To: Fuentes, Rene[fuentes.rene@epa.gov]
From: Humphrey, Chip
Sent: Wed 3/6/2013 7:42:19 PM
Subject: FW: Summary COC table
SummaryCOCs20130305.docx
COCEvalTable20130305.xlsx

Is this version any better?

-----Original Message-----
From: King, Todd W. [mailto:KingTW@cdmsmith.com]
Sent: Tuesday, March 05, 2013 7:10 PM
To: Humphrey, Chip; Koch, Kristine
Cc: Penoyar, Susan
Subject: Summary COC table

I got everything onto one 4 page table. Think this will work for TCT update?

Made some tweaks to Excel spreadsheet (attached).

If you like the format, I'd like to run by Burt and Elizabeth for QA/QC.

Thanks,

TK

To: Fuentes, Rene[fuentes.rene@epa.gov]; Muza, Richard[Muza.Richard@epa.gov]
From: Koch, Kristine
Sent: Tue 2/26/2013 6:37:55 PM
Subject: FW: Key Issues for Initial Discussion with EPA
koch_2012-01-13_DF RI_Sec3_Environmental Setting_Text_Integral.doc

I think I'm going to need both your support in the near future…a lot of what they have issues on is groundwater – surprise, surprise! Please look over language they have highlighted in the attached document and let me know what you think. I don't need a response today, but the sooner I can resolve these issues, the better.

Thanks,

Kristine

From: Gene Revelas [mailto:grevelas@integral-corp.com]
Sent: Tuesday, February 26, 2013 10:13 AM
To: Koch, Kristine
Cc: 'James McKenna'; 'Jennifer Woronets'
Subject: FW: Key Issues for Initial Discussion with EPA
Importance: High

Hi Kristine –

To support today's call, Integral has highlighted some subsections in the EPA's Section 3 redline that we have technical concerns with and would like to discuss. In addition to the yellow highlighting, these subsections are noted with a bracketed label [KEY ISSUE FOR DISCUSSION WITH EPA] and are found in the following sections:

3.1.3.3

3.1.3.4

3.1.5.2.2

3.1.5.2.4

3.1.5.2.5

3.1.7.1.

Note that we did not have time to closely review subsequent sections may have additional issues for discussion in later sections.

Thanks,

Gene

Gene Revelas | Senior Managing Scientist

Integral Consulting Inc. | www.integral-corp.com

1205 West Bay Drive NW | Olympia, WA 98502

Tel: 360.705.3534, ext. 418 | Cell: 360.870.4950 | Fax: 360.705.3669

HEALTH ENVIRONMENT TECHNOLOGY SUSTAINABILITY

3.0 ENVIRONMENTAL SETTING

This section describes the current and historical physical characteristics and human uses of the Portland Harbor Superfund Site. Physical characteristics of the site include meteorology, regional geology and hydrogeology, surface water hydrology, the physical system (which includes bathymetry, sediment characteristics, and hydrodynamics and sediment transport), habitat, and surface features. Human characteristics of the site that are discussed here include historical and current land and river use, the municipal sewer system, and human access and use. In addition to providing context to the RI sampling and analysis, the factors presented in this section are considered in the refinement of the Study Area-wide CSM, which is presented in Section 10.

Sections 3.1 through 3.7 focuses primarily on the physical setting within the Study Area (RM 1.9 to 11.8). However, the physical features of the Willamette River from Willamette Falls (RM 26) to the Columbia River (RM 0), as well as the upstream portion of Multnomah Channel, are discussed as needed to place the Study Area's physical characteristics into a regional context.

The Willamette River basin has a drainage area of 11,500 square miles and is bordered by foothills and mountains of the Cascade and Coast ranges up to 10,000 feet high to the south, east, and west (Franble 1963). The main channel of the Willamette forms in the southern portion of the valley near Eugene, at the convergence of the Middle and Coast forks. It flows through the broad and fertile Willamette Valley region and at Oregon City flows over the Willamette Falls and passes through Portland before joining the Columbia River (Map 3.1-1).

The Willamette flows predominantly from the south to the north and has a total channel length of about 309 miles. It is the 10th largest river in the contiguous United States in terms of volume and the 13th largest in terms of discharge. The portion of the river from Willamette Falls to the Columbia River is considered the lower Willamette River. (See Map 1.2-1). Multnomah Channel is a distributary channel of the lower Willamette River that begins at RM 3.1 and flows northwest approximately 21 miles to its confluence with the Columbia River.

The upstream reaches of the Willamette River above Willamette Falls constitute a meandering and, in some cases, braided river channel. Upstream flooding is largely controlled by 13 major tributary reservoirs (Uhrich and Wanta 1998). In the lowerWR Willamette River, especially in the vicinity of Portland Harbor, the channel banks have been stabilized in several areas by the placement of riprap, and construction of seawalls, bulkheads, etc. These measures have created a much more stable channel in the lower Willamette River.

The portion of the river where the federal navigation channel is maintained at –40 ft Columbia River Datum (CRD; see Section 3.4.1) defines Portland Harbor and extends upstream from the Columbia River (RM 0) to the Broadway Bridge (RM 11.7; Map 1.2-

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). From 1973 through 2007, average annual mean flow in the Willamette River was approximately 33,800 cubic feet per second (cfs) at the Morrison Bridge (near RM 12.8) in Portland.[1]

3.1 PHYSICAL ENVIRONMENT

3.1.1 Meteorology

Located about 65 miles inland from the Pacific Ocean, the city of Portland and Portland Harbor are situated near the confluence of the Willamette and Columbia rivers. This area lies approximately 20 ft above sea level and is about midway between the Coast Range to the west and the Cascades Range to the east. The climate of Portland is usually described as temperate or Oceanic, with mild, damp winters and relatively dry, warm summers. The Coast Range provides limited protection from Pacific Ocean storms while the steep slope of the Cascades Range impedes moisture-laden westerly winds, resulting in moderate rainfall in the area, especially during the winter months (NOAA 2010).

Precipitation falls primarily as rain, with nearly 90 percent occurring between mid-October and mid-May. Rainfall varies across the metropolitan area with the West Hills (located to the west of the Study Area) receiving nearly 60 inches of rain per year while the Portland International Airport (located to the east of the Study Area) only receives about 36 inches. Forest Park, which is located in the West Hills, drains to the Study Area. Measurable snow accumulations are rarely more than 2 inches, occurring most frequently at elevations over 500 ft (including the West Hills) or along Portland's eastern boundary near the Columbia River Gorge at Troutdale (NOAA 2010). The city has experienced some major snow and ice storms caused by cold air outflow from the gorge. A storm in 1893 resulted in approximately 60 inches of snow accumulation (NOAA 2010).

Winds are from the north and west during the late spring and summer dry season and from the east and south during the fall and winter rainy season. Annual monthly wind speeds average 8.0 mph at the Portland airport (NOAA 2011). Average temperatures range from a low of 45°F (7°C) in the winter months to a high of the middle 90s (~35 °C) in the late summer (NOAA 2000). The lowest temperature ever recorded in Portland was −3°F (−19°C), which occurred on February 2, 1950. The highest temperature ever recorded was 107°F (42°C), on July 30, 1965 and again on August 8 and 10, 1981 (NOAA 2011).

3.1.2 Geology

3.1.2.1 Geologic Setting

The Study Area is located along the southwestern edge of a large geologic structure known as the Portland Basin. The Portland Basin is a bowl-like structure that is 40

[1] Data obtained from the USGS Water Resources web site (http://waterdata.usgs.gov/or/nwis/sw).

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miles long and 20 miles wide and bounded by folded and faulted uplands. These northwest-trending structural zones are interpreted as dextral wrench faults that delineate the Portland pull-apart basin (Beeson et al. 1985; Yeats and Patton 1991). The Tualatin Mountains (Portland West Hills) form a ridge that runs parallel to the Willamette River to the west, from the Multnomah Channel to the City of Portland. The mountains define the western edge of the Portland Basin; groundwater and creeks and channels along the east face of the mountains flow downward to the Willamette River.

The basin has been filled with up to 1,400 ft of alluvial and glacio-fluvial flood deposits since the middle Miocene (approximately 12 million years ago). These sediments overlie older (Eocene and Miocene) rocks including the Columbia River Basalt Group (CRBG), Waverly Heights basalt, and older marine sediments. The older rocks are exposed where uplifting has occurred (e.g., RM 7 west side in the Doane Lake area) on the margins of the basin, including adjacent to the Study Area.

Because the Study Area is located at the edge of the basin, both the older rocks and overlying sediments are present near the surface and play a significant role in defining interactions between groundwater and the river. The geologic units found in the vicinity of the Study Area are illustrated in Figure 3.1-1 and briefly described below, from youngest to oldest (Beeson et al. 1991; Swanson et al. 1993):

3.1.2.1.1 Recent Anthropomorphic Fill.

Anthropomorphic fill blankets much of the lowland area next to the river and is predominantly dredged river sediment, including fine sand and silty sand. Hydraulic dredge fill was used to fill portions of the flood plain, such as Doane Lake, Guild's Lake, Kittridge Lake, Mocks Bottom, Rivergate, and a number of sloughs and low-lying areas. The fill also was used to connect Swan Island to the east shore of the Willamette River and to elevate or extend the bank along significant lengths of both sides of the riverfront by filling behind artificial and natural silt and clay flood levee dike structures. Rocks, gravel, sand, and silt also were used to fill low-lying upland and bank areas. The thickness of this unit ranges from 0 to 20 or more feet. The permeability of this unit, where composed of clean dredge fill sand, is higher than the natural fine-grained alluvium. The presence of silt fill or a silty matrix in the sand fill generally reduces the permeability of the unit significantly.

3.1.2.1.2 Fine-grained Pleistocene Flood Deposits and Recent Alluvium (Undifferentiated).

This unit includes fine-grained facies of the Pleistocene Flood Deposits, as well as recent alluvium deposited by the present Willamette River. This unit generally consists of silt, clay, silty sand, and fine-to-medium sand that borders and underlies the present floodplain of the river (Beeson et al. 1991). The lower portions of this unit and where it forms the large bluffs bordering the east side of the river likely consist of the fine-grained facies of the flood deposits, whereas the upper portions

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near the river are likely more recent alluvium. The upper fine-grained portion of the unit has likely been reworked and deposited by the present Willamette River. The sands of this unit may be indistinguishable from overlying dredge fill in some places (Landau 2002a). The thickness of this unit ranges from 20 to over 100 ft. The permeability of the clay, silt, and silty sand of this unit is generally relatively low, whereas the portions of the unit consisting of clean sands may have a relatively higher permeability. This unit forms part of the Unconsolidated Sedimentary Aquifer regional hydrostratigraphic unit proposed by Swanson et al. (1993).

3.1.2.1.3 Coarse-grained Pleistocene Flood Deposits (Gravels).

This unit includes fluvial deposits from the Pleistocene Missoula floods. The deposits fill deep channels that were incised into the Troutdale Formation and CRBG during the floods. The unit consists of uncemented sand, gravel, and cobbles with boulders in places. This unit is generally between 10 and 200 ft thick in the vicinity of the Study Area and underlies fine-grained flood deposits and recent alluvium under much of the Study Area. The Willamette River subsequently incised the flood deposits in places. The rise in sea level from the end of the Pleistocene to the present resulted in the filling of the incised channel by finer-grained flood and recent alluvial facies to form the current floodplain channel of the river.

3.1.2.1.4 Upper Troutdale Formation.

The upper Troutdale Formation in the vicinity of the lower Willamette River includes cemented and uncemented alluvial sand, gravel, and cobbles deposited by the ancestral Willamette and Columbia rivers. The Troutdale Formation comprises the Troutdale Gravel Aquifer hydrostratigraphic unit. This unit is present in some places on the west side of the Study Area to thicknesses of 100 ft and is present along the entire length of the east side of the Study Area at thicknesses of up to 200 ft (Swanson et al. 1993).

