on conventional sediment sampling programs.

PRESENTATIONS

Browning D., D.R. Kendall, and E.C. Revelas. 1993. Delineation and biogenic reworking of a dredged material deposit placed at a deep water disposal site. *In:* Proc. Pacific Northwest Chapter SETAC. Seattle, WA.

Browning D., E.C. Revelas, R.C. Hollar, and A. Risko. 1996. Confined disposal and capping of dredged sediments in the Long Beach borrow area. *In:* Proc. WEDA Pacific Chapter, Honolulu, HI.

PUBLICATIONS

Browning, D.G., and E.C. Revelas. 1996. Development and application of the physical disturbance index (PDI) for sediment profile images. *In:* PERS, Pacific Northwest Chapter Proc., Olympia, WA.

Dasler, J.L., E.C. Revelas, and J.C. Creech. 2003. Sediment transport mapping in a complex riverine environment using multibeam bathymetry. *In:* Proc. of the 2003 U.S. Hydrographic Conference. Biloxi, MS.

Revelas, E.C., D.R. Kendall, E.E. Nelson, D.C. Rhoads, and J.D. Germano. 1991. Post-disposal mapping of dredged material in Port Gardner and Elliott Bay. pp. 267-280. *In:* Proc. of Puget Sound Research '91. Puget Sound Water Quality Authority, Olympia, WA.

Revelas, E.C., J.D. Germano, and D.C. Rhoads. 1987. REMOTS: Reconnaissance of benthic environments. pp. 2069-2083. *In*: Proc. of the Coastal Zone '87 Meeting, May 26-29, 1987. ASCE, Seattle, WA.

Revelas, E.C., D.C. Rhoads, and J.D. Germano. 1987. San Francisco Bay Sediment Quality Surveys and Analyses. NOAA Technical Memorandum NOS OMA 35, Rockville, MD.

Rhoads, D.C., E.C. Revelas, and J.D. Germano. 1986. Development of a UV fluorescence imaging system for *in-situ* detection of petroleum in marine sediments. pp. 441-445. *In:* Offshore Technology Proc., Houston, TX.

Rhoads, D.C., R.A. Lutz, R.M. Cerrato, and E.C. Revelas. 1982. Growth and predation activity at deep-sea hydrothermal vents along the Galapagos rift. *J. Mar. Res*. 40:503-516.

Rhoads, D.C., R.A. Lutz, E.C. Revelas, and R.M. Cerrato. 1981. Growth and predation activity at deep-sea hydrothermal vents along the Galapagos Rift. *Science* 214:911-913.

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Joseph A. Thompson
Associate Scientist

PROFESSIONAL PROFILE

Joe Thompson has extensive experience coordinating and managing fieldwork for various marine sediment investigations, especially those involving dredged material. He is proficient in all aspects of sediment collection and processing in the field. Mr. Thompson is experienced with data collection and analysis procedures, managing chemical and biological data collected in the field, and writing technical reports.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Geology, Washington State University, 2001
B.S., Geology, University of Nebraska, 1998

Northwest Geological Society
Hazardous Waste Operations and Emergency Response 40-hour Certification
Hazardous Waste Operations and Emergency Response Supervisor Certification
Red Cross First Aid and CPR Training

RELEVANT EXPERIENCE

Los Angeles Harbor Sediment Investigation, Confidential Client — Led field sampling effort to collect subtidal surface sediment samples. Planned and conducted mobilization and field collection efforts.

Wyckoff/Eagle Harbor, Washington, Year-8 Cap Monitoring — Responsible for field collection of subtidal surface (grab sampling) and subsurface (vibracoring) samples for the Year 8 monitoring at the Superfund site. Participated in preparation of the Field Report, including graphical logging of all cores in LogPlot®.

Wyckoff/Eagle Harbor, Washington, Outfall Sediment Monitoring — Participated in the 2002 sediment sampling program to assess impacts of groundwater treatment plant discharge on marine sediments. Prepared field sampling plan and health and safety plan. Conducted fieldwork and participated in preparation of the data report.

U.S. Army Corps of Engineers, Marine Sediment Sampling, Chemical and Biological Analyses in Western Washington — Participated in PSDDA sediment characterizations to determine the suitability of materials for open-water disposal for the following projects:

- Grays Harbor Navigation Channel (FY02) – Field cruise leader, report preparation
- Swinomish Navigation Channel – Field cruise leader, report preparation

Elliott Bay, Washington, PSDDA Disposal Site Monitoring, 2002 — Acted as field cruise leader for the 2002 PSDDA monitoring of the Elliott Bay disposal site. Sampling included sediment profile imaging, benthic infaunal, and surface sediment. Prepared cruise report and contributed to the preparation of the summary data report.

Portland Harbor CERCLA RI/FS, Portland, Oregon — Acted as field cruise leader for the 2002 Round 1 sediment collection at the Superfund site. Sampling included subtidal and beach surface sediment, benthic infaunal, and *Corbicula fluminea* tissue collection. Also supported field activities for the 2001 SPI-survey of the lower Willamette River. Prepared technical report detailing the integration of STA®

Port of Gray's Harbor, Washington — Supported field data collection of surface (grab sampling) and subsurface (vibracoring) samples.

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Susan FitzGerald
Scientist

PROFESSIONAL PROFILE

Ms. Susan FitzGerald has over six years experience in the environmental field, during which time she has been responsible for the collection of soil, groundwater, sediment, and surface water quality data from upland, freshwater, and marine environments. She has experience leading CERCLA preliminary assessments and site inspections for U.S. EPA (Region 10), including the generation of Hazard Ranking System (HRS) site scores, leading Phase I and II environmental site assessments, and conducting environmental baseline studies.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Oceanography and Coastal Sciences, Louisiana State University, 1998
B.A., Geology, Mercyhurst College, 1991

Licensed Geologist in the State of Washington (#715)
40-Hour Wetland Delineation Training Workshop
Hazardous Waste Operations Supervisor 8-Hour Certification
Hazardous Waste Operations and Emergency Response 40-Hour Certification
Red Cross First Aid and CPR Training

RELEVANT EXPERIENCE

CERCLA Site Assessment Management

U.S. EPA Region 10, Superfund Technical Assistance Response Team (START) — Led performance of CERCLA preliminary assessments and site inspections in Washington and Oregon at river sediment sites, mine sites, a pulp mill, and a former hazardous waste landfill. Served as primary contact point to EPA Site Assessment Manager. Responsible for preparing work plans, negotiating project budgets, coordinating site access, procuring subcontractors, organizing and executing sampling plans, managing field team members, and monitoring site health and safety practices. Responsible for the generation of project reports and site Hazard Ranking System (HRS) scores.

U.S. EPA Region 10 START, Upper Columbia River/Lake Roosevelt Expanded Site Inspection, Northeastern Washington — Organized, conducted, and supervised the collection of 188 surface sediment and water samples to support a CERCLA site evaluation according to the HRS. Served as primary contact point to EPA. Prepared and executed sampling plan on an accelerated schedule, and coordinated and supervised the 6-week field efforts of dual sampling crews to collect samples along the banks and beaches of Lake Roosevelt, the upper Columbia River, and 115 tributaries. Coordinated the sampling event with EPA, USFS, and tribal personnel. Accommodated frequent client-directed changes in scope during field effort. Managed project data, and authored the trip report. Performed statistical analyses and authored report comparing metals concentrations in river and tributary sediment.

PRP Oversight, Commencement Bay Nearshore/Tideflats Superfund Site, Ruston and Tacoma, Washington — Provided oversight for EPA of potentially responsible parties' sediment sampling activities for the Asarco sediments problem area within the Commencement Bay Nearshore/Tideflats Superfund site.

Environmental Site Investigations/Field Sampling

Duwamish Waterway, Confidential Client, Seattle, Washington – Collected, described, and subsampled a set of ten vibracores from the Duwamish Waterway.

Independent Site Assessment, James Hardie Gypsum, Seattle, Washington — Organized field effort and executed sediment sampling plan in the intertidal zone of the Duwamish Waterway. Interpreted analytical results using Washington Sediment Management Standards and co-authored the project report.