3.1.2.1.5 Lower Troutdale Formation/Sandy River Mudstone.

The Sandy River Mudstone (SRM) is a fine-grained equivalent of the lower Troutdale Formation (channel facies) that overlies the CRBG in the center of the basin and at the margins of the basin away from the axis of the Columbia River. The lower Troutdale Formation/SRM is present in places under the lower Willamette River (Swanson et al. 1993) and borders the Portland Hills, but is not considered a significant hydrogeologic unit within the Study Area. The lower Troutdale Formation/SRM consists mostly of silt and clay with lenses of sand and gravel and tends toward fine-grained (low permeability) textures at the basin margins (Swanson et al. 1993).

- **Columbia River Basalt Group.**

The CRBG consists of a thick sequence of Miocene basalt flows dating from between 17 and 6 million years ago (mya), but the CRBG flows that underlie much of the Portland Basin entered the area between 16.5 mya and 12 mya.

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Basalt flows of the CRBG were folded and faulted during the uplift of the Tualatin Mountains, concurrent with eruption and emplacement of younger flows present in the Portland Basin (Beeson et al. 1991). The CRBG is present at the surface or at relatively shallow depths along the west side of the Study Area and may be in direct contact with the river in places. The top of the unit drops off below ground surface (bgs) over a relatively short distance and is 400 or more feet bgs on the east side of the Study Area. The thickness of the CRBG in the vicinity of the Study Area is estimated to be approximately 600 ft (Beeson et al. 1991).

3.1.2.2 Tectonic Setting

- The regional sources of seismicity affecting the Portland Metropolitan area are associated with three separate fault mechanisms. These include "mega-thrust" subduction earthquakes (moment magnitude [Mw] 8 to 9) and relatively deeper, Benioff-zone, intraplate events (Mw 6.5 to 7.3) both associated with the Cascadia Subduction Zone (CSZ), as well as the relatively shallow crustal zone earthquakes (Mw 5.0 to 7.0). Geotechnical analyses for seismic hazards associated with liquefaction and earthquake-induced slope deformation require that the specific earthquake sources be recognized so that effects of ground motion attenuation, duration, and frequency content on these hazards can be assessed. Descriptions of these potential earthquake sources are presented as follows.

3.1.2.2.1 Cascadia Subduction Zone (CSZ)

The CSZ extends from Northern California to British Columbia and the seismogenic portion of the CSZ is largely located offshore at the latitude of Portland. Within this zone, the oceanic Juan De Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between the two plates is dipping to the east, and, therefore, becomes deeper toward Portland. At the easternmost portion of the interface zone that is thought to be capable of generating strong ground motions, the interface between these two plates is located at a depth of approximately 20 to 25 kilometers (km). Quantifying the seismicity and hazard posed by the CSZ is subject to several uncertainties, including the size of the maximum credible earthquake as described by the moment magnitude of the event, the rate of seismicity associated with the CSZ, and the nature of the ground motions associated with CSZ earthquakes. Geologic evidence of previous CSZ earthquakes has been observed within coastal marshes along the Oregon coast and in off-shore landslide deposits (turbidites). This paleoseismic data has been used to infer the size of pre-historic earthquakes as well as their rate of recurrence. These geologic investigations indicate that large (Mw > 8) subduction zone earthquakes along Cascadia occur at intervals on the order of 300 to 500 years, well within the period of interest for this project. The most recent mega-thrust earthquake is estimated to have occurred approximately 300 years ago.

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Based on the most current Probabilistic Seismic Hazard Analyses (PSHA) performed by the USGS National Seismic Hazard Mapping Program (Peterson et al. 2011), the closest distance from the site to the portion of the CSZ that is thought to be capable of generating significant ground motions is approximately 95 to 100 km. This fault location is consistent with that specified by agencies such as the Oregon Department of Transportation (ODOT), U.S. Army Corps of Engineers (USACE), and U.S. Bureau of Reclamation, and accepted by regulatory agencies such as the Federal Energy Regulatory Commission (FERC).

3.1.2.2.2 Benioff Zone

The Benioff zone encompasses the portion of the subducting Juan De Fuca Plate located at a depth of approximately 30 to 50 km below western Oregon. Very low levels of seismicity have been observed within the intraplate zone in Oregon. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested by Geomatrix (1995) and these include changes in the direction of subduction between Oregon and British Columbia as well as the effects of volcanic activity along the Cascade Range. Historical activity associated with the intraplate zone includes the 1949 Olympia Mw 7.1, 1965 Puget Sound Mw 6.5, and 2001 Nisqually Mw 6.8 earthquakes. The regional PSHA prepared for the USGS (Peterson et al. 2011) indicates that the Benioff zone earthquakes significantly contribute to the seismic hazard at the return period associated with the CLE (i.e., 475 years).

3.1.2.2.3 North American Plate

- The third source of seismicity that can result in significant ground shaking within the greater Portland area is near-surface, crustal earthquakes occurring within the North American Plate. The historical seismicity of moderate-sized crustal earthquakes in western Oregon is higher than the seismicity associated with the CSZ and the intraplate zone. The 1993 Scotts Mills (Mw 5.6) and Klamath Falls (Mw 6.0) earthquakes are examples of relatively shallow (approximately 15 km) crustal earthquakes. The characterization of the local crustal earthquake sources includes known faults thought to be active in the Portland region, and consideration of possible seismicity that may occur in the region along unmapped sources. The crustal earthquakes that occur along currently unmapped faults in the region have been referred to in seismic hazard investigations as "randomly occurring" earthquakes, "aerial sources," or "gridded seismicity".

3.1.3 Hydrogeology

The current understanding of the generalized hydrogeology of the Study Area is presented in this section. The detailed hydrogeology of the upland areas on both sides of the river varies by location. This generalized discussion is intended to describe the important basic hydrogeologic units and their properties and groundwater flow within the Study Area and is not representative of any one particular location. An upland

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groundwater data review that summarizes hydrogeologic information and groundwater quality data from specific upland sites in the vicinity of the Study Area has been completed by LWG (ESI 2003a).

3.1.3.1 Hydrogeologic Units

The geologic units described above can be grouped into Study Area-wide hydrogeologic units on the basis of having generally similar hydrogeologic characteristics. Important hydrogeologic characteristics include the position of the water table relative to each hydrogeologic unit, the physical relationship between each hydrogeologic unit and the river, and physical characteristics of each hydrogeologic unit, such as permeability, heterogeneity, and anisotropy.

These hydrogeological units are described from uppermost to lowermost in the following sections and presented in Figure ???.

3.1.3.1.1 Fill, Fine-grained Facies of Flood Deposits, and Recent Alluvium (FFA).

FFA unit is composed of the fill, the combined fine-grained facies of the Pleistocene flood deposits, and the recent alluvium geologic units described by Beeson et al. (1991) and in Section 3.2.1. These geologic units were grouped together on the basis of each unit's shared textures and intrinsic heterogeneity, proximity to the river and to each other, and importance with regard to the occurrence of upland groundwater and interactions with the river.

This unit encompasses a broad range of soil textures and hydraulic characteristics that blankets much of the lowland area next to the river and includes much of the material abutting the river. The unit also consists of the fine sand and silty sand dredge fill overlying recent and Pleistocene silt and clay overbank sediments, which are interbedded with lenses and layers of fine to coarse sand. As discussed in Section 3.1.2.1, the dredge fill was placed behind low-permeability, artificial and natural flood levee dike structures in some locations. The thickness of this unit can be up to 150 ft, but it typically ranges between 30 and 100 ft.

The FFA hydrogeologic unit is the primary unit of importance in defining the interactions between upland groundwater and the river because of the following characteristics of the unit:

- The unit forms most of the river channel within the Study Area as well as the surrounding upland areas and, therefore, controls groundwater interactions with the river; and
- Most contaminate groundwater plumes present in the upland areas occur within strata of this unit.

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The distribution of textures and thus groundwater flow properties of the unit vary both vertically and horizontally by location along the Study Area. Silt, clay, and silty sand are present adjacent to the river at a majority of locations where the unit is observed near low river stage levels. Boring logs at sites north of RM 4 on the east side of the river indicate that a greater portion of the unit north of RM 4 and at depths below low river stage levels consists of sand layers. This is generally true for most of the shallower areas within historical Portland Harbor flood plain. [support with reference of not accept] Comparison of hydraulic conductivity values for different textures within the FFA unit listed below illustrates the importance of the channel sand lenses and layers in focusing groundwater fluxes to the river at any particular location where present within this unit:

- Silt/clay: 0.005 to 2 ft per day (0.0000018 to 0.0007 cm per sec.)
- Silty sand: 0.1 to 2 ft per day (0.000035 to 0.0007 cm per sec.)
- Sand: 0.5 to 30 ft per day (0.00018 to 0.011 cm per sec.).

The typical measured hydraulic conductivities in the silt/clay facies of the FFA indicate that groundwater fluxes from these sediments within the Study Area are generally low. Identification of seeps present in silt/clay during the seep reconnaissance survey (GSI 2003a) is consistent with this conclusion. Conversely, groundwater fluxes from the uplands to the river within the FFA are expected to be greater in those areas where more permeable sand zones are present, such as on the east side of the river.

3.1.3.1.2 Coarse-grained Flood Deposits and Upper Troutdale Formation (CGF).

The CGF unit combines the unconsolidated coarse-facies flood deposits, including sands, gravels and cobbles, with the underlying uncemented and cemented gravels and cobbles of the upper Troutdale Formation. The flood gravels that compose the upper portion of this unit typically occupy scour channel surfaces on older units (e.g., the CRBG). Anthropomorphic fill, silt, clay, and sand of the flood deposits, and alluvium mostly cover the CGF, except in places on the highland bluffs on the east side of the river where the unit may be exposed.

The CGF unit is adjacent to and underlies much of the Study Area to thicknesses exceeding 200 ft. The overall thickness of the unit is more typically in the range of 100 ft. However, the unit is missing in places, including on the west side of the river towards the south end of the Study Area and directly under the river at RM 7. The top of the CGF unit is present at elevations of 0 ft to over –100 ft mean sea level (MSL). The unit is present at relatively shallow depths adjacent to the west side of the river in the vicinity of the Doane Lake area and may be in contact with river sediments. The hydraulic conductivity of this unit measured

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in the vicinity of the Doane Lake area ranges from 3 ft per day (0.0011 cm per sec.) to greater than 40 ft per day (0.014 cm per sec.) (AMEC 2001).

Because this unit has a relatively higher hydraulic conductivity than the overlying FFA unit, groundwater may flow more readily through this unit to deeper units where downward gradients are present and where the unit is present adjacent to the river, allowing deeper groundwater to more readily discharge to the river. Higher fluxes to the river within the CGF unit may increase downward gradients and thus increase groundwater and contaminant plume movement in the FFA unit. The effect of the CGF unit on groundwater flow in the FFA is a factor in the selection of characterization methods. Locations where the CGF unit may exert a stronger influence on deeper groundwater flow to the river, and thus vertical gradients in the FFA, include the Doane Lake area (RM 6-7 west), the southern edge of the Study Area (RM 11), and on the east side of the river in the vicinity of the International Terminal (RM 4 east).

3.1.3.1.3 Lower Troutdale Formation/Sandy River Mudstone

This hydrogeologic unit is present in some places under the west side of the Study Area and is present under the entire length of the east side of the Study Area. The unit is predominantly silt and clay where explored in the vicinity of the Study Area, and thus the permeability of the unit is low. Where present, the unit overlies the CRBG below depths of –100 to –150 ft MSL and tends to pinch out on the west side and towards the southern end of the Study Area where the CRBG is present at shallower depths. The unit typically is separated from the river by at least 100 to 200 ft of alluvium and deposits of the upper Troutdale Formation. Based on the hydrogeologic characteristics of this unit and the depth relative to the river, it is not considered to contribute significantly to surface water/groundwater interactions within the Study Area.

3.1.3.1.4 Columbia River Basalt Group

The CRBG consists of a concordant sequence of basalt lava flows. Groundwater flow in the CRBG is focused along the higher permeability interflow zones and in some areas of fracture-enhanced permeability (e.g., faults). Hydraulic conductivities measured in individual basalt interflow zones in the vicinity of the Study Area range from 1.5 to 10.9 ft per day (0.00053 to 0.0038 cm per sec.) (AMEC 2001). Hydraulic conductivities measured in CRBG basalt flow interiors at Hanford, Washington, range from 1×10^{-4} to 1×10^{-7} ft per day (3.5×10^{-8} to 2.5×10^{-13} cm per sec.) (Strait and Mercer 1986), illustrating that the basalt interflow zones (flow top and bottom collectively) are the primary groundwater flow pathways in the CRBG.

The CRBG is present at relatively shallow depths along portions of the west side of the Study Area and may be in direct contact with the river in places. The top of the unit is irregular on the west side of the Study Area with channels from

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scouring by flood events and the ancestral Willamette River. The top of the unit on the west side of the Study Area is between elevation 0 ft and –50 ft MSL north of RM 9, except for an ancestral channel in the vicinity of Doane Lake (Figure 3.1-1). The top of the CRBG slopes down to an elevation of –250 ft MSL or more across the river on the east side of the Study Area. The relief of the unit across the Study Area appears to be due to structural downwarping towards the center of the basin, and may be accentuated by normal faulting postulated along both sides of the Study Area (Beeson et al. 1991; Beeson 2003, pers. comm.). The overall significance of the CRBG with regard to groundwater/surface water interactions within the Study Area is not well characterized; however, the CRBG is considered to be most relevant to groundwater interactions with the river on the west side of the river downstream of about RM 9 because of its proximity to the river.

3.1.3.2 Groundwater Flow

The general groundwater flow systems of interest recognized along the Study Area are a shallow (shallow FFA), an intermediate (deep FFA), and a deep (CGF and CRBG) system. A deeper, regional flow system also is present, which includes the CRBG, where it is deep below the river (on the east side of the river), and lower Troutdale Formation/SRM. This deeper, regional flow system is not considered to be important in understanding the interactions between upland groundwater and the river that are relevant to this RI. The deeper, regional flow system may be relevant to contaminated groundwater or product from upland sources that may be posing a threat to such system.

At a local level, these divisions between flow systems are likely indistinct in places along the Study Area. Additionally, some investigations have identified further flow system refinements or divisions based on the local hydrogeology. However, the general flow systems described above appear to apply for the majority of the Study Area and provide a general model from which variations can be evaluated on a local scale. Figure 3.1-2 presents the generalized conceptual picture of groundwater flow through these flow systems. This figure supports the following discussions of groundwater flow systems.

The Willamette River is the focus of discharge for the three flow systems of interest to the RI, including where the CRBG is present near the surface on the west side of the river. The shallow flow system is the primary focus of most upland groundwater investigations, and is the focus of this RI because most of the upland groundwater affected by contaminants of interest is present within this system, and this system discharges to the shallow and nearshore areas where exposure to human and ecological receptors is most likely. The potential for impact to the deeper system is relatively low, except where there may be a large source of dense non-aqueous phase liquid (DNAPL) that has the potential to migrate to the FFA and/or upper portion of the basalt. Impact to sediments from the shallow and intermediate flow systems are the focus of this RI,

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except at locations where the CGF and CRBG appear to be impacted by chemical constituents and are connected to the river.

3.1.3.2.1 Shallow Flow System

The shallow, unconfined, groundwater flow system along the margins of the Study Area consists mostly of fill and alluvial silt and clay deposits and some medium- to coarse-grained channel sand of the shallow FFA that blankets the lowlands next to the river, as shown in the generalized conceptual image on Figure 3.1-2. At many locations, the shallow flow system is hosted within the lower portion of fine dredge-fill sand and underlying silty sand and silt. The shallow system is recharged by direct precipitation and infiltration, infiltration from the hills on the west side of the Study Area, and exchange with several surface water bodies along the Study Area (e.g., Doane Lake). Groundwater in this system is unconfined. Groundwater level data in the upland areas indicate that there is a downward gradient toward deeper units from the shallow system. Groundwater levels and fluxes in the shallow system are affected by seasonal river stage changes, as well as by diurnal tidal influences. The degree of tidal influence decreases with increasing distance from the river and shallower groundwater depths. Groundwater gradients within the shallow system are generally steep immediately adjacent to the river and flatten out away from the river bank. The shallow flow system discharges to the river either above the river surface as surface seeps, or below the river surface as subsurface discharge, generally in nearshore areas. Because of tidal and seasonal river stage fluctuations, a given groundwater discharge may express above or below the river surface at different times.

The permeability of the FFA materials is variable within the shallow flow system, but generally is relatively low. The presence of low-permeability features, such as silt and clay dikes constructed to retain hydraulically emplaced dredge fill, cutoff walls, and retaining walls, may act to impede groundwater flow locally in the shallow system, resulting in higher groundwater levels and steep shallow groundwater gradients near the shore. The presence of preferential pathways (human-made and natural) in the shallow FFA can be a significant, albeit localized, influence on the discharge of groundwater to the river.

Light non-aqueous phase liquid (LNAPL) spills are present only within the shallow flow system. Dissolved chemicals associated with upland releases are present in the shallow flow system. Dissolved plumes may be affected by vertical hydraulic gradients, which may cause vertical migration of the dissolved constituents. The shallow system also appears to influence the effect of DNAPL releases by retaining a portion of the released volume through spreading and retention in or along less permeable sediments. These stratigraphic controls can limit the depth of downward migration of DNAPL.

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3.1.3.2.2 Intermediate Flow System

The intermediate flow system occurs within thicker sequences of the fine-grained alluvial sediments of the FFA. Groundwater in the intermediate system generally discharges to the Willamette River below the river surface to deeper portions of the river (Figure 3.1-2), with discharge focused at the locations where more permeable strata (typically sand) may intersect the river. Horizontal hydraulic gradients within the intermediate flow system tend to be flatter near the river than observed in the shallow system, and thus high river stages and tidal changes may exert a greater influence on fluxes from the intermediate system to the river by further flattening or perhaps reversing the gradient locally.

The intermediate flow system is particularly relevant for groundwater transport of chemicals to the river where DNAPL is present or where chemical densities, preferential pathways, or downward gradients could potentially allow dissolved chemical constituents to penetrate into the deeper units. The intermediate flow system is the most likely mechanism that would allow for groundwater discharge into the sediments present in the deeper portions of the Willamette River. However, most groundwater chemical plumes identified in the upland areas of the Study Area do not occur within the intermediate flow system.

3.1.3.2.3 Deep Flow System

The deep flow system occurs within the CGF and basalt interflow zones of the CRBG, where the CRBG is present near the surface on the west side of the river. Downstream of about RM 9 on the west side of the river, residual basalt gravels immediately overlying the CBRG have been identified as important hydrogeologic features and potential conduits for groundwater contaminant transport. Groundwater in the deep system discharges to the Willamette River only in deeper portions of the river, with discharges focused at the locations where the gravels and/or basalt interflow zones are near or intersect the river sediments (Figure 3.1-2).

The CRBG does not play a role in the deep flow system on the east side of the river, because it occurs at substantially greater depth due to structural downwarping and associated normal faulting. The flow system becomes strongly affected by the Columbia River on the east side of the Study Area with increasing distance from the Willamette River. Deep groundwater flow from the base of Tualatin Hills toward the east side of the river occurs in the CGF, which is generally highly transmissive; however, gradients may be relatively low. Seasonal gradient reversals are known to occur during periods of high river stages. Where near the river, the connection, and thus response, to river stage changes is expected to be great.

The deep flow system is not anticipated to play a significant role in groundwater contaminant transport from the upland areas to the river within the Study Area because the majority of contaminants in groundwater are not present within this system.

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3.1.3.3 Groundwater Processes

Generally, groundwater flow adjacent to the Study Area is toward the river. The Tualatin Mountains (Portland West Hills) form a ridge that runs parallel to the Willamette River to the west, from the Multnomah Channel to the City of Portland. The mountains define the western edge of the Portland Basin; groundwater and creeks and channels along the east face of the mountains flow downward to the Willamette River. On the east side of the river, starting upstream of RM 4, a broad terrace divides the floodplains of the Willamette and Columbia Rivers. Deep groundwater flows are influenced by the Columbia on the east side of the river, with effects increasing as distance from the Willamette River increases. Groundwater gradients are relatively flat in some areas along the east side of the river, due to both underlying geology and the influence of the Columbia River.

In the absence of preferential pathways, groundwater flow to the sediments and river will be diffuse along the length of the interface of each flow system with the river. However, permeability contrasts of several orders of magnitude can be expected in the FFA where alluvial processes create lenses and channels of sand within or surrounding finer-grained materials. The result of these permeability contrasts is that groundwater discharge will tend to be heavily influenced by the location and geometry of higher permeability layers (e.g., sands) in relation to the river.

Discharge from the shallow water-table groundwater system tends to be focused at or below the river/shore interface. Low river stages expose zones of focused discharge as seeps along the bank where the shallow groundwater surface intersects the ground surface. Preferential pathways, including coarse backfill (e.g., around utilities), historic stream channels, or sand/gravel layers focus groundwater flow, particularly where they occur in predominantly fine-grained sediment sequences in the shallow groundwater system. [KEY ISSUE FOR DISCUSSION WITH EPA] [redacted] The groundwater flow regimes of all of the flow systems show seasonal patterns related to seasonal river stage and precipitation variations.

The gradient and the resultant flux from these systems vary with seasonal river stage changes. Diurnal tidal stage changes also result in temporary gradient and thus flow changes, particularly where the degree of connection between the river and adjacent aquifer is greater. Discharge of these deeper groundwater flow systems through the river sediments to surface water is controlled by: 1) the permeability contrast between the sediments and underlying aquifer, and 2) the difference between the hydraulic head

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in groundwater at the aquifer/sediment interface and the river stage, which determines hydraulic gradient.

Direct measurements of groundwater seepage rates to the river were taken during the LWG Round 2 investigation and during the offshore investigation performed by Northwest Natural at RM 6.2 (Anchor et al. 2007). Locations of these measurements are discussed in Appendix C2. Measurements were taken in nearshore areas as well as farther offshore, including several locations within the navigational channel. In all, 77 ultrasonic seepage meter measurements were taken (70 LWG measurements and 7 non-LWG measurements), primarily during the season of presumed maximum groundwater flux (high upland groundwater levels and low river stage). Daily average measurements of the seepage rates ranged from –18.2 cm/day (recharge) to 14.2 cm/day (discharge to the river), with an average of 1.5 cm/day. These measurements were taken in areas where contaminated groundwater plumes were suspected to be discharging to the riverl. Measured groundwater flux rates showed substantial variability between measurement sites; in general, the highest seepage rates were observed in sandy areas, and the lower values were observed in less conductive clay zones, as expected. Site-specific groundwater discharge estimates were used to calculate groundwater chemical loads to the river (Section 6 and Appendix E). [KEY ISSUE FOR DISCUSSION WITH EPA]

3.1.3.4 Groundwater/Surface Water Transition Zone

The groundwater/surface water transition zone (Transition Zone) is the interval where both groundwater and surface water comprise some percentage of the water occupying pore space in the sediments. The physical and biochemical properties of water within the Transition Zone reflect the effects of mixing between groundwater and surface water that occurs within the sediments. The transition zone is the interval where both groundwater and surface water comprise some percentage of the water occupying pore space in the sediments. The physical and chemical properties of water within the transition zone reflect the effects of mixing between groundwater and surface water that occurs within the sediments, as well as biological and geochemical processes occurring within the sediment matrix and pore water. The transition zone is significant to the RI because it is the location where important chemical and biological transformation processes occur that affect the properties of chemicals that may be present in groundwater, and it encompasses the sediment biologically active zone where benthic infaunal ecological receptors may reside.

[KEY ISSUE FOR DISCUSSION WITH EPA]

3.1.4 Surface water Hydrology

River stage and currents in the lower Willamette River and Portland Harbor are influenced by hydrologic conditions in both the Willamette and Columbia rivers, and are further affected by the operations of federal and non-federal dams along these two rivers. River stage refers to the height of the river measured relative to a specific elevation or "datum." A variety of vertical datums are used in the Portland Harbor region, and these are discussed below.