The Boeing Company, Remedial Investigation and Interim Action, Seattle, Washington — Performed soil sampling utilizing direct-push, split-spoon, and hand auger equipment. Supervised the installation and development of monitoring wells, and performed groundwater sampling from pushprobes and monitoring wells to characterize and delineate extent of subsurface contamination at the facility. Assisted with aquifer slug testing. Compiled site health and safety plans; monitored air quality parameters using PID and FID meters and Drager tubes. Performed O&M tasks, monthly and quarterly groundwater sampling, and reporting relating to remedial systems at the site. Performed site-wide groundwater level survey, and constructed groundwater flow diagrams. Compiled stratigraphic cross-sections and coauthored sections of RI report.

Washington State Department of Ecology Voluntary Cleanup Program, Fairchild Air Force Base, Spokane, Washington — Conducted soil and groundwater sampling and performed oversight of building demolition, ACM abatement, and UST decommissioning subcontractors for redevelopment of property as a business park. Responsible for site health and safety, and authored project reports.

Underground Storage Tank Removal, Columbia HCA, Los Robles Regional Medical Center, Thousand Oaks, California — Supervised removal of 10,000-gallon diesel UST, performed confirmation soil sampling, and monitored air quality for site health and safety. Authored closure report and co-authored Risk-Based Closure Assessment report for the Ventura County Department of Health.

Air Quality Sampling and Reporting, Seattle, Washington — Collected airborne particulate samples using Andersen and slide samplers, serviced and maintained H_2S monitors, processed data records, and authored project reports regarding indoor air quality and ongoing hydrogen sulfide monitoring.

Atchafalaya River and Wax Lake Outlet Deltas Research, Louisiana State University — Designed and managed thesis project including sediment vibracore collection and sediment sample processing. Operated boats, vibracoring equipment, surveying instruments, and X-ray radiography equipment. Led a team constructing time-series digital terrain models of Atchafalaya Bay for the U.S. Army Corps of Engineers, New Orleans District. Collected and processed ground truth topographic and bathymetric data for use in the models. Co-authored project reports. Collected suspended sediment samples and conducted channel cross-section profiles as part of a study to determine effects of a weir on water levels, sediment load, and channel morphology of the Lower Atchafalaya River.

Phase I Environmental Site Assessments/Environmental Baseline Surveys

U.S. EPA Region 10 START, Targeted Brownfields Assessment, University of Washington Tacoma Campus — Served as primary contact point to EPA Brownfield Coordinator and directed the completion of five Phase 1 Environmental Site Assessments (ESAs) at parcels within the Tacoma Campus redevelopment area. Prepared project budget and project reports.

Phase I Environmental Site Assessments, King County, Washington, US West Communications, Inc. — Conducted "Pre-lease" assessments of properties, including site walkovers, environmental records reviews, historical aerial photo/topographic map reviews, environmental conditions assessment, and report preparation.

U.S. Army Corps of Engineers, Omaha District, Environmental Baseline Survey (EBS), California, Defense Depot San Joaquin—Tracy and Sharpe facilities — Performed facility inspections and records reviews regarding current and former industrial, maintenance, and storage areas at the Tracy facility, and co-authored EBS reports for both facilities. The EBS was to be used to determine the suitability of land parcels, buildings, and utility systems on the facility properties for potential easement, lease, or ownership transfer.

Site Investigative Research and Data Compilation

Identification of Contaminant Sources, Confidential Client — Conducted reviews of regulatory agency files and historical data reports to identify potential sources of contamination along an industrial waterway, and preparation of a summary memo.

Slip 4, Duwamish Waterway, Seattle, Washington — Conducted reviews of regulatory agency files and databases for information regarding the environmental history and status of several properties bordering Slip 4 of the Duwamish River. Summarized and incorporated this information to revise and expand an historical data summary report.

PUBLICATIONS

(*note that S. FitzGerald also published as S. Majersky*)

Majersky, S., H.H. Roberts, R. Cunningham, G.P. Kemp, and C.J. John. 1997. Facies Development in the Wax Lake Outlet Delta: Present and Future Trends. Basin Research Institute Bulletin, Vol. 7. Basin Research Institute, Louisiana State University, Baton Rouge, LA.

Roberts, H.H., N. Walker, R. Cunningham, G.P. Kemp, and S. Majersky. 1997. Evolution of sedimentary architecture and surface morphology: Atchafalaya and Wax Lake Deltas (1973 - 1994). Presented at the Gulf Coast Association of Geological Societies Conference, New Orleans, LA.

Cunningham, R.H.W., S. Majersky and F. Jones. 1996. Compilation of the U.S. Army Corps of Engineers Hydrosurveys and Associated Aerial Photography of Atchafalaya Bay, LA. Proc. of the United States Intergraph Graphics Users Group Conference, New Orleans, LA.

APPENDIX D
FIELD FORMS AND CHECKLISTS

Core Description and Sample Information

STATION:
REPLICATE:

Field Log by:	Processing by:	Coring by:
Tide Level from MLLW: Depth to Mudline: Mudline Elev.:	Date: Time:	Total Drive Length: Recovered Length: Recovery Efficiency:

Note: All elevations, depths, and distances in feet.

Core Description - Core Tube Lengths

Tube Length	Sample No.	Visual Description
_1		
_2		
_3		
_4		
_5		
_6		
_7		
_8		
_9		
_10		
_11		
_12		
_13		
_14		
_15		
_16		
_17		
_18		

In-Situ Summary Log

Interpreted Summary	Sample No.	Acquisition Notes
_1		
_2		
_3		
_4		
_5		
_6		
_7		
_8		
_9		
_10		
_11		
_12		
_13		
_14		
_15		
_16		
_17		
_18		

Core Tube Field Cut Information

Sample No.	Tube Length Interval	Segment Length

Sample Test Information

Sample No./Tests	In-Situ Depth Int.

Notes:

CORRECTIVE ACTION RECORD

Page ____ of ____   Audit Report No.: ______________________________   Date: ______________________

Report Originator: ____________________________________

Person Responsible for Response: ____________________________________

DESCRIPTION OF PROBLEM:

Date and Time Problem Recognized: ____________________________________   By: ____________________________________

Date of Actual Occurrence: ____________________________________   By: ____________________________________

Analyte: ____________________________________   Analytical Method: ____________________________________

Cause of Problem:

CORRECTIVE ACTION PLANNED:

Person Responsible for Corrective Action: ____________________________________

Date of Corrective Action: ______________________________

Corrective Action Plan Approval: ____________________________________   Date: ______________________________

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Person Responsible for Follow-up Activities: ____________________________________

Date of Follow-up Activity: ______________________________

Final Corrective Action Approval: ____________________________________   Date: ______________________________

FIELD CHANGE REQUEST

Page ____ of ____ Field Change No.: ____________________ Project Number: ______________________

Project Name: ____

CHANGE REQUEST

Applicable
Reference: ____

Description of Change:

Reason for Change:

Impact on Present and Completed Work:

Requested by: ____________________________________ Date: ______________________________
(Field Scientist)

Acknowledged by: _________________________________ Date: ______________________________
(Field Task Leader)

SAMPLING AND ANALYSES COORDINATOR RECOMMENDATION

Recommended Disposition:

Recommendation by: ______________________________ Date: ______________________________

CERCLA COORDINATOR APPROVAL

LWG Notification Requred: Yes / No

Final Disposition:

Approved/Disproved by: ___________________________ Date: ______________________________

EPA PROJECT MANAGER APPROVAL

Approved/Disproved by: ___________________________ Date: ______________________________

SEDIMENT SAMPLE LOG

Date: **Page:**

Time	Station	Rep	Pen (cm)	Texture	Color	Debris	Odor	Sample Quality/Comments

Comments:

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

Page ______ of ______ Turn Around Requested: ________

Report to:	Phone:	Analyses Requested	Notes/Comments
Company:	Fax:		
Address:	Proj Name:		
City:	Proj Number:		
State:	Sampler:		
Zipcode:			

Sample ID	Sample Date	Sample Time	Sample Matrix	No. Containers											Notes/Comments

Relinquished: (Signature)	Received by: (Signature)	Special Instructions/Notes	
Printed name:	Printed name:		
Company:	Company:		Number of Coolers:
			Cooler Temp(s):
Date: Time:	Date: Time:		COC Seals Intact?
			Bottles Intact?