3.1.4.1 Regional Datums

Current or historical bathymetric and topographic data may be referenced to a variety of vertical datums in Portland Harbor. The bathymetric data collected as a part of this RI/FS are presented relative to the North American Vertical Datum of 1988 (NAVD88). This vertical datum is the national standard geodetic reference for heights and was selected for this project because it is a level datum and is easy to use with global positioning systems (GPS). NAVD88 is a fixed datum derived from local mean sea level observations at Father Point/Rimouski, Quebec, Canada. NAVD88 replaced NGVD29/47 as the national standard geodetic reference for heights.

The National Geodetic Vertical Datum of 1929 through the Pacific Northwest Supplemental Adjustment of 1947 (NGVD29/47) is a fixed datum adopted and adjusted in 1947 as a national standard geodetic reference for heights prior to June 24, 1993 and is now considered superseded by NAVD88. NGVD29 is sometimes referred to as Sea Level Datum of 1929 or as MSL on some early issues of U.S. Geological Survey (USGS) topographic quads. NGVD29 was originally derived from observations at 26 long-term tide stations in the U.S. and Canada. Data referencing MSL as the vertical datum in the Portland Harbor is technically based on NGVD29/47.

The Columbia River Datum (CRD) is used as the nautical chart datum for the lower Willamette River. CRD is a reference plane established by the U.S. Army Corps of Engineers (USACE) in 1912 by observing low water elevations at various points along the Columbia and Willamette rivers ([illegible]). Consequently, the CRD is not a fixed/level datum but slopes upward as one moves upstream. The CRD is used upstream of RM 24 on the Columbia to the Bonneville Dam and on the Willamette River to Willamette Falls. Mariners can obtain the depth on a chart and apply tide or river-level gauge readings, relative to CRD, to compute actual water depth at the time of sailing. Low water values are used for navigation charting to provide conservative depth values in the event accurate tide data are not available to the mariner.

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These three datums, NAVD88, NGVD29/47, and CRD, are the major datums used on maps and charts of Portland Harbor. The relationships or conversion factors between them are shown in Table 2-1 for the lower Willamette River to about RM 16 (Ross Island). In the lower Willamette, elevations reported relative to the CRD are approximately 5 ft less than NAVD88 elevations (e.g., the –15 ft NAVD88 contour on LWG bathymetry maps equates to a –20 ft CRD elevation).

Water level (river stage) data measured by the Morrison Bridge gauge (RM 12.8) are recorded as the Portland River Datum (PRD) and are 1.55 ft above NGVD29/47 (USACE 1994). The CRD is 1.85 ft above NGVD29/47 at the Morrison Bridge. On December 27, 2001, David Evans and Associates, Inc. (DEA) confirmed the relationship between this gauge and the CRD by running a differential leveling circuit from a nearby control monument used in the control network for the Willamette multibeam surveys. This survey confirmed that the Morrison Street staff gauge reports water levels 0.30 ft above CRD, as defined by the USACE (1994).

The river stages discussed in this Section are the directly measured Morrison Bridge gauge levels and are therefore reported as PRD elevations in feet. To convert from PRD to CRD, subtract 0.3 ft from the reported river level.

The datum relationships discussed for Portland Harbor above are illustratedin figure 3.1.4-1.

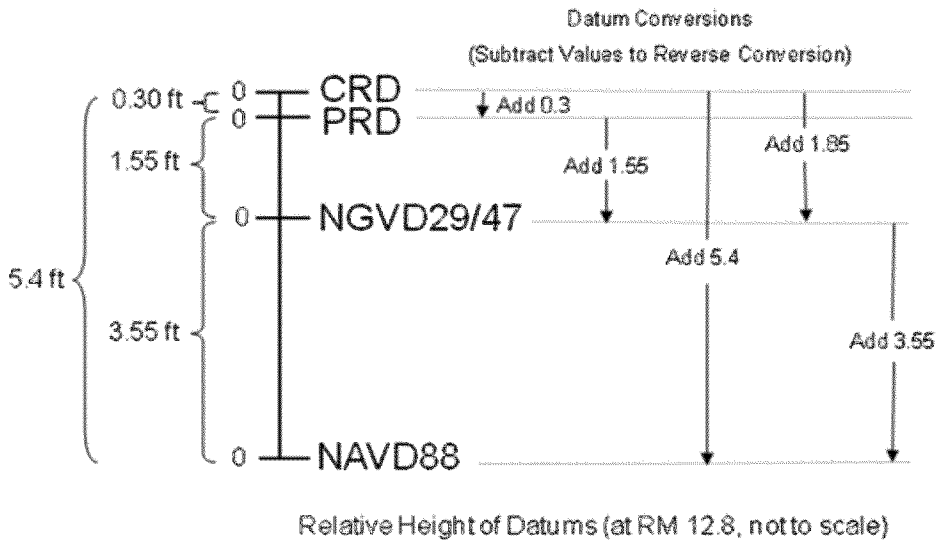

Figure 3.1.4-1. Datum Relationships for Portland Harbor.

3.1.4.2 Regional Hydrology

The Columbia River drains a large segment of the northwestern United States and parts of western Canada. The Columbia basin is so large that isolated events such as localized rainstorms may have little or no effect on river flow. In its natural state, high

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flows on the Columbia River are most influenced by snow melt, which takes place during the spring months. This results in high water typically occurring in late May or early June, followed by receding water levels until the rains begin in late fall.

Lowest water on the Columbia River typically occurs in October or early November, reflecting a lack of precipitation and snowmelt in the basin during the summer months. With the onset of winter rains and snow, runoff will vary during the winter months, until the spring snowmelt leads to the high water period.

The Willamette River is a major tributary of the Columbia River and flows into the river at Columbia River Mile 103. Over the water years 1973 through 2007—a 35-year period of record—the Willamette River average daily mean discharge was 33,000 cfs, while that of the Columbia River above the confluence of the Willamette was 177,000 cfs.[2]

The lowest water levels in the Willamette, as in the Columbia, typically occurs between September and early November prior to the initiation of the winter rains. Unlike the Columbia River, however, Willamette River flows generally increase in response to regional storms due to the comparatively small size of the basin. Record winter floods (e.g., 1964 and 1996) occurred when periods of heavy snowfall at lower elevations were followed by warming periods and heavy rains, resulting in rapid increases in runoff.

Figure 7? shows a plot of the mean daily river state data (reported in feet, PRD) measured by the USGS gauge #14211720 on the Morrison Bridge in Portland near RM 12.8 from 1973 through 2007. The seasonal water level trends described above are evident in this plot. Low water typically occurs during the regional dry season from August to November. Winter (November to March) river stage is relatively high but variable due to short-term changes in precipitation levels in the Willamette basin. Finally, a distinct and persistent period of relative high water occurs from late may through June when the Willamette River flow into the Columbia is slowed during the spring freshet by the high-water stage in the Columbia River.

The effect of the multipurpose dams on the Columbia River and its tributaries has generally been to reduce the spring high water flows with retention and storage of the excess water through the system-wide management of reservoir pool levels at each dam. Beginning in late summer, stored water is released, which increase flows above the naturally occurring low-flow hydrograph. By winter, these reservoirs have been drawn down, and the storage capacity is used to take the peak off of winter flows and to optimize the generation of electricity.

[2] The average daily mean values noted are based on data from the USGS gauge #14211720 (Willamette River at Portland, OR) and from USGS gauge #14105700 (Columbia River at The Dalles, OR), which is located downstream of the confluence of the Willamette but is the closest USGS gauge for which data are available for water years 1973–2007. These data are available at: http://waterdata.usgs.gov/nwis/sw.

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There are 13 federal reservoirs on the Willamette River and its tributaries, having a combined storage capacity of over 1.6 million acre-ft. These reservoirs reduce the river flow during the winter snow and rain events by storing water (Table 3.1-1). With each major storm, water is retained and then released at the end of the storm to dampen hydrographic peaks and valleys. During persistent rainy periods and/or during exceptionally large precipitation events, the storage capacity may be exceeded, and additional flow entering the system leads to flooding, as occurred in 1964 and 1996. During these flood events, water flow in the river can be up to 50 times greater than the flow during low-water periods. Late in the winter, after the likelihood of a major flooding event has passed, the reservoirs are filled to capacity. These reservoirs are used for recreation during the summer and are drawn down in the fall to supplement natural low flows and to provide storage capacity in preparation for the flood season.

Water levels and currents in the lower Willamette River can be influenced by the Columbia River in several ways. The most apparent influence occurs during spring when high flows from the Columbia River act as a hydraulic dam to Willamette River, resulting in rises in the Willamette River stage. When this occurs, currents in the Willamette are much reduced due to the elevated river stage in the Columbia River. As the summer progresses, the Columbia River flow declines and this effect is diminished.

A less obvious influence can occur in the winter when the Willamette River is in flood stage. The flows on the Columbia River can be held back by its dam system, which has the effect of lowering the backwater effect of the Columbia River and thus lowering the water levels in Portland Harbor below their typical conditions. This mechanism was used in the 1996 flood to lower the flood stage levels of the Willamette River in Portland.

Tidal action also compounds the hydrology and interplay of the two rivers, and affects the Willamette River upstream as far as Portland Harbor and beyond. Tides along the North American West Coast are mixed semidiurnal (two unequal high tides and two unequal low tides daily), with an average tidal range of approximately 8 ft in the Pacific Ocean. The high tide can influence Willamette River levels by up to 3 ft in Portland Harbor when the river is at a low stage. These tidal fluctuations can result in short-term flow reversals (i.e., upstream flow) in Portland Harbor during times of extremely low river stage combined with a large variation in tide levels, which can occur in late summer to early fall. This effect was measured in May 2003 as part of the bathymetry survey effort using an acoustic Doppler current meter (DEA 2003b). As river stage rises, the tidal effect is gradually dampened and disappears at river levels around 10 ft CRD.

3.1.4.3 Willamette River Hydrology

River stage and currents in the lower Willamette River and Portland Harbor are influenced by hydrologic conditions in both the Willamette and Columbia rivers, and are further affected by the operations of federal and non-federal dams along these two

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rivers. River stage refers to the height of the river measured relative to a specific elevation or "datum" which is discussed in Section 3.1.4.1.

Recent investigations of the hydrodynamics of the lower Willamette River, Study Area, and Multnomah Channel are summarized in this section. Both empirical information (flow measurements) and HST modeling (refer to Where is model discussed?) have been conducted as part of this RI to support the understanding of the physical system and hydrodynamics. The primary objective of these efforts for the RI was to gain a sufficient understanding of the physical system to support the RI site characterization, the BHHRA, the BERA, and site-wide fate and transport modeling.

3.1.4.3.1 Stages and Discharges

The Columbia River drains a large segment of the northwestern United States and parts of western Canada. The basin is so large that isolated events such as rainstorms may have little or no effect on river flow. In its natural state, high flows on the Columbia River are most influenced by snow melt, which takes place in the basin during the spring months. This results in high water typically occurring in late May or early June followed by receding water levels until the rains begin in late fall.

The lowest water levels on the Columbia River typically occurs in the months of October or early November, reflecting a lack of precipitation and snowmelt in the basin during the summer months. With the onset of winter rains and snow, runoff will vary during the winter months until the snowmelt takes place in the spring leading to the high water period described above.

The Willamette River is a major tributary of the Columbia River and flows into the river at Columbia River mile 103. Lowest water in the Willamette, as in the Columbia, typically occurs between September and early November prior to the initiation of the winter rains. With the onset of the rains, flows in the Willamette will generally increase, sometimes in rapid (several days) response to regional storms. The record winter floods (e.g., 1964 and 1996) occurred when a period of heavy snowfall at lower elevations was followed by a period of warming and heavy rains. The combination of the snowmelt and rain leads to exceptionally high runoff that occurs rapidly due to the small size of the basin as compared, for example, with the Columbia River basin.

The effect of the multipurpose dams on the Columbia River and its tributaries has been to generally reduce the spring high water flows through ponding of the excess water to the extent permitted by the capacity of the reservoirs at each of the dams. Starting in late summer, this stored water is released, which increases flows above the low flows that would otherwise occur. By winter, these reservoirs have been drawn down and the reservoir capacity is used to take the peak off of winter flows and to optimize the generation of electricity.

There are 13 federal reservoirs on the Willamette River and its tributaries, having a combined storage capacity of over 1.6 million acre-feet. These reservoirs reduce the

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river flow during the winter snow and rain events by storing water. With each major storm, water is stored and then released at the end of the storm to smooth out the flow of the river. During persistent rainy periods and/or during exceptionally large precipitation events, the storage capacity may be exceeded, and additional flow entering the system leads to flooding as occurred in 1964 and 1996. During these flood events, water flow in the river can be up to 50 times greater than the flow during low-water periods. Late in the winter, after the probability of a major flooding event has passed, the reservoirs are filled to capacity. These reservoirs are used for low flows and to provide storage capacity in preparation for the flood season.

Water levels and currents in the lower Willamette River can be influenced by the Columbia River in several ways. The most apparent influence occurs during spring when high flows from the Columbia River increase the hydraulic head at the confluence of the two rivers and causes the Willamette River flow to be detained (WR Figure 2-2). When this occurs, currents in the Willamette are much reduced due to the elevated river stage in the Columbia River. As the Columbia River drops, the Willamette water level will also drop and flows will increase to more typical conditions.

A less obvious influence can occur in the winter when the Willamette River is in flood. The flows on the Columbia River can be held back by its dam system, which has the effect of lowering the backwater effect of the Columbia and thus dropping the levels in Portland Harbor below their typical condition. This mechanism was used in the 1996 flood to reduce the flood levels of the lower Willamette River, including Portland Harbor.

Compounding the complexity of the influence of two separate river systems and drainage basins, the Portland Harbor reach is also affected by tidal action. The tidal range at the Pacific Ocean is approximately 8 feet and there are two high tides and two low tides daily. The tidal "wave" comes up the river and when the Willamette River is at a low stage, the tidal action can influence river levels by up to 3 feet in Portland Harbor. These tidal fluctuations can result in upstream flows in the Portland Harbor during times of extreme low discharge combined with a large variation in tide levels, which can occur in late summer to early fall. As river stage rises, the tidal effect is gradually dampened and disappears at river levels around 10 feet CRD.

USGS Guage Data

Figure 3.1-3 shows a plot of the mean daily river stage data (reported in feet PRD) from October 1, 1972 through March 31, 2008 at the Morrison Bridge in Portland near RM 12.8 (USGS gauge #14211720).[3] Mean historical daily discharge (cfs) calculations from this gauge are shown in Figure 3.1-4, and Figure 3.1-5 presents the annual average

[3] Data obtained from Regulation and Water Quality Section Web site (http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:PRTO+record://PRTO/HG//1DAY/MEAN/) and the USGS National Water Information System Web site (http://waterdata.usgs.gov/or/nwis/uv?14211720). Where USGS data are available, they replaced USACE data for compiling the graphs shown in this section. The USACE site notes that these "data

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discharges by water year[4] over the period of record. Flow data from October 1972 to September 1994 were computed by the USGS using an acoustic velocity meter (Lee 2002, pers. comm.). Most data after September 1994 are USGS estimates based on measurements from regional stations (Miller 2006, pers. comm.).

The seasonal cycle of water levels on the Willamette River is illustrated in Figure 3.1-3. Annual low water levels typically occur during the regional dry season from August to November. Winter (November to March) river stage is relatively high but variable due to short-term changes in precipitation levels in the Willamette Basin. Finally, a distinct and persistent period of relatively high water levels occurs from late May through June when Willamette River flow into the Columbia is slowed by high-water stage/flow in the Columbia River during the spring freshet in the much larger Columbia River Basin, as described above.

The two highest peaks in the daily mean discharge record occurred in the winters of 1996 and 1997, when peak flows reached 420,000 cfs on February 9, 1996 and 293,000 cfs on January 2, 1997 (Figure 3.1-4).For the water years 1973 through 2007—a 35-year period of record—the mean annual daily discharge was between 20,000 and 30,000 cfs during 14 years of this period (Figure 3.1-5). Annual mean daily flows were above 30,000 cfs during 19 years, with seven of those years above 40,000 cfs, and three in excess of 50,000 cfs. Only two water years (1977 and 2001) had average daily flows between 10,000 and 20,000 cfs. Figure 3.1-6 presents the frequency (number of days per year) distribution of daily mean discharge values from the October 1, 1972 through March 31, 2008 data set. Flow on the Willamette River is most often between 10,000 and 30,000 cfs. Approximately 75 percent of the time flows are less than about 40,000 cfs, and exceed 90,000 cfs less than 10 percent of the time.

Figures 3.1-7a–h show river stage data through each of the RI sample-collection years (i.e., 2001–March 31, 2008). For comparison, the graphs also include a plot of average annual river stage values based on the entire period of record (October 1972–March 2008), and plots of the values within one and two standard deviations from the average (representing approximately 68 percent and 95 percent of the recorded values, respectively). The lower Willamette River flood stage (18.3 ft PRD [18 ft CRD]) was not reached during the RI sampling period.

The lower Willamette River discharge rates during the RI years followed a typical seasonal pattern and, as with river stage levels, have generally been within the range of typical discharges on record. Figures 3.1-8a–h present plots of river discharge data through each of the RI years (2001–March 31, 2008), with plots of the average daily discharge (October 1, 1972–March 31, 2008) and values within one and two standard

have not been verified and may contain bad and/or missing data and are only provisional and subject to revision and significant change." The data are used here only to illustrate long-term relative trends in the Willamette River stage at Portland. No data are available for 1991 and 1992.

[4] A water year extends from October 1 to September 30 (e.g., October 1, 1972 to September 30, 1973 comprises the 1973 water year).

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deviations from the average shown for comparison. Early 2001 and early 2005 were relatively low-flow winter/spring periods and early and late 2006 had relatively high flows compared with the long-term averages.

ADCP Surveys

Flows were also measured by the LWG at multiple locations in the lower Willamette River using an ADCP during three of the four time-series bathymetric surveys which were conducted to measure riverbed elevation changes over time (see Section 3.6.2). The ADCP data provided snapshot observations of flows in the Study Area across a range of flow and tidal conditions (DEA 2002 & 2003b, 2004). The empirical flow data also supported the development and calibration of a hydrodynamic model developed for this RI/FS (WEST and Integral 2005). The model output shows that currents generally flow downstream during four of the six flow-tide combinations. Reverse or upstream flows occur when river flow is low and the tide is in flood.

In general, flow in many of the relatively shallow nearshore embayments and slips is characterized by eddies and/or inshore flow, except on ebbing tides during low-flow periods, when downstream or offshore flow directions are dominant. As expected, higher current speeds occur in the deeper portions of the river channel, and lower speeds occur in the shallow nearshore areas, regardless of flow direction. Flow in Multnomah Channel is downstream under all flow/tide combinations modeled.

During high flows on the Willamette and comparable flows on the Columbia (Figures 3.1-14a-h), flow is consistently downstream on the lower Willamette River, and the model predicts that there is an apparent eddy effect (reduced circular flows) where the Willamette River flows into the Columbia River.

The flow data collected during the ADCP surveys in April 2002, May 2003, and January 2004suggested that lower Willamette River discharge through Multnomah Channel could be significant, ranging from 25 to 50 percent of the discharge volume of the Willamette during the "snap-shot" ADCP measurement periods. The percentage of Willamette River flow through Multnomah Channel is a function of the relative flow regimes in the Willamette and Columbia rivers, as well as tidal stage.

Multnomah Channel Flows

To investigate Multnomah Channel flows on a more continuous temporal basis, the CE-QUAL-W2 hydrodynamic model of the Columbia River/Willamette River System developed by Portland State University was used to model daily average flows in the system over a nearly four-year period from January 1999 through December 2002 (Integral 2006a). Figure 3.1-15 shows the flows (daily average cubic meters per second) for the Willamette and Columbia rivers and the modeled flows for the Multnomah Channel over the 1,400+ day (approximately 4-year) model run. The figure also shows the fraction of the total Willamette River flow through Multnomah Channel

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(black line). "Fraction" values greater than 1 indicate that flow down Multnomah Channel exceeds the Willamette River flow upstream of Multnomah Channel (i.e., at these times, Multnomah Channel flows are a mixture of Willamette River water and inflow from the Columbia River).

The modeling effort identified three distinct river flow combinations and evaluated the proportion of discharge carried by Multnomah Channel:

1. **Low flows in both the Columbia River and Willamette River**—When flows are relatively low in both the Willamette and Columbia rivers, about 50 to 60 percent of the Willamette flow goes down Multnomah Channel.
2. **Low flow in the Columbia River and high flow in the Willamette River**—When relatively high flows in the Willamette River are concurrent with relatively low flows in the Columbia River, the proportion of Willamette River flow carried by Multnomah Channel decreases to about 25 to 30 percent of the total Willamette River flow.
3. **High flow in the Columbia River and low flow in the Willamette River**—When Columbia River flows are high and Willamette River flows are low, the increased river stage at the Columbia/Willamette confluence forces much of the Willamette River flow down Multnomah Channel. At certain low-flow Willamette periods (summer/early fall), all of the Willamette River flow, in terms of daily average volumes, plus some flow from the Columbia River, goes down Multnomah Channel. This last condition occurs about 25 percent of the time over the period modeled (January 1999 to December 2002).

No clear periods of concurrent high flows in both the Willamette River and Multnomah Channel were identified within the nearly four-year model simulation period. Averaged over the study period, flows in Multnomah Channel represent about 60 percent of the Willamette River flow upstream of Multnomah Channel. It should be kept in mind that some of the Multnomah Channel flow is Columbia River water, but the relative volumes of Willamette River versus Columbia River water flowing down Multnomah Channel cannot be determined from these modeling results.

3.1.4.3.2 Velocities and Currents

Velocity data for the lower Willamette River consists mainly of data collected over the years by the USGS. From July 1962 to January 1965, the USGS measured velocities at the Broadway Bridge near RM 11.7 and the Ross Island Bridge near RM 14. Stream flow conditions varied from low tidal-affected flows to near maximum flood of record during December 1964. Measured cross-sectional mean velocities ranged from a maximum of 8 feet per second downstream during the December 1964 flood to a low upstream velocity of nearly 1 foot per second during a tidal cycle on October 15-16, 1963 (Dempster and Lutz 1968).

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From October 1972 to September 1994, the USGS maintained an acoustic velocity meter with water stage and velocity index recorder at the Morrison Bridge gauge near RM 12.8. During that time period, rating curves were periodically updated with velocity measurements at the gauge location over a range of flow conditions. On January 14, 2000, the USGS collected isolated transects of velocity data using a vessel-mounted Acoustic Doppler Current Profiler (ADCP). Transects were collected at RM 12.8, a relatively narrow stretch of the river, and near RM 4.1, a broader stretch of the river (Barrett 2002, Wood 2002).

Flows were measured by the LWG at multiple locations in the lower Willamette River using an ADCP during three of the four time-series bathymetric surveys which were conducted to measure riverbed elevation changes over time (see Section 3.1.6.2 for discussion on bathymetric surveys). The ADCP data provided snapshot observations of flows in the Study Area across a range of flow and tidal conditions (DEA 2002b, 2003b, 2004). The first survey was conducted on April 19, 2002 along 16 transects from RM 1 to 11 during a high-water event. The second survey occurred on May 13, 2003. ADCP profiles were collected in the vicinity of the Multnomah Channel (RM 3) to understand the flows to the Multnomah Channel. On January 31, 2004, a third ADCP survey was conducted during a relatively high-flow event along the same 17 transects sampled in the previous two studies. Detailed ADCP survey and data processing methods are described in the Acoustic Doppler Current Profiler Survey Reports (DEA 2002b, 2003b, 2004).

April 2002 Survey

ADCP data were collected by DEA for the LWG during a high water event on April 19, 2002 (DEA 2002b). The transects were located at RMs 1, 2, 2.5, 3.1 (Multnomah Channel), 4, 4.6 (into T-4 Slip 3), 5.8 (St. John's Bridge), 6.3 (off Gasco), 6.8 (into Willamette Cove), 7.8 (off Willbridge Terminal), 8 (from Coast Guard Station, across shipyard to west bank), Swan Island Lagoon (2 short transects - one across mouth, one at upper end), 9.6, 10, and 11. The river stage at the time of the data collection was approximately 11.6 feet CRD at the Morrison Street Bridge (DEA 2002b).