COMMERCIAL INVOICE FOR INTERNATIONAL SHIPPING

DATE OF EXPORTATION:	EXPORTER REFERENCE (i.e., order no., invoice no., etc.):
SHIPPER/EXPORTER (complete name and address):	CONSIGNEE (complete name and address:
Country of Export:	REASON FOR SHIPMENT:
Country of Manufacture:	
Country of Ultimate Destination:	
International Air Waybill No.:	

MARKS / Nos.	No. of PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	Qty.	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.
DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT.

SIGNATURE OF SHIPPER/EXPORTER (Type name and title, and sign). DATE

____ ________________________________

Sediment Sampling Equipment Checklist

Sample Handling
- ❑ Bowls, large, stainless
- ❑ Jars, sample-analysis-specific
- ❑ Sampler, core and tubes[1]
- ❑ Sampler, grab[2] and stand
- ❑ Hand cores and plates[3]
- ❑ Spoons, large, stainless
- ❑ Spoons, large, stainless

Tools
- ❑ Beakers, plastic, 50 mL
- ❑ Core extrusion pole[1]
- ❑ Hacksaw[1]
- ❑ Locking-pliers, chain clamp[1]
- ❑ Measuring tape[1]
- ❑ Measuring stick
- ❑ Pipe cutter[1]
- ❑ Rubber mallet[1]
- ❑ Screwdrivers (Phillips, flat)
- ❑ Sieves, 63 µm
- ❑ Siphon tubes[2]
- ❑ Utility knife
- ❑ Lead line (if not on vessel)

Equipment Decontamination
- ❑ Brushes, long-handled and short-handled
- ❑ Detergent, laboratory (Alconox)
- ❑ Methanol in dispensing bottle
- ❑ Nitric acid, 10% in dispensing bottle
- ❑ Pail
- ❑ Distilled water in dispensing bottle

Documentation
- ❑ Field sampling plan
- ❑ Health and safety plan
- ❑ Field logs
- ❑ Sample description logs
- ❑ Chain-of-custody forms
- ❑ Request-for-change forms
- ❑ Correction forms
- ❑ Maps

PPE Equipment
- ❑ Boots, steel-toed, waterproof
- ❑ Gloves, nitrile, heavy outer
- ❑ Gloves, nitrile, thin inner
- ❑ Hard hats
- ❑ Hearing protection
- ❑ Rain slicks
- ❑ Safety glasses/goggles

Supplies
- ❑ Aluminum foil
- ❑ Bags, plastic zip, gallon-size
- ❑ Bags, plastic zip, quart-size
- ❑ Coolers
- ❑ Custody seals
- ❑ Duct tape
- ❑ Ice
- ❑ Tape, clear, shipping
- ❑ Pens, felt-tip, permanent
- ❑ Pens, ballpoint, permanent
- ❑ Pencils
- ❑ Sample labels
- ❑ Bubble wrap
- ❑ Cell phone
- ❑ First aid kit

[1] Specific to core sampling.
[2] Specific to grab sampling.
[3] Specific to beach sampling.

APPENDIX E

TARGET STATION MODIFICATIONS BASED ON SITE RECONNAISSANCE

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
G55	001	Surface Only	
G213	002	Surface Only	
G58	003	Surface Only	
G56	004	Surface Only	
MC235	005	Surface Only	
G96	006	Surface Only	
13	007	Surface Only	
G97	008	Surface Only	
14	009	Surface/Subsurface	
12	010	Surface Only	
11	011	Surface/Subsurface	
G214	012	Surface Only	
7	013	Surface Only	
G98	014	Surface Only	
8	015	Surface/Subsurface	
6	016	Surface Only	
343	017	Surface Only	
MC236	018	Surface Only	
342	019	Surface/Subsurface	Station repositioned off of outfall [1]
20	020	Surface/Subsurface	
5	021	Surface Only	
19	022	Surface/Subsurface	
G59	023	Surface Only	
4	024	Surface Only	
3	025	Surface/Subsurface	
2	026	Surface Only	
1	027	Surface/Subsurface	Station moved due to obstruction [2]
G60	028	Surface Only	
G99	029	Surface Only	
G100	030	Surface Only	
G61	031	Surface Only	
G101	032	Surface Only	
17	033	Surface Only	Station repositioned off of outfall
16	034	Surface/Subsurface	Station repositioned off of outfall
15	035	Surface Only	Station repositioned off of outfall
MC237	036	Surface Only	
G62	037	Surface Only	
18	038	Surface/Subsurface	Station repositioned off of outfall
G102	039	Surface Only	
G83	040	Surface Only	
G103	041	Surface Only	
G104	042	Surface Only	
G84	043	Surface Only	
G105	044	Surface Only	
G93	045	Surface Only	
G94	046	Surface Only	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
G95	047	Surface Only	
G215	048	Surface Only	
G86	049	Surface Only	
G87	050	Surface Only	
G108	051	Surface Only	
G107	052	Surface Only	
G64	053	Surface Only	
G85	054	Surface Only	
G116	055	Surface Only	
MC238	056	Surface Only	
G109	057	Surface Only	
G115	058	Surface Only	
G68	059	Surface Only	
53	060	Surface/Subsurface	Station moved to deeper water
48	061	Surface/Subsurface	
51	062	Surface/Subsurface	
G110	063	Surface Only	
54	064	Surface/Subsurface	
G70	065	Surface Only	
55	066	Surface/Subsurface	
23	067	Surface/Subsurface	
G113	068	Surface Only	
MC239	069	Surface Only	
G111	070	Surface Only	
G72	071	Surface Only	
G69	072	Surface Only	
21	073	Surface/Subsurface	
22	074	Surface/Subsurface	
G118	075	Surface Only	
G112	076	Surface Only	
57	077	Surface/Subsurface	
26	078	Surface/Subsurface	Station repositioned off of outfall
24	079	Surface/Subsurface	
25	080	Surface/Subsurface	
MC240	081	Surface Only	
47	082	Surface/Subsurface	
46	083	Surface/Subsurface	
45	084	Surface/Subsurface	
29	085	Surface Only	
35	086	Surface/Subsurface	
34	087	Surface/Subsurface	
36	088	Surface/Subsurface	
27	089	Surface/Subsurface	Station repositioned off of outfalls
33	090	Surface/Subsurface	
32	091	Surface/Subsurface	
28	092	Surface/Subsurface	Station repositioned off of outfall