Water velocities obtained from the ADCP survey ranged from an upstream velocity of nearly 1 feet/second (upstream flow in back eddy) to a downstream velocity of 2 feet/second. Flows across the transects were computed at approximately 70,000 cfs above Multnomah Channel and approximately 35,000 cfs below Multnomah Channel. The Willamette flow on April 19, 2002 was roughly double the average Willamette discharge rate of about 32,000 cfs. Table 2-3 summarizes ADCP transect time, location, and approximate total flow.

Figure 2-6a presents ADCP data at transect 11 at RM 8, just downstream of Swan Island and the Portland Shipyard. Both the vector plot (Figure 2-6a) and velocity profile (Figure 2-6b) reveal a sharp drop in velocity behind Swan Island and a small back eddy

into Swan Island Lagoon. The velocity profile in Figure 2-6b also illustrates some vertical structure with increased flows in the upper water column in mid-channel.

Figure 2-7a presents the measured ADCP data at transect 14 at RM 9.6 across the deep dredged hole off of Swan Island. An increase in the water column average velocities can be seen in Figure 2-7b. A back eddy can be observed in both the vector plot and the velocity profile. The velocity profile also shows strong near-bottom velocities in the hole with increased velocity toward the water surface.

May 2003 Survey

On May 13, 2003, multiple ADCP profiles were collected along the three transects in the lower Willamette River in the vicinity of the Multnomah Channel (RM 3), and a fourth transect was located within the MC. ADCP profiles were repeated 5-6 times along each transect over a 14-hour period to capture ADCP data over a complete tidal cycle. The complete results of this effort have been documented by David Evans and Associates (DEA 2003b).

Table 4-2 shows the discharges (Q, ft3/sec) observed along the four transects of the May 2003 survey during each ADCP pass. Positive values equal net downstream discharge in the lower Willamette River and Multnomah Channel. Note that discharge, Q, does not equate directly to flow velocities because the cross-sectional area of the river varies from place-to-place. Net discharge was downstream along all transects over the entire tidal cycle with two exceptions: during the maximum flood tide (Pass 5), net discharge was upstream at Transect 3 (downstream of the Multnomah Channel) and at Transect 4 (at the Multnomah Channel head). Water velocities along the transects were relatively steady during Passes 1 to 3, the ebb tide. Velocities averaged from 0.25 – 0.5 ft/sec in the lower Willamette River channel. Velocities were slightly higher (0.5 – 1.0 ft/sec) in the Multnomah Channel. Near low tide, Pass 4, water velocities in the lower Willamette River slowed and began to reverse direction, first along the eastern bank and propagating westward. By Pass 5, the flood tide, the water flow was completely upstream at Transect 3, and reversed direction along the eastern half of the lower Willamette River at Transect 4, and along a narrow portion of the eastern bank at Transect 5. By Pass 6, the high tide, flow velocities, both in direction and magnitude, were comparable those seen during the morning ebb tide.

January 2004 Survey

A third ADCP survey was conducted on January 31, 2004 to provide data on current velocities during a high-flow event. The results of this effort have been documented in the survey results report (DEA 2004). Seventeen transects between RMs 0 and 11 were profiled over a 9-hour period during a 130,000 cubic feet per second (130 kCFS) flood event (DEA 2004). Selected transects near the head of the Multnomah Channel (3, 4, 5, and 17) were run once in the morning on a rising tide, and again in the afternoon on a falling tide (DEA 2004). The discharge (Q) data from these transects are included in

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Table 4-3. Measured discharges just upstream of Multnomah Channel, transect 5, peaked at about 130 kCFS during this high-flow event; this is 3-4 times greater than the peak discharges measured in May 2003. Based on the measured discharges in the Multnomah, approximately 25% of the Willamette flow was exiting the system down the channel during the high-flow event. During the lower flow period in May 2003, over 50% of the Willamette flow was discharging down the Multnomah during the ebbing tide.

Plots of the winter 2004 transect data indicate that flow is predominantly downstream throughout the survey, with current speeds up to a maximum of 3.5 ft/sec observed at RM 11.0 (transect 16). Lower maximum velocities on the order of approximately 2.5 ft/sec are observed in the downstream transects, particularly downstream of the Multnomah Channel. Areas of relatively sluggish flow or eddies are apparent on the margins of certain transects that enter relatively shallow or protected areas (transects 3, 6, 9, 10), and across the entrance to Swan Island Lagoon. River level readings from the Morrison Street Gage at RM 12.8 at the time of the survey display a tidal signal, indicating that the tidal influence on river levels was not overridden by the high-flow event (DEA 2004).

The empirical flow data supported the development and calibration of a hydrodynamic model developed for this RI/FS (WEST and Integral 2005). The revised Phase 2 HST model (WEST and Tetra Tech 2009) was used here to develop vector plots of current velocities throughout the Study Area during both mid-ebb and mid-flood tides for both high- and low-river-flow periods (Figures 3.1-9a through 3.1-12a). Vector plots were also generated that show current velocities during maximum flood tide coupled with low river flow (Figures 3.1-13a-h) for the entire lower Willamette River (to assess the maximum extent of upstream flow reversals) and during high flows in both the Willamette and Columbia rivers (Figures 3.1-14a-h). Lower Columbia and Willamette flow and stage data are included in footnotes on the vector plots.

During high flows on the Willamette and comparable flows on the Columbia (Figures 3.1-14a-h), flow is consistently downstream on the lower Willamette River, and the model predicts that there is an apparent eddy effect (reduced circular flows) where the Willamette River flows into the Columbia River.

3.1.5 Soils

3.1.5.1 Regional Soils

The regional soils in the vicinity of the site are comprised of Sauvie-Rafton-Pilchuck soils (about 30 percent Sauvie soils, 10 percent Rafton soils, 10 percent Pilchuck, and 50 percent soils of minor extent and Urban land) that consist of silt loams, silty clay loams, and sands (NRCS 1983). They formed in recent alluvium. These soils are generally underlain by coarse or moderately course alluvium below a depth of 60 inches. Slopes range from nearly level to moderately steep (0 to 15 percent) soils on bottom lands, and elevation ranges from 10 to 20 feet (NRCS 1983).

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The Sauvie soils have a surface layer of very dark grayish brown silt loam and a subsoil of dark grayish brown, mottled silty clay loam. The substratum is dark grayish brown, mottled silt loam over fine sandy loam to a depth of 60 inches or more (NRCS 1983).

The Rafton soils have a surface layer of dark grayish brown, mottled silt loam and a subsoil of grayish brown and brown mottled silt loam. The substratum is dark grayish brown silt loam over black silt loam to a depth of 60 inches or more. These soils are subject to frequent flooding from December to July and in places are subject to ponding in July (NRCS 1983).

The Pilchuck soils have a surface layer of very dark grayish brown sand. The substratum is dark grayish brown sand to a depth of 60 inches or more (NRCS 1983). Sandy material dredged from the river channel is in some areas of Pilchuck soils.

Of minor extent in this area are the somewhat excessively drained Burlington fine sandy loam, the poorly drained Faloma silt loam, the very poorly drained Moag silty clay loam, and the somewhat excessively drained Sifton gravelly loam soils (NRCS 1983). The Burlington is on long narrow terraces, generally above an elevation of 20 feet. The Faloma soil has a sandy substratum. The Moag soil is in convex areas. The Sifton soil is on terraces, generally above an elevation of 20 feet. Other soils found in this area include Urban land, Riverwash, and water areas (NRCS 1983).

3.1.5.2 River Sediments

Several types of investigations have been conducted as part of the RI to characterize the physical nature of bedded sediments and their potential for movement within and through the lower Willamette River due to natural or anthropogenic forces. Additionally, a numerical HST model was developed (Integral 2006c; Integral and WEST 2006; WEST 2004, 2005, 2006b; WEST and Integral 2005; WEST and Tetra Tech 2009) and used to predict physical characteristics where they were not measured and the potential impact of extreme (flood) events on site sediments, particularly the potential for buried contaminated sediments to be re-exposed.

The sections that follow provide an overview of the major physical system site information, including sediment characteristics and a description of the major sediment transport regimes based on this body of empirical and modeling information.

3.1.5.2.1 Physical Characteristics

The physical properties of sediments yield significant information regarding the physical dynamics of the river system. Physical sediment data (e.g., grain size, specific gravity, total solids) and total organic carbon (TOC) have been collected as part of all sediment sampling for the RI and are also available from other sampling efforts conducted in the lower Willamette River (see Table 2.2-1 and 2.2-2). Total organic carbon in river sediments comes from decaying natural organic matter and from synthetic sources (e.g., detergents, pesticides, fertilizers, herbicides, industrial

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chemicals, and chlorinated organics) and is usually associated with fine-grained or silty sediments.

The grain-size data measured in surface sediment samples in the RI database[5] were used to generate contour maps of surface sediment grain size (as percent fines; i.e., coarse silt [63 μ] and finer) and TOC (percent) in the Study Area (Maps 3.1-2 and 3.1-3). In the absence of anthropogenic activities that affect sediment textures, the physical characteristics of surface-bedded sediment are general indicators of the energy regime of the riverbed at that location. Typically, fine-grained sediments (silts, clays) dominate in relatively low-energy environments where current velocities are low enough to allow fine particles to settle out of the water column and remain deposited, whereas coarse sediments (sands, gravels) are indicative of higher-energy environments where fines are kept in suspension in the water column and/or winnowed out of previously deposited material and transported away during transitory high-energy events (e.g., floods or anthropogenic disturbances, such as prop wash, wave action, dredging, etc.).

The samples collected displayed a large variety of sediment types ranging from sandy gravel to mud, although the majority of the sediments are sands or muddy sands. The most common sediment types found in the lower Willamette River are sand, muddy sand and sandy mud, which account for 83.5 per cent of all the samples (refer to Table in Section 2).

Upriver Reach

In the Upriver Reach, the river is confined in Tertiary basalt, which outcrops on much of its bottom. The Clackamas River brings some sand into the river, and there are pockets of reworked sand along the margins and in backwaters. Most of the bottom is hard ground in this area, and no sediment could be obtained upstream from this environment in either the Willamette or Clackamas Rivers. Where sediment is found, it is sand or gravelly sand, although there are pockets of muddy sand near the banks in a few locations. Accretion of coarse sandy sediments occurs downstream of Oswego Creek, which drains Lake Oswego and may account for the accretion of sediments in this area.

Downtown Reach

A mix of sediments characterizes the Downtown Reach, but they consist mostly of either sand or muddy sand. Pure mud, which is rare throughout the river, is found along the western margins of the lagoon inside Ross Island, where extensive aggregate mining takes place. Some Hard Ground is also found in this Reach, but now only in more isolated and smaller areas than in the Upstream Reach. Between Elk Rock Island to the vicinity of the Marquam Fixed Bridge, the river generally widens and flows through

[5] The majority of surface samples in the RI database were collected from intervals within 30 cm of the mudline; however, a limited number of non-LWG samples were collected from 0 to 40 cm bml. These were included in the surface sample data set as these samples include the near-surface sediment texture.

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Pleistocene sediments, with the result that hard ground is considerably less frequent and sediments contain somewhat more mud than in the Upriver Reach. The sediments from inside the lagoon in Ross Island are generally much muddier than the sediments in the adjacent channel. Any fine sediment entering the lagoon from upstream is able to settle inside the lagoon, although there is constant human activity taking place.

RI Study Area Reach

The river widens as it enters the RI Study Area Reach, and as a result the sediment type changes from sand at the upstream end, through muddy sand to sandy mud in the main part of the Reach. Exceptions to this are pure mud samples in Swan Island Lagoon, and coarser sediments found near the center of the river downstream of Swan Island. Originating on the east side of the river next to Swan Island, the quantity of mud rapidly increases suggesting a significant new source of sediment in this area. The north side of Swan Island Lagoon appears to have a coarse sediment source. Inside Swan Island Lagoon there appears to be a source of fine sediments. Sediments between RM 1 and RM 7, which includes the downstream portion of the river up to Columbia Slough and part of Multnomah Channel, are nearly all muddy sand. There are some coarser sediments near the center of the river and in the Multnomah Channel, together with several, randomly scattered, mud samples.