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
31	093	Surface/Subsurface	
30	094	Surface/Subsurface	
G71	095	Surface Only	
37	096	Surface/Subsurface	Station repositioned off of outfall
G117	097	Surface Only	
G122	098	Surface Only	
38	099	Surface/Subsurface	
G92	100	Surface Only	Station moved due to obstruction
G119	101	Surface Only	
MC270	102	Surface Only	
39	103	Surface/Subsurface	Station repositioned off of outfall
G121	104	Surface Only	
59	105	Surface/Subsurface	Station repositioned off of outfall
40	106	Surface/Subsurface	
G88	107	Surface Only	
G129	108	Surface Only	
41	109	Surface/Subsurface	Station repositioned off of outfall
G120	110	Surface Only	
44	111	Surface/Subsurface	
42	112	Surface/Subsurface	
G123	113	Surface Only	
69	114	Surface Only	
67	115	Surface Only	
66	116	Surface/Subsurface	
58	117	Surface Only	
68	118	Surface Only	
MC276	119	Surface Only	
G124	120	Surface Only	
60	121	Surface/Subsurface	Core vessel can't access Staitons 60-65, two cores will be taken
61	122	Surface/Subsurface	see 60
62	123	Surface Only	see 60
63	124	Surface Only	see 60
G125	125	Surface Only	
64	126	Surface Only	see 60
65	127	Surface/Subsurface	
MC275	128	Surface Only	
G126	129	Surface Only	
901	130	Surface/Subsurface	Station moved to deeper water
G130	131	Surface Only	
G90	132	Surface Only	
74	133	Surface/Subsurface	Station repositioned off of outfall
G131	134	Surface Only	
73	135	Surface/Subsurface	
72	136	Surface/Subsurface	Station moved due to obstruction
G132	137	Surface Only	
71	138	Surface/Subsurface	Station moved due to obstruction
70	139	Surface/Subsurface	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
G78	140	Surface Only	
G133	141	Surface Only	
75	142	Surface/Subsurface	
G80	143	Surface Only	
103	144	Surface/Subsurface	
102	145	Surface/Subsurface	
MC242	146	Surface Only	
101	147	Surface/Subsurface	
100	148	Surface/Subsurface	
G2	149	Surface Only	
99	150	Surface/Subsurface	
98	151	Surface/Subsurface	
97	152	Surface/Subsurface	
G1	153	Surface/Subsurface	
G141	154	Surface Only	
96	155	Surface/Subsurface	
95	156	Surface/Subsurface	
93	157	Surface/Subsurface	Station moved to deeper water
92	158	Surface/Subsurface	
G3	159	Surface Only	
90	160	Surface/Subsurface	Station moved to deeper water
104	161	Surface/Subsurface	
106	162	Surface/Subsurface	
105	163	Surface/Subsurface	
903	164	Surface/Subsurface	
G140	165	Surface Only	
108	166	Surface/Subsurface	
107	167	Surface/Subsurface	
G82	168	Surface Only	
115	169	Surface/Subsurface	
113	170	Surface/Subsurface	Station moved due to obstruction
118	171	Surface/Subsurface	
116	172	Surface/Subsurface	Station moved due to obstruction
121	173	Surface/Subsurface	
120	174	Surface/Subsurface	
G5	175	Surface Only	
119	176	Surface/Subsurface	Station moved due to obstruction
123	177	Surface/Subsurface	
345	178	Surface Only	
122	179	Surface/Subsurface	
344	180	Surface Only	
G138	181	Surface Only	
902	182	Surface/Subsurface	
MC244	183	Surface Only	
124	184	Surface/Subsurface	
125	185	Surface/Subsurface	
G7	186	Surface Only	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
126	187	Surface/Subsurface	
G149	188	Surface Only	
G137	189	Surface Only	
G9	190	Surface Only	
G8	191	Surface Only	
127	192	Surface/Subsurface	
G10	193	Surface Only	Station moved to improve spatial coverage
MC245	194	Surface Only	
G142	195	Surface Only	
128	196	Surface/Subsurface	
904	197	Surface/Subsurface	Station moved due to obstruction
129	198	Surface Only	Station moved due to obstruction
132	199	Surface/Subsurface	
151	200	Surface Only	Station repositioned off of outfall
130	201	Surface/Subsurface	Station moved due to obstruction
134	202	Surface/Subsurface	
133	203	Surface Only	
135	204	Surface Only	
152	205	Surface Only	Station repositioned off of outfall
136	206	Surface/Subsurface	
137	207	Surface/Subsurface	
G143	208	Surface Only	
346	209	Surface Only	Station moved due to obstruction
154	210	Surface/Subsurface	
153	211	Surface Only	
155	212	Surface Only	
156	213	Surface/Subsurface	Station moved due to obstruction
G148	214	Surface Only	
139	215	Surface/Subsurface	
MC246	216	Surface Only	
G11	217	Surface Only	Station moved due to obstruction
G13	218	Surface Only	Cannot access by boat - will collect hand Surface/Subsurfaces
149	219	Surface/Subsurface	
148	220	Surface/Subsurface	
150	221	Surface/Subsurface	
G144	222	Surface Only	
147	223	Surface/Subsurface	
G147	224	Surface Only	
G12	225	Surface Only	
G14	226	Surface Only	Cannot access by boat - will collect hand cores from land side
140	227	Surface/Subsurface	Station moved to deeper water
141	228	Surface/Subsurface	Station moved due to obstruction
G145	229	Surface Only	
347	230	Surface Only	
143	231	Surface/Subsurface	
905	232	Surface/Subsurface	Station moved due to obstruction
G156	233	Surface Only	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
144	234	Surface Only	
MC247	235	Surface Only	
G16	236	Surface Only	Station moved due to obstruction
G146	237	Surface Only	
G155	238	Surface Only	
G18	239	Surface Only	
145	240	Surface/Subsurface	
G15	241	Surface Only	
348	242	Surface Only	
G154	243	Surface Only	
261	244	Surface/Subsurface	
146	245	Surface/Subsurface	
G150	246	Surface Only	
262	247	Surface/Subsurface	
MC248	248	Surface Only	
G153	249	Surface Only	
G20	250	Surface Only	
G151	251	Surface Only	
164	252	Surface/Subsurface	
MC249	253	Surface Only	
245	254	Surface/Subsurface	
244	255	Surface/Subsurface	
160	256	Surface/Subsurface	
247	257	Surface/Subsurface	
176	258	Surface/Subsurface	
G152	259	Surface Only	
249	260	Surface/Subsurface	
MC250	261	Surface Only	
246	262	Surface/Subsurface	
161	263	Surface/Subsurface	
159	264	Surface/Subsurface	
184	265	Surface/Subsurface	
248	266	Surface/Subsurface	
252	267	Surface/Subsurface	
250	268	Surface/Subsurface	
157	269	Surface/Subsurface	
175	270	Surface/Subsurface	
MC251	271	Surface Only	
188	272	Surface/Subsurface	
174	273	Surface/Subsurface	Station moved due to obstruction
173	274	Surface/Subsurface	
251	275	Surface/Subsurface	
183	276	Surface/Subsurface	
256	277	Surface/Subsurface	
179	278	Surface/Subsurface	
258	280	Surface/Subsurface	
200	281	Surface/Subsurface	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
260	282	Surface/Subsurface	
178	283	Surface/Subsurface	
187	284	Surface/Subsurface	
MC252	285	Surface Only	
204	287	Surface/Subsurface	
186	288	Surface/Subsurface	
195	289	Surface/Subsurface	
253	290	Surface/Subsurface	
257	291	Surface/Subsurface	
185	292	Surface/Subsurface	
255	293	Surface/Subsurface	
194	294	Surface/Subsurface	
259	295	Surface/Subsurface	
358	296	Surface Only	
199	297	Surface/Subsurface	
193	298	Surface/Subsurface	
203	299	Surface/Subsurface	
212	300	Surface/Subsurface	
197	301	Surface/Subsurface	Station moved to deeper water
202	302	Surface/Subsurface	
360	303	Surface Only	
201	304	Surface/Subsurface	
207	305	Surface/Subsurface	
MC254	306	Surface Only	
216	307	Surface/Subsurface	
350	308	Surface Only	
211	309	Surface/Subsurface	
MC255	310	Surface Only	
210	311	Surface/Subsurface	
209	312	Surface/Subsurface	
220	313	Surface/Subsurface	
215	314	Surface/Subsurface	
214	315	Surface/Subsurface	
213	316	Surface/Subsurface	
219	317	Surface/Subsurface	
G157	318	Surface Only	
MC271	319	Surface Only	
349	320	Surface Only	
218	321	Surface/Subsurface	
G158	322	Surface Only	
217	323	Surface/Subsurface	
243	324	Surface/Subsurface	
240	325	Surface/Subsurface	
235	326	Surface/Subsurface	
239	327	Surface/Subsurface	Station moved closer to former outfall location
MC256	328	Surface Only	
234	329	Surface/Subsurface	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
242	330	Surface/Subsurface	
233	331	Surface/Subsurface	
238	332	Surface/Subsurface	
241	333	Surface/Subsurface	
237	334	Surface/Subsurface	
236	335	Surface/Subsurface	
G21	336	Surface Only	
227	337	Surface/Subsurface	
G160	338	Surface Only	
351	339	Surface Only	
G162	340	Surface Only	Station moved due to obstruction
226	341	Surface/Subsurface	
264	342	Surface/Subsurface	
229	343	Surface/Subsurface	
G161	344	Surface Only	
352	345	Surface Only	
263	346	Surface/Subsurface	
266	347	Surface/Subsurface	
225	348	Surface/Subsurface	
228	349	Surface/Subsurface	
353	350	Surface Only	
230	351	Surface/Subsurface	
265	352	Surface/Subsurface	Station moved due to obstruction
355	353	Surface Only	
G168	354	Surface Only	
354	355	Surface Only	
231	356	Surface/Subsurface	
335	357	Surface/Subsurface	
G164	358	Surface Only	
222	359	Surface/Subsurface	
221	360	Surface/Subsurface	
334	361	Surface/Subsurface	
224	362	Surface/Subsurface	
G31	363	Surface Only	
291	364	Surface/Subsurface	
MC259	365	Surface Only	
223	366	Surface/Subsurface	
365	367	Surface Only	
232	368	Surface/Subsurface	
G165	369	Surface Only	
G33	370	Surface Only	
356	371	Surface/Subsurface	
295	372	Surface/Subsurface	
292	373	Surface/Subsurface	
G166	374	Surface Only	
294	375	Surface/Subsurface	
364	376	Surface Only	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
267	377	Surface/Subsurface	Station moved to mouth of creek
MC261	378	Surface Only	
278	379	Surface/Subsurface	
285	380	Surface/Subsurface	
268	381	Surface/Subsurface	
271	382	Surface/Subsurface	
910	383	Surface/Subsurface	Station repositioned off of outfall
337	384	Surface/Subsurface	
279	385	Surface Only	
401	386	Surface/Subsurface	
363	387	Surface Only	
286	388	Surface/Subsurface	Station moved due to obstruction
G30	389	Surface Only	
361	390	Surface Only	
G172	391	Surface Only	
339	392	Surface/Subsurface	
272	393	Surface/Subsurface	
G171	394	Surface Only	
MC263	395	Surface Only	Station moved due to obstruction
287	396	Surface/Subsurface	
280	397	Surface/Subsurface	
362	398	Surface Only	
G34	399	Surface Only	
333	400	Surface/Subsurface	
906	401	Surface/Subsurface	Change to surface and subsurface samping location
273	402	Surface/Subsurface	
270	403	Surface/Subsurface	
269	404	Surface Only	Change to surface only sample
911	405	Surface/Subsurface	Station repositioned off of outfall
G181	406	Surface Only	
G35	407	Surface Only	
366	408	Surface Only	
402	409	Surface/Subsurface	
G174	410	Surface Only	
289	411	Surface Only	Change to surface only sample - can't access with coring vessel
G182	412	Surface Only	
299	413	Surface/Subsurface	Station repositioned off of outfall
MC277	414	Surface Only	
275	415	Surface/Subsurface	Station moved due to obstruction
367	416	Surface Only	
290	417	Surface/Subsurface	Station repositioned off of outfall
G177	418	Surface Only	
G183	419	Surface Only	
908	420	Surface/Subsurface	
276	421	Surface/Subsurface	Station moved due to obstruction1
G54	422	Surface Only	
G178	423	Surface Only	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
G184	424	Surface Only	
914	425	Surface/Subsurface	
277	426	Surface/Subsurface	
G179	427	Surface Only	
G180	428	Surface Only	
G189	429	Surface Only	
913	430	Surface/Subsurface	Station repositioned off of outfall
296	431	Surface/Subsurface	
907	432	Surface/Subsurface	Station moved due to obstruction
G188	433	Surface Only	
297	434	Surface/Subsurface	
G185	435	Surface Only	
305	436	Surface/Subsurface	
300	437	Surface/Subsurface	
G187	438	Surface Only	
301	439	Surface/Subsurface	
307	440	Surface/Subsurface	
304	441	Surface/Subsurface	
G195	442	Surface Only	
G186	443	Surface Only	
309	444	Surface/Subsurface	
308	445	Surface/Subsurface	
G196	446	Surface Only	
310	447	Surface/Subsurface	
302	448	Surface/Subsurface	
312	449	Surface/Subsurface	
303	450	Surface/Subsurface	
G197	451	Surface Only	
316	452	Surface/Subsurface	
313	453	Surface/Subsurface	
912	454	Surface/Subsurface	Station repositioned off of outfall
909	455	Surface/Subsurface	
315	456	Surface/Subsurface	
317	457	Surface/Subsurface	
318	458	Surface/Subsurface	
G37	459	Surface Only	
319	460	Surface/Subsurface	
320	461	Surface/Subsurface	
322	462	Surface/Subsurface	
G39	463	Surface Only	
326	464	Surface/Subsurface	
G198	465	Surface Only	
G192	466	Surface Only	
323	467	Surface Only	Change to surface only sample - can't access with coring vessel
325	468	Surface/Subsurface	