Starting at the upstream end of the Study Area (RM 11.8), Map 5.1-2 shows that coarse-grained surface deposits (i.e., 0–20 percent fines[6]) are predominant from upstream of the Study Area downstream to RM 11, especially along the western half of the river. The river gradually widens from RM 11 to 10, and this area is a mosaic of mostly sandy mud (21–40 percent fines) and muddy sand (41–60 percent fines) textures, and deeper holes and nearshore areas and embayments dominated by muds (61–100 percent fines).

The river widens markedly from RM 10 to 7, and surface sediments are dominated by fines, with the exception of some nearshore bank areas and some discontinuous areas along the western edge of the navigation channel. The finest texture sediments (81–100 percent fines) are widespread from RM 9 to 7, including locations within Willbridge Terminal, in the downstream lee of Swan Island (Portland Shipyard), and in Swan Island Lagoon.

From about RM 7 to 5, the river and navigation channel narrows again, and this reach is dominated by sands with relatively small subareas (e.g., within Willamette Cove and western nearshore around RM 6) that are dominated by fines characteristic of lower energy environments. Much of the remainder of the Study Area and beyond, to about RM 1.5, is dominated by fines, with a texture of 61–80 percent fines dominant upstream of Multnomah Channel (RM 3–5) and 81–100 percent fines widespread downstream of

[6] Fines are defined as sediments less than 63 microns in diameter that would pass through a through a No. 230 U.S. Standard sieve mesh. Based on the Wentworth Size Class, this includes course silt, medium silt, fine silt, very fine silt, and clay.

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Multnomah Channel (RM 1.5–3). Conversely, the relatively shallow and narrow Multnomah Channel is dominated by sands, as is a portion of the Study Area upstream and immediately adjacent to the Multnomah Channel entrance extending to the east bank. This is the largest area in the lower Willamette River between RM 1.5 and 5 that is not dominated by fines.

As expected, the TOC content of the surface sediments (Map 3.1-3) generally mirrors the sediment grain-size distribution, with higher TOC content collocated with the finer-grained deposits. TOC levels generally range from 0.5 to approximately 3 percent, but a few isolated areas contain higher levels (6 to up to 27 percent); these are all downstream of RM 7 and include the head of Willamette Cove, an area west of the main channel from RM 6.2 to 6.4, a mid-channel area at RM 5.7, and a relatively large area east of the channel at RM 2.

Vertical gradients in grain size can be examined visually across the Study Area by comparing Map 3.1-2 (contoured surface sediment texture; i.e., upper 30 cm, 1 foot) with Map 3.1-4 (contoured sediment texture for the shallow subsurface horizon; i.e., subsurface intervals ranging between 1 and 4 feet). Overall, the surface and shallow subsurface sediment textures are consistent throughout the Study Area, suggesting that the energy regimes in the system are relatively stable over the more recent time. There is, however, a subtle but perceptible widespread shift from finer-grained surface sediments to a slightly coarser-grained subsurface layer (e.g., from 81–100 percent fines to 61–80 percent fines) across much of the site. This may reflect seasonal or inter-annual winnowing of the finer sediments from the sediment bed during higher flow periods and the subsequent long-term burial of the slightly coarser residual sediments. Finally, there are three areas that show distinctly coarser surface sediments overlying finer material; these include the head of Swan Island Lagoon, the McCormick and Baxter/Willamette Cove area, and the area outside the entrance to Multnomah Channel, extending into the channel itself. Anthropogenic placement of fill and the sand cap cover placed in the river and beach at the McCormick and Baxter site in 2005 appear to explain this pattern in Swan Island Lagoon and around McCormick and Baxter/Willamette Cove, respectively. The vertical shift to finer material at depth immediately adjacent to and within the mouth of the Multnomah Channel is not as apparent, but the "relict" muds may reflect the less dynamic sedimentary environment that existed in this portion of the river prior to the Portland Harbor navigation channel dredging and other land use modifications in the region (e.g., bank treatments).

3.1.5.2.2 Riverbed Elevation Changes

Riverbed elevations changes are presented as changes in bathymetry measured at two points in time. The elevation change maps were created by overlaying the 1-m cells from each survey and subtracting the January 2009 data from the January 2002 data (the depth values are generally negative numbers, e.g., –15 ft NAVD88) to generate a

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direction and magnitude of change for each cell. The vertical resolution of the multibeam survey overlay was ±0.25 ft (approximately 7.6 cm), so cell comparisons that show positive or negative changes less than or equal to 0.25 ft represent no discernible change in riverbed elevation.[8] Map 3.1-7 shows the net bathymetric change over the seven-year period between the first (January 2002) survey and the January 2009 survey in the lower Willamette River.

On Map 3.1-7, positive elevation changes (shallower in 2009 compared to 2002) indicate shoaling, and negative elevation changes (deeper in 2009 compared to 2002) indicate deepening. The no-change areas are shaded gray, while shoaling areas (positive change) are shown in yellow to orange shades, and areas that deepened (negative change) are shown in blue shades. Comparisons of the time-series bathymetric change data between each survey period from 2002 to 2004 (i.e., 2002 to 2003, 2003 to 2004, and 2002 to 2004) showed generally consistent results with those shown in Map 3.1-7. Key observations and conclusions from those evaluations are listed below: [KEY ISSUE FOR DISCUSSION WITH EPA]

- Areas of shoaling and deepening occur more frequently in off channel, shallow nearshore areas than in the main navigation channel.
- River zones that were inferred to be higher energy zones based on the STA® and SPI summarized above (e.g., above RM 12 and between RMs 5-7) show numerous small-scale changes from bank-to-bank.
- Zones that were inferred to be lower energy (e.g., RMs 3-5, 7-9) show fewer small-scale changes in the channel.
- In some places, bedforms (e.g., at RM 5-6 and RM 11-12) can be seen propagating downstream (alternating high and low spots).
- Deposition or in-filling of some former in-channel dredged or borrow areas (e.g., at RMs 2, 5.2, and 9-10) is evident.
- The most extensive stretch of nearshore deepening extends along the west side of the river from RMs 0 to 3; this appears to be a natural sediment erosion pattern.
- The most extensive stretch of nearshore shoaling extends along the west side of the river from RM 4 to 5; this appears to be a natural sediment shoaling area.
- Bridge footings create localized areas of deep scour and accretion (e.g., the Railroad Bridge at RM 7).
- Many areas of deepening appear to be closely associated with pier structures, berthing areas, and slips; it is likely that much of this sediment movement is the result of anthropogenic factors (e.g., prop wash).
- Some recently dredged areas (e.g., at RM 10 off Terminal 2) are evident.

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The sediment transport regimes inferred from the SPI results in the deeper portions of Portland Harbor (navigation channel and lower channel slopes) differed notably from those inferred for the nearshore areas (upper channel slopes, off-channel benches and beaches). The division between these "channel" and "nearshore" areas was delineated by the –15-foot NAVD88 contour that equates approximately to the –20- foot CRD contour in the survey area.

[KEY ISSUE FOR DISCUSSION WITH EPA] Table 2-5 lists the numbers of square meters in each river mile that show no change, shoaling, and deepening across the full range of vertical change intervals observed. The no-change category is defined as +/- 0.25 foot based solely on the vertical resolution of the overlain bathymetry measurements. The percentage of the area within each river mile that fits into each of these three categories is shown at the bottom of Tables 2-5a and 2-5b, and cumulative shoaling and deepening percentages by change interval are tabulated on the right. The percentage of the area within each river mile showing no change, shoaling, and deepening is graphed on Figure 2-10. Several general trends are evident:

- First, consistent with the patterns on the bathymetry change maps, the proportion of each river mile that shows no change (gray bars) is substantially greater in the channel areas (Figure 2-10b) than nearshore areas (Figure 2-10a).
- Second, in nearshore areas (Figure 2-10a), the percentage of the river exhibiting shoaling (green bars) peaks between RMs 4-5 and 10-11; these are reaches identified as "depositional zones" based on the SPI survey data (SEA 2002f). Channel shoaling peaks are less distinct than the nearshore peaks, but also occur in the "depositional zones" at RMs 1-2, 4-5, and 9-10, as well as in an upstream area around Ross Island (RM 14-15.7).
- Finally, in the nearshore areas, the percentage of the area that deepened (red bars) peaks at RMs 0-3 and 11-13. In channel areas, the peaks in deepening occur at RMs 2-3, 5-6, 11-13 and 14-15.7. The upstream (RMs 11-13) and mid-reach (RMs 5-6) areas were identified as "transport zones" based on the STA® (GeoSea Consulting 2001) and SEA (2002b) results. The peak in deepening in the nearshore downstream areas (RMs 1-3) appears to reflect the large, contiguous zone of erosion that is evident along the west side of the river from RMs 0 to 3 (Map 2-7a and 2-7b).

The data compiled in Tables 2-5a and 2-5b allow the total percentage channel and nearshore areas that either deepened or shoaled to be quantified.

Channel Areas

Across all channel areas combined, approximately 65.9% of the riverbed shows no change in elevation between the two surveys, while 22.5% of the area deepened measurably and 11.6% shoaled. The cumulative percent of the channel area that is shoaling and deepening by vertical change interval is also provided in Table 2-5b. For both shoaling and deepening, over 90% of the cells that exhibit vertical change show change that is less than or equal to 1 foot in magnitude, and over 98% of the cells show vertical change that is less than or equal to 2 feet. When the no-change cells are included in the calculation (i.e., the sum of the no-change cells

and the shoaling/deepening cells ≤ 1 foot over the total cell count), only 2.8% of the total area of the channel shows vertical change (either shoaling or deepening) greater than 1 foot. This represents a total channel area of about 260,000 m^2.

Nearshore Areas

Across all nearshore areas combined, approximately 43.3% of the riverbed shows no change in elevation between the two surveys, while 40.3% of the area deepened measurably and 16.4% shoaled. The cumulative percent of the nearshore area shoaling and deepening by vertical change interval is shown in Table 2-5a. The magnitude and the extent of vertical change are greater in nearshore areas than offshore. Still, over 75% of the cells that exhibit vertical change show change that is less than or equal to 1 foot, and over 93% 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 shoaling or deepening) greater than 1 foot is approximately 13.4%. This represents a total nearshore area of about 215,000 m^2.

[KEY ISSUE FOR DISCUSSION WITH EPA]The vertical changes in riverbed elevations that were measured by the LWG cover a seven year period from 2002 through 2009. Because changes in riverbed elevations are assumed to be directly influenced by river flow, an analysis of river stage height data was also conducted. The 2002 river stage height year is included on each water year plotted in Figure 2-2 for comparison purposes. Visual examination of Figure 2-2 indicates that the January to September period in 2002 was relatively typical in terms of river stage heights compared with the same period in other years since 1973 for which there are relatively complete river stage data. The January to September 2002 river stage pattern was similar in magnitude to that observed in 1978-80, 1985, 1987, 1989, 1990, 1993, 1995, 2000, and 2003, notably less than the January to September river stages observed in 1974-76, 1981-84, 1986, 1996, and 1997-1999, and notably greater in magnitude than the river stages measured in 1973, 1977, 1988, 1994, and 2001. For the 30-year period from 2003 to 1973 only 28 year-to-year comparisons could be made because there are no data for 1991 and 1992. Based on those data, the 2002 river stages were either greater than or similar to the river stages observed in other years 57% of the time (16 years), and were less than the river stages observed in other years 43% of the time (12 years).