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
327	469	Surface/Subsurface	
G199	470	Surface Only	
332	471	Surface/Subsurface	
G41	472	Surface Only	
324	473	Surface Only	Change to surface only sample - can't access with coring vessel
329	474	Surface/Subsurface	
G193	475	Surface Only	
G200	476	Surface Only	
330	477	Surface/Subsurface	
MC264	478	Surface Only	
G36	479	Surface Only	
331	480	Surface/Subsurface	
G45	481	Surface Only	
G38	482	Surface Only	
G203	483	Surface Only	
G202	484	Surface Only	
G40	485	Surface Only	
G204	486	Surface Only	
G47	487	Surface Only	
G42	488	Surface Only	
G205	489	Surface Only	
G210	490	Surface Only	
G48	491	Surface Only	Station moved due to obstruction
G44	492	Surface Only	
G206	493	Surface Only	
920	494	Surface/Subsurface	New surface station added off of outfall
G211	495	Surface Only	
MC266	496	Surface Only	
368	497	Surface Only	
G49	498	Surface Only	
G208	499	Surface Only	
G218	500	Surface Only	
G212	501	Surface Only	
G220	502	Surface Only	
G219	503	Surface Only	Station moved due to obstruction
MC267	504	Surface Only	
G222	505	Surface Only	Station repositioned off of outfall
G221	506	Surface Only	
G224	507	Surface Only	
G223	508	Surface Only	Station repositioned off of outfall
G226	509	Surface Only	
G225	510	Surface Only	
G227	511	Surface Only	
MC268	512	Surface Only	
G228	513	Surface Only	Station repositioned off of outfall

Appendix E. Sediment Station Adjustments Made during May 24-25, 2004 Site Reconnaissance.

EPA ID	New ID	Sample Type	Comments
G232	514	Surface Only	
G233	515	Surface Only	New surface station added off of outfall
G230	516	Surface Only	Station repositioned off of outfall
G234	517	Surface Only	New surface station added off of outfall
G231	518	Surface Only	
G128	519	Surface Only	
50	N/A	Surface Only	
52	N/A	Surface Only	
91	N/A	Surface Only	Station dropped -overlaps with repositioned 90
94	N/A	Surface Only	Station dropped -overlaps with repositioned 93
114	N/A	Surface Only	Station dropped - overlaps with repositioned 113
117	N/A	Surface Only	Station dropped - overlaps with repositioned 116
321	N/A	Surface Only	Station dropped - no access behind dock
341	N/A	Surface Only	Station dropped - no access under drydock
359	N/A	Surface Only	Station dropped - under McCormick and Baxter cap footprint
G127	N/A	Surface Only	
G134	N/A	Surface Only	
G135	N/A	Surface Only	
G216	N/A	Surface Only	
G6	N/A	Surface Only	
G74	N/A	Surface Only	
G75	N/A	Surface Only	
G76	N/A	Surface Only	
G81	N/A	Surface Only	

1- Stations were generally moved closer and just downstream of observed outfalls

2- Obstructions include piers, docks, dolphins, moored vessels and barges, underwater pilings, and underwater debris and in-water structures

APPENDIX F

STANDARD OPERATING PROCEDURES: COLLECTION OF SEDIMENT SAMPLES

SURFACE SEDIMENT SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to define and standardize the methods for collecting surface sediment samples from freshwater or marine environments. For the purpose of this SOP, surface sediments are defined as those from 0 to at most 30 cm below the sediment-water interface. The actual definition of surface sediments is typically program-specific and is dependent on the purpose of the study and the regulatory criteria (if any) to which the data will be compared.