In reviewing the river stage data in Figure 2-2, note that lower Willamette River flood stage is +18 feet CRD (18.3 feet PRD), and the ordinary high water mark in the lower Willamette River is approximately +15 feet CRD (15.3 feet PRD). The patterns of sediment movement measured over the 8-9 month period in 2002 are consistent with the understanding of sediment transport regimes in the system based on the work conducted during the planning phases of the RI/FS (GeoSea Consulting 2001, SEA 2002b,f). In addition, the scale of the observed elevation changes is consistent with the annual depositional rates of 0.5 to 1 foot/year estimated by comparing historical dredge records from the navigation channel for the 10-year period 1990-

1999 (SEA 2002b). [WP states here that additional activities planned to verify and expand this understanding of PH Physcial system, p.41]

3.1.5.2.3 Erodibility

Sediment erosion rates and critical erosion shear stress values for the lower Willamette River sediments were measured directly as part of the data collection effort conducted by the LWG in the spring of 2006 (Integral 2006b). This study involved the collection of 17 cores from locations throughout the Study Area selected to represent a range of bottom conditions in terms of sediment texture and local hydrodynamic conditions. These data are discussed here for their empirical value as a measure of riverbed erodibility of surface sediments throughout the Study Area in late March 2006.

The sediment cores were subjected to various flows using a Sedflume system to produce a range of shear stresses (a force applied parallel or tangentially to a surface; from 0.1 Newtons [N]/m^2 to 10 N/m^2) to the sediment surface. Resulting critical erosion flow velocities and erosion rates were measured at approximately 5-cm intervals to depths of approximately 25 cm. Physical properties of bulk density and grain-size distributions were also analyzed at approximately 5-cm intervals. Erosion rates per shear stress applied varied depending on sediment grain size, bulk density, and sediment depth. A summary of the number of applications per shear stress value and the range of observed erosion rates (in cm/s, depth of sediment eroded per unit time) on all Sedflume cores is presented in the Table 3.5-1.

Table 3.5-1: Summary of Shear Stress and associated Erosion Rates for Portland Harbor Sediments.

Shear Stress	Measurements	Erosion Rate (cm/s)	
(N/m^2)	Count	Min	Max
0.1	16	0	0.0003
0.2	23	0	0.0003
0.4	55	0	0.001
0.8	74	0	0.04
1.6	76	0.0002	0.1
3.2	76	0.0003	0.3
6.4	60	0.007	0.4
10	2	0.02	0.04

Critical erosion velocity shear stress values[9] (Sea Engineering 2006) were calculated at approximately 5-cm intervals. Median grain size (d50) values for the sediment intervals ranged from 9.7 μm (medium silt) to 401 μm (medium sand), and critical shear stresses

[9] Critical erosion velocity shear stress is defined in the Sedflume method (citation) as the shear stress at which erosion occurs at 10^{-4} cm/s.

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(T_{cr}) were calculated to range from 0.06 N/m^2 to 1.28 N/m^2. These data from the SedFlume cores, summarized by core depth interval, are tabulated in Table 3.5-2.

Table 3.5-2: Summary of grain size and critical shear stress for sedflume cores by core depth interval at Portland Harbor.

Sample Depth Category	d50 (µm)		T_{cr} (N/m^2)	
	Min	Max	Min	Max
0–5 cm	9.7	401	0.06	0.64
5–10 cm	12	367	0.32	1.28
10–15 cm	10	378	0.22	1.28
15–20 cm	7.8	384	0.26	1.28
20–25 cm	10.9	357	0.24	1.28

The Phase 1 Hydrodynamic model (WEST and Integral 2005) was also used to predict bed shear stresses that would occur in the lower Willamette River under typical low-flow (e.g., 40,000 cfs) and relatively infrequent high-flow (e.g., 160,000 cfs) conditions.[10] Map 3.1-8 shows modeled bed shear under these low- and high-flow conditions. Under the low-flow conditions, bed shear values are predicted to remain below 0.4 N/m^2 throughout most of the channel and below 0.1 N/m^2 in the nearshore areas. Slightly higher shear stresses (up to 0.7 N/m^2) are predicted for the channel near RM 11 and for the head of Multnomah Channel. As a first-order approximation, these data indicate that significant sediment bed movement or resuspension due to natural hydrodynamic forces does not occur under the typical flow conditions that take place over much of the year (i.e., less than 50,000 cfs) in the lower Willamette River.

Under the relatively rare high-flow conditions, the predicted bed shear values remain low in most nearshore areas, slips, and embayments but are much higher, as well as more variable, in the channel. The predicted bed shear values in the main channel range from 0.614 N/m^2 between RM 2 and 2.3 to the maximum value of 19.7 N/m^2, which occurs in the channel at approximately RM 10.3. The highest values (>5.0 N/m^2) occur in both the nearshore and channel areas in the more constricted reaches (e.g., between RM 10 and 11, and again between RM 5 and 7; Map 3.1-8). The predicted high-flow bed shear values in the channel approach or exceed the highest critical shear stress calculated from the Sedflume study (1.28 N/m^2) throughout much of the Study Area, indicating that sediment transport is likely to occur throughout much of the channel during this flow condition.

3.1.5.2.4 Suspended Sediment

Suspended sediment loads are an important component to understanding the lower Willamette River physical system in describing the transportation of sediment

[10] Mean daily flows of approximately 160,000 cfs or more were recorded on 119 days (0.9 percent) over the 30-year period of record and on 14 days (0.5 percent) over the RI water years 2001 through March 31, 2008. Mean daily flows of 40,000 cfs or less were recorded on 9,374 days (74 percent) over the period of record and on 2,031 days (77 percent) over the RI water years 2001 through March 31, 2008.

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throughout the river system. Sediment load in a river system can be divided into two components: the bed material and the wash load. The transport of sediments is accomplished both along the bed (bed load) and suspended within the river (suspended load). Total suspended solids (TSS) data have been collected by the LWG both as part of the surface water characterization (2004 – 2005) and physical system (2005 – 2006) sampling efforts and by the City of Portland (2000 – 2008) at RM 6.8 in order to understand the relationship between river hydrodynamics and the suspended sediment (i.e., suspended load).

The TSS data collected by the LWG are presented in Tables 3.1-3 and 3.1-4. Data were collected within the Study Area during the remedial investigation period by the LWG in November 2004, March 2005, July 2005 and April 2006 and by the City of Portland (see Appendix A:WLC1200Z) at RM 6.8 between 2000 and 2008. Upriver data were also collected during the remedial investigation period as a time-series from a RM 23 transect between December 2005 and April 2006, as well as one sample from RM 23.7 and another from RM 16.

[KEY ISSUE FOR DISCUSSION WITH EPA] **Upriver**

[redacted]

Study Area

[redacted]

[redacted]

Other observation that can be made from the data collected are:

- [redacted]
- TSS concentrations are relatively low (< 5 mg/L) in Swan Island Lagoon compared to the river indicating that TSS transport within the river does not enter SIL.
- [redacted]
- [redacted]
- [redacted]

- [redacted]

In situ suspended particle sizes were measured at HMV01 through HMV05 (RM 2, RM 6.3, RM 11, and RM 18) in early April 2006 using a laser *in situ* scattering and transmissometer (LISST) as part of the physical system data collection (Integral 2006n). Particle size was measured in 0.5-m increments through the water column. The median grain-size measurements with depth at each station are plotted in Figure 3.1-17, and a summary of the grain-size ranges measured is tabulated in Table 3.1-??. As indicated by the data, particles primarily in the silt and fine-to-medium sand size ranges were in suspension when river flows were less than 30,000 cfs. The coarsest median grain sizes were found upstream of the harbor at station HMV05 (RM 18) where the river is relatively narrow.

Table 3.1-??. TSS Grain Size Distribution throughout Portland Harbor Study Area.

Location	Station	Maximum Grain Sizes per Station		
		d10(µm)	d50(µm)	d90(µm)
RM 2 West Side	HMV01	4.28	25.76	204.36
RM 6.3 East Side	HMV02	4.1	40.66	274.53
RM 11 West Side	HMV03	3.32	35.28	242.34
RM 11 Mid-Channel	HMV04	2.98	32.11	242.91
RM 18 Mid-Channel	HMV05	3.78	79.3	383.11

Note:
d10, d50, d90 = diameter of the 10th, 50th, and 90th percentiles of the grain-size distribution.

[KEY ISSUE FOR DISCUSSION WITH EPA]

3.1.5.2.5 Hydrodynamic and Sediment Transport

A numerical HST modeling effort was conducted as part of the Portland Harbor RI to complement the empirical observations and gain a further understanding of physical system dynamics. A primary objective of this modeling for the RI was to predict the potential impact of extreme (flood) events on site sediment stability, particularly the potential for buried contaminated sediments to be re-exposed. Other objectives include understanding the complex hydrodynamics (i.e., the movement of surface water) of the lower Willamette River system (e.g., see Section 3.1.3)

Development of the HST model began in 2003, and the model has been through several development phases with EPA coordination and input. The RI HST modeling work is detailed in a series of documents (Integral 2006b; Integral and WEST 2006; WEST 2004, 2005, 2006b; WEST and Integral 2005), and the final revised RI Phase 2 HST modeling report has been provided under separate cover (WEST and Tetra Tech 2009). Key aspects of the model, important developmental milestones, site-specific data collected to improve model performance, and major model sediment transport outputs are summarized in the sections that follow.

The HST model uses the Environmental Fluid Dynamics Code (EFDC). EFDC is a public domain, multifunctional, surface water modeling system, which can include hydrodynamic, sediment-transport, and eutrophication components. EFDC has been used for more than 80 modeling studies of rivers, lakes, estuaries, coastal regions, and wetlands in the United States and abroad.

The EFDC model's sediment-transport component is capable of simulating the transport of multiple size classes of cohesive and non-cohesive sediment (Tetra Tech 2002). A sediment processes function library allows the model user to choose from a wide range of currently accepted parameterizations for settling, deposition, resuspension, and bedload transport. The sediment bed is represented by multiple layers and includes a number of armoring representations for noncohesive sediment and a mixed bed material finite-strain consolidation formulation for dynamic prediction of bed-layer thickness, void ratio, and pore water advection. The sediment-transport component can operate in a morphological mode, with full coupling between the hydrodynamic components, to represent dynamic evolution of bed topography. Water column/bed exchange processes include particulate deposition and resuspension, pore water entrainment, and pore water advection and diffusion.

Phase 1 Modeling

In accordance with the Modeling Approach Technical Memorandum (WEST 2004), Phase 1 of the RI modeling, including model setup, an analysis of model sensitivity, and initial model calibration runs for both hydrodynamics and sediment transport were conducted (WEST and Integral 2005) and revised (WEST 2005). The primary objective of the Phase 1 modeling was to determine if a two-dimensional (2-D) model would be adequate for the site, in terms of addressing model objectives. Due to the relatively small tidal influence in the lower Willamette River and the general lack of a significant density structure (WEST 2004), Phase 1 concluded that a 2-D model was adequate. The secondary Phase 1 modeling objective was to gain an understanding of the site's physical processes and the impact of various model parameters on the model predictions. Based on the model sensitivity and performance analyses, additional potential site-specific data needs were identified.

Overall, the Phase 1 model effectively simulated the hydrodynamics. However, bed elevation changes were not well captured by the model at the target accuracy levels. As a result, a number of site-specific data needs related to improving the sediment transport performance of the model were identified and collected in 2006.

In general, these data needs were associated with the behavior of cohesive sediments in the system (e.g., settling velocities and erodibility).

Phase 2 Modeling

In Phase 2, the HST model was revised and recalibrated using the site-specific modeling data collected in 2006. The revised model computation domain extends from the confluence with the Columbia River (RM 0) to the confluence with the Clackamas River (RM 24.1), and the Multnomah Channel to its confluence with the Columbia River near St. Helens, Oregon (WEST 2006b). The upstream boundary of the Phase 2 HST model was shifted to approximately 2.4 miles downstream of the Willamette Falls (RM 26.6), which was the upstream boundary in the Phase 1 model (WEST 2006b).

The Phase 2 model focused on identifying a combination of the reference critical shear stress for deposition, reference resuspension rate, reference critical shear stress for resuspension, and reference void ratio to minimize the differences (both statistically and graphically) between the measured and simulated bed change over the calibration period.

Compared to the revised Phase 1 results, the Phase 2 model showed some improvement in the agreement between simulated and measured bed elevations by incorporating site-specific data. The model did a better job in the deeper