This SOP utilizes and augments the procedures outlined in Puget Sound Estuary Program (PSEP 1996) guidelines. A goal of this SOP is to ensure that the highest quality, most representative data be collected, and that these data are comparable to data collected by different programs that follow PSEP guidelines.

SUMMARY OF METHOD

Sediment samples for chemical and toxicity analysis are collected using a surface sediment sampling device (e.g., grab sampler). If a sample meets acceptability guidelines, overlying water is siphoned off the surface and the sediment is described in the field log. Sediment samples for chemical analysis may be collected directly from the sampler (e.g., volatile organic compounds and sulfides) or sediment from the sampler may be homogenized using decontaminated, stainless-steel containers and utensils prior to being placed in sample jars. Sediment from several sampler casts may also be composited.

SUPPLIES AND EQUIPMENT

A generalized supply and equipment list is provided below. Additional equipment may be required depending on project requirements.

- Sampling device:
  Grab sampler or box corer

- Field equipment:
  Siphoning hose
  Stainless-steel bowls or containers
  Stainless-steel spoons, spatulas, and/or mixer
  Decontamination supplies
  (Alconox™ detergent, 0.1 N nitric acid, methanol dionized water)
  Personal protective equipment for field team
  (rain gear, safety goggles, hard hats, nitrile gloves)
  First Aid kit
  Cell phone

Sample containers
Bubble wrap
Sample jar labels
Clear tape
Permanent markers
Pencils
Coolers
Ice

- Documentation

  Waterproof field logbook
  Field sampling plan
  Health and safety plan
  Correction forms
  Request for change forms
  Waterproof sample description forms

PROCEDURES

EQUIPMENT DECONTAMINATION

The basic procedure used most commonly in Integral field projects to decontaminate field sampling equipment is as follows:

1. Rinse with tap or vessel water.
2. Wash with brush and Alconox™ detergent.
3. Rinse with tap or vessel water.
4. Rinse with distilled water.
5. Rinse with 0.1 N Nitric acid (optional - if metals analysis is to be performed).
6. Rinse with methanol or hexane (optional - if organics analysis is to be performed or adhering petroleum residue present).
7. Rinse with distilled water.
8. Cover with aluminum foil (dull side down).

This procedure may be modified depending on site-specific requirements, as described in PSEP (1986). For example, if sampling is in areas known to be uncontaminated or only slightly contaminated, the solvent and/or acid rinses may be eliminated. Conversely, if creosote or other petroleum-based residue is encountered, a hexane rinse may be added.

Decontamination with acid or solvents should always be performed outdoors using appropriate protective equipment, including, at a minimum, chemical-resistant gloves (e.g., nitrile) and goggles. All decontamination liquids that include solvents or acids should be contained in tightly sealed buckets or other containers for disposal in an approved onshore facility. Alternatively, low-vapor pressure solvents may be evaporated in a well-ventilated open area away from the work zone.

SEDIMENT SAMPLE COLLECTION

To collect sediment for chemical and biological analyses, a sampler that obtains a quantifiable volume of sediment with minimal disturbance of the sediments must be employed. Additionally, the sampler should be composed of a material such as stainless steel or aluminum, or have a non-contaminating coating such as Teflon™. Samplers capable of providing high-quality sediment samples include grab-type samplers (van Veen, Smith-McIntyres, Young grab, power-grab and ponar grab) and box cores (Soutar, mini-Soutar, Gray-O'Hara, spade core). Some programs require a sampler that collects from a specific area (e.g., 0.1 m^2). Most sampling devices are typically a standard size; however, some non-standard sizes are available to meet the requirements of specific programs. Grab samplers, especially the van Veen grab, are the most commonly used samplers to collect surface sediment. Power grab samplers are often used for programs requiring collection of sediment deeper than 10 cm or in areas with debris.

A hydraulic winch system should be used to deploy the sampler at a rate not exceeding 1 m/sec to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, the jaws are slowly closed and the sampler is brought to the deck of the vessel at a rate not exceeding 1 m/sec to minimize any washing and disturbance of the sediment within the sampler. At the moment the sampler hits the bottom, the time, depth, and location of sample acquisition are recorded in the field logbook.

Once onboard, the sampler is secured, any overlying water is carefully siphoned off, and the sample is inspected to determine acceptability. Criteria used to determine acceptability are those detailed in PSEP (1986), except when noted in the project-specific field sampling plan (FSP). These criteria include but are not limited to:

- There is minimal or no excessive water leakage from the jaws of the sampler.
- There is no excessive turbidity in the water overlying the sample.
- The sampler is not over-penetrated.

- The sediment surface appears to be intact with minimal disturbance.
- The program-specified penetration depths are attained.

If the sample meets acceptability criteria, the sample is recorded and observations entered into a sample description form or log. Once the sample has been characterized, the sediment is then sub-sampled for chemical and biological analyses.

SAMPLE PROCESSING

Sediment for chemical and/or toxicity analyses is removed from the sampler using a stainless-steel spoon. Depending on programmatic goals, the upper 2 to 30 cm of sediment are removed. To prevent possible cross contamination, sediments touching the margins of the sampler are not used.

Samples for volatile compounds (either organics or sulfides) are collected using a decontaminated stainless-steel spoon while sediment is still in the sampler. These sediments are not homogenized. The volatile organics sample jar should be tightly packed with sediment (to eliminate obvious air pockets) and filled so that there is no headspace remaining in the jar. Alternatively, if there is adequate water in the sediment, the container may be filled to overflowing so that a convex meniscus forms at the top, and the cap carefully placed on the jar. Once sealed, there should be no air bubbles. The sulfides sample is preserved with 0.2 N zinc acetate.

The remaining sediment is then placed into a pre-cleaned, stainless-steel bowl. Typically, sediment from a minimum of three separate casts of the sampler is composited at each station. Once a sufficient amount of sediment has been collected, the sediment is homogenized until it is of uniform color and has obtained a smooth consistency. It is then dispensed into pre-cleaned sample jars for the various chemical or biological analyses. Sample jars for biological analyses should be filled to the top with sediment to minimize available headspace. This procedure will minimize any oxidation reactions within the sediment. Sample jars for chemical analysis may be frozen for storage, leaving enough headspace left in the container to allow for expansion of the sediment upon freezing. After dispensing the sediment, the containers are then placed into coolers with ice and are either shipped directly to the analytical laboratories or transported to a storage facility.

CHAIN-OF-CUSTODY

Field

The cruise leader or other designated field sample custodian is responsible for all sample tracking and chain-of-custody procedures until sample custody is transferred to the laboratory. Custody procedures in the field are as follows:

1. Record all field and sample collection activities (including sample identification number, collection time and date) in the field logbook. While being used in the field, the logbook remains with the field team at all times. Upon completion of the sampling effort, the logbook should be reproduced and then kept in a secure area.
2. Complete a chain-of-custody form whenever samples are being transferred or removed from the custody of field sampling personnel. A sample form is provided in Appendix B. Record each individual sample on the form. Include additional information to assist in sample tracking such as collection date and time, number of containers, and sample matrix. The chain-of-custody may also serve as the sample analysis request form, with the required analysis indicated for each individual sample.
3. Sign the form and ensure that the samples are not left unattended unless secured.
4. Store, pack, or ship samples as described in the following section. Place the original completed chain-of-custody form in a sealed plastic bag inside the shipping container. A copy is retained by the shipping party.
5. Complete a separate custody form for each individual shipping container or a single form for all samples in multiple shipping containers in a single shipment, with the number of containers noted on the custody form.
6. Attach completed custody seals to any shipping container that will be sent to the laboratory by delivery service or courier. Delivery personnel are not required to sign the custody form if custody seals are used. Custody seals are used to detect unauthorized tampering with the samples. Gummed paper or tape should be used so that the seal must be broken when the container is opened. The laboratory sample custodian (or other sample recipient) will establish the integrity of the seals.

7. The laboratory custodian (or other sample recipient) acknowledges receipt of the samples by signing, dating, and noting the time of transfer on the chain-of-custody form. The condition of the samples and any problems or irregularities (e.g., cracked or broken jars, loose lids, evidence of tampering) should also be recorded. Return a copy of the completed custody form to the project manger or designated sample coordinator.

Laboratory

The laboratory will designate a sample custodian who is responsible for receiving samples and documenting their progress through the laboratory analytical process. Each custodian will ensure that the chain-of-custody and sample tracking forms are properly completed, signed, and initialed on transfer of the samples. Specific laboratory chain-of-custody procedures should be in writing, included in the laboratory QA plan, and approved prior to beginning sampling and analysis. Laboratory custody procedures should include the following:

- A designated laboratory person initiates and maintains a sample tracking log that will follow each sample through all stages of laboratory processing and analysis.
- The laboratory tracking log includes, at a minimum, the sample number, location and type of storage, date and time of each removal, and signature of the person removing or returning the sample.
- The final disposition of the sample is recorded.

CHAIN-OF-CUSTODY QUALITY CONTROL PROCEDURES

Complete and correct chain-of-custody is essential to ensure and demonstrate sample integrity. Errors in entering information or transferring custody can result in analytical or data reporting errors. Inaccuracies or errors in sample tracking and custody records can compromise data usability, particularly as legal evidence.

Quality control procedures include the following:

- Allow adequate time to take accurate and complete field records and to carefully complete chain-of-custody forms.
- When possible, work in pairs or more to complete the chain-of-custody form and check for accurate information entry.

- Complete all custody records in ink; errors should be neatly crossed out and corrected and initialed by the person making the change.
- Immediately notify the project manager of any deviation from required custody procedures.

PACKING AND SHIPPING SAMPLES

Environmental samples are packed in a manner to reduce the chance of sample breakage, ensure sample integrity, and prevent material leakage and potential exposure to hazardous materials in the event of breakage. Samples are placed in sealed plastic bags and packed in a sturdy container with adequate packing material to prevent breakage. Ice or dry ice may be included to maintain sample storage conditions. Samples are transported by field personnel or shipped via courier or common carrier. Shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24).

All preserved samples should be shipped as soon as possible after completion of sampling. This minimizes the number of people handling samples and protects sample quality and security.

Sample Packing

Upon completion of final sample inventory by the field sample custodian and completion of chain-of-custody, samples are packed as follows:

1. If not already done after sample collection, wipe the outside of each sample container and lid with a disposable cloth to remove any soil or sediment adhering to the outside of the jar and place each container in a sealed plastic bag (e.g., ziplock).
2. Wrap each glass sample container in bubble wrap or place it in a bubble wrap plastic bag. [Note: When samples are being transported by field personnel directly from the field site to the laboratory (thereby ensuring careful handling), this step is recommended but may be omitted. However, this step is required when a courier or delivery service is transporting the samples.]
3. Line the shipping container with heavy-duty plastic bags (e.g., garbage bags) and bubble wrap. Use a leak-proof, sturdy container that can withstand rough treatment during shipping. If ice chests or coolers are used, the drain should be securely plugged and sealed with duct tape.

4. Place the samples tightly in the shipping container:
   - Use dividers or bubble wrap to separate all glass containers
   - Fill any empty space in the shipping cooler or box with packing material so that the jars are held securely.

5. Place the original completed chain-of-custody form in a sealed plastic bag and place it inside the shipping container. If using a cooler or ice chest, the form should be securely taped to the inside of lid.
6. For liquid samples, absorbent material (e.g., vermiculite) should be placed in the container in sufficient quantity such that all liquid could be absorbed.
7. Tie or seal the bag lining the shipping container.
8. If required to meet sample storage requirements, fill the ice chest with crushed or block ice, blue ice (refrigerated samples, 4°C) or dry ice (frozen samples). A temperature blank (provided by the laboratory) should be packed in each cooler.
9. If samples for volatile organics analysis (VOA) are included in the shipping container, two VOA trip blanks (provided by the analytical laboratory) should also be packed in the cooler.
10. Seal shipping container securely with packing or duct tape.
11. If the shipping container will be transported by anyone other than the person who completed and signed the chain-of-custody form, attach completed custody seals so that the shipping container cannot be opened without breaking the seal.
12. Attach a *This End Up* label to each side of the shipping container to ensure that jars are transported in an upright position. A *Fragile* label may also be attached to reduce rough handling of the samples.
13. Label the shipping container with all appropriate information (name of project, time and date, responsible person and company name, address and phone) to enable positive identification.

Sample Shipping

Packed containers may be delivered to the laboratory or storage facility by field personnel, courier, or common carrier (FedEx, UPS). However, any outside carrier or courier service must provide a delivery receipt. The carrier or courier must also ensure delivery time if holding time and storage conditions are critical.

Unless arranged in advance, shipping charges should be prepaid by sender to avoid confusion and possible rejection of the package by the laboratory.

The adequacy of handling and shipping procedures is reflected in the condition of the samples upon receipt by the laboratory:

- No jars are cracked or broken.
- There is no evidence of sample leakage.
- Measuring the temperature of the temperature black indicates that correct storage conditions have been maintained.

The sample custodian or other designated person is responsible for confirming that copies of all shipping documents, completed in full and correctly, are on file at Integral.

QUALITY CONTROL PROCEDURES

Field quality control (QC) samples that may be collected during surface sediment sampling are the same as for any field sampling program. The types and frequency of field QC sample collection are project-specific and will be described in the project field sampling plan. The most commonly collected field QC sample are described below (PSEP 1996):

- **Field Blank**. A field blank is a sample of analyte-free water that is supplied by the laboratory. The field blank is generated by transferring the analyte-free water to another laboratory-supplied sample container while at the field sampling location. Field blank results are used to measure and document any possible onsite contamination.

- **Field Split Sample**. A field split sample consists of aliquots of the same homogenized sediment sample that are equally distributed in two sets of sample containers. These samples may be analyzed identically or analyzed by different laboratories to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.

- **Field Replicate**. A field replicate consists of a second sample that is collected using the same sampling methodology used to obtain the first sample. It is collected at the same sampling location and as soon after the original sample as possible. Analysis of the field replicate allows evaluation of the repeatability of field sampling methodologies, as well as the heterogeneity of the sample matrix. Statistical analysis of multiple replicates may also be used to calculate the likely range of an analyte concentration at a given sampling location.

REFERENCES

PSEP. 1996. Puget Sound Estuary Program: Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Final Report. TC-3991-04. Prepared for U.S. Environmental Protection Agency, Region 10 and Puget Sound Estuary Program, Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA.

SEDIMENT CORE COLLECTION AND PROCESSING

Sediment cores are collected to evaluate chemical and/or biological characteristics of surface and subsurface sediments at depths that greatly exceed those achieved by grab or other surface samplers. The purpose of this SOP is to define and standardize procedures for the collection of samples from surface and subsurface sediment cores. Additionally, this SOP will help ensure that the highest quality, most representative data are collected, and that these data are comparable to data from other programs. This SOP is based on the procedures outlined in Puget Sound Estuary Program guidelines (PSEP 1996).

SUMMARY OF METHOD

Sediment cores are collected using some type of coring device, including gravity corers, piston corers, vibracorers and diver-driven cores. Actual operations will vary depending on the equipment selected. Selection of the most appropriate corer usually depends on may factors, including but not limited to:

- The quantity of sample required
- The penetration depth required
- The sediment type (e.g. rocky, soft, compact)
- Vessel availability and capability (i.e. size, lifting capacity etc.).

Regardless of the coring method, the core tube should be constructed of a non-contaminating material such as stainless steel or aluminum, or should use a liner constructed of a non-contaminating material (e.g., polycarbonate).

Once the sediment core is collected, it is extruded or split so that the sediment can be sampled, processed, and transported to the analytical laboratory.

Supplies and Equipment

A generalized supply and equipment list is provided below. Additional equipment may be required depending on project requirements.

- Sampling device:

  Corer
  Core tubes
  Core tube liners (optional)
  Core tube caps

- Field equipment:

  Aluminum foil
  Duct tape
  Hack saw
  Indelible ink pen

Pipe cutter
Circular saw (if splitting tube longitudinally)
Plunger (if necessary)
Table or tray
Ice (if storing cores)
Stainless-steel bowls
Stainless-steel spoons, spatulas, and/or mixer
Personal protective equipment for field team
(rain gear, safety goggles, hard hats, nitrile gloves) First Aid kit
Cell phone
Sample containers
Bubble wrap
Clear tape
Permanent markers
Pencils
Coolers

- Documentation

  Core description forms or log book
  Waterproof field logbook
  Field sampling plan
  Health and safety plan
  Correction forms
  Request for change forms
  Waterproof sample description forms

CORE COLLECTION PROCEDURES

CORER DEPLOYMENT

Gravity and piston corers utilize inertia as the primary driving force to achieve the desired penetration depth. The degree of penetration can be altered by either adjusting the number of weights at the top of the tube or by changing the vertical distance that the core tube is allowed to free-fall. During descent, the corer should be lowered under power to its predetermined free-fall distance above the bottom. The lowering should be halted when this vertical distance equals the difference between the meter wheel reading and the fathometer reading.

If the device is equipped with a trip-weight or a small gravity trip-corer, the free-fall distance will equal the length of the core tube plus the vertical distance between the core cutter and the trip-weight suspended beneath it. When the trip-weight contacts the bottom, it relaxes the tension on the release mechanism and the core tube free-falls into the sediment. Consistent penetration depths can be obtained with this method, as the free-fall distance is independent of winch control and changing bottom depth.

The vibracorer uses a hydraulic system that vibrates and drives a length of aluminum tubing into the sediment. A continuous sediment sample is retained within the tubing with the aid of a stainless-steel core cutter/catcher. Coring can continue until the total sample depth is reached.

CORE RETRIEVAL

The core is extracted from the substrate and pulled onto the sampling vessel using the vessel winch or crane. The amount of pull that is required depends on the coring device and its contents, plus the amount of frictional force against the surface of the core tube that must be overcome. The frictional force depends on the sediment type (e.g. clay-based material requires more pull) and the depth penetrated (PSEP 1996). During core extraction, the wire strain should be steady and continuous, with the vessel held stationary directly above the coring device. Once the core is extracted from the bottom, the winch speed may be increased to about 4 ft/sec.

The core is brought on board the vessel. While the tube is still vertical, overlying water may be siphoned off the top of the core tube. Recovery is estimated to accurately determine the true depth from which the sediments were collected and the location of those sediments within the core barrel. In most cases, recovery is estimated by comparing the length of the sediment core material to the overall penetration depth (as indicated by traces of sediment material on the outer surface of the core tube). The ratio of penetration depth to core material length is calculated to determine the compaction of the sediment during coring. Alternatively, some vibracorers are equipped with a transducer to measure penetration depth. A second transducer is mounted directly above the core tube to determine the height of the sediment column within the core barrel. Recovery can be estimated from the difference between the two transducer readings. Recoveries typically range between 50 and 90 percent.

Continuous core lengths (such as those obtained by a vibracorer) may be sectioned into smaller lengths for ease of handling and/or to represent the desired sampling intervals. The core tube is placed on a secure surface and tightly anchored. Beginning at the top of the core tube, sample sections are marked on the outside of the core tube in indelible ink. Before the tube is cut, a label identifying the station and core section is securely attached to the outside of the casing at the top of each section, and wrapped with transparent tape to prevent loss or damage of the label. (Note that care should be taken when measuring core sections to consider core compaction.) Core sections may then be cut using a manual, heavy-duty pipe cutter.

After the tube is cut, sediment at the end of each tube section cut is visually classified for qualitative sample characteristics. Changes from the top to the bottom of each section of the tube are noted and recorded in the field log or core description forms. If the core section will be stored or transported, the core ends are then covered with aluminum foil, a protective cap, and duct tape to prevent leakage. Ideally, the core sections should be stored upright in a container chilled with ice to approximately 4°C. Empty tubing should be removed to help ensure that each section is full of sediment. This limits disturbance during storage and transport. If necessary, cores should be stored securely in a manner consistent with chain-of-custody procedures. Typically, cores remain in the custody of field staff until sampling is completed and sample jars transported to the analytical laboratory (see SOPs for Surface Sediment Sampling).

CORE PROCESSING PROCEDURES

SEDIMENT CORE EXTRUSION

Cores should be split or extruded and processed within 24 hours of collection, either onboard the vessel or at an onshore sample processing facility. The sediment may be removed from the core tube by either extrusion or longitudinal sectioning (i.e., splitting). Extrusion is done by tilting the core tube until the sediment core slides out onto a clean, aluminum-foil-covered table or tray. Vibration or tapping of the core tube may aid extrusion. If the sediment core does not slide out easily, a plunger may be used to push the sediment out of the tube. The plunger should be cleaned and covered with clean aluminum foil each time it is used. Once the tube is extruded, a thin (0.25 to 0.5 cm) outer layer of the sediment core is scrapped away using a decontaminated, stainless-steel knife (see SOP for Surface Sediment Sampling. This outer material may be used for sediment grain-size determination if sediment volume is of concern, but should not be used for any chemical analyses.

In longitudinal core splitting, the core tube or liner is split with a circular saw to expose the sediment core, or the core material can be run across a splitting knife as it is extruded. If a core tube liner is used, care should be taken to scrap the surface of the sediment core to remove any shavings of liner material.

SEDIMENT SAMPLE PROCESSING

Regardless of how the sediment core is obtained and prepared, the procedures for record keeping, sediment processing and sampling techniques are as follows:

1. Immediately following core extrusion or splitting, collect samples for volatile compounds (either organics or sulfides) using a

decontaminated,stainless-steel spoon. The volatile organics sample jar should be tightly packed (to eliminate obvious air pockets) and filled so that there is no head-space remaining in the jar. Alternatively, if there is adequate water in the sediment, the container may be filled to overflowing so that a convex meniscus forms at the top, and the cap carefully placed on the jar. Once sealed, there should be no air bubbles. The sulfides sample is preserved with 0.2 N zinc acetate.

2. Record core sediment characteristics on a core description form (see attached). Observations should include stratification of color and sediment composition, odor, biological organisms, foreign objects etc.
3. Place remaining core sediment in a decontaminated, stainless-steel bowl (see SOP for Surface Sediment Sampling) and mix thoroughly with a stainless-steel spoon, spatula or mixer until uniform color and texture are achieved. Large rocks or wood pieces may be omitted from the final laboratory sample, but should be noted in the log or description form.
4. If sediment from multiple core sections will be composited, cover the bowl with clean foil and set the bowl aside (refrigerate or keep cool on ice) while handling additional cores. Once all the required sediment has been placed in the bowl, thoroughly mix until uniform color and texture are achieved.
5. Transfer aliquots of homogenized sediment to labeled sample containers provided by the analytical laboratory. Labels should include, at minimum, the company name, project name, sample identifier, date and time of collection, and the initials of sampling personnel.
6. Pack and transport samples as described in the SOP for Surface Sediment Sampling. If samples will be stored, follow procedures specified in the project sampling plan.

QUALITY CONTROL PROCEDURES

Field quality control (QC) samples that may be collected during sediment coring are the same as for any field sampling program. The types and frequency of field QC sample collection are project-specific and will be described in the field sampling plan. The most commonly collected field QC sample are described below (PSEP 1996):

- **Field Blank**. A field blank is a sample of analyte-free water that is supplied by the laboratory. The field blank is generated by transferring the analyte-free water to another laboratory-supplied sample container while at the field sampling location. Field blank results are used to measure and document any possible onsite contamination.

- **Field Split Sample**. A field split sample consists of aliquots of the same homogenized sediment sample that are equally distributed in two sets of sample containers. These samples may be analyzed identically or analyzed by different laboratories to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.

- **Field Replicate**. A field replicate consists of a second sample that is collected using the same sampling methodology used to obtain the first sample. It is collected at the same sampling location and as soon after the original sample as possible. Analysis of the field replicate allows evaluation of the repeatability of field sampling methodologies, as well as the heterogeneity of the sample matrix. Statistical analysis of multiple replicates may also be used to calculate the likely range of an analyte concentration at a given sampling location.

Additional types of QC samples are described in the SOP for Surface Sediment Sampling.

REFERENCES

PSEP. 1996. Puget Sound Estuary Program: Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, and Puget Sound Estuary Program Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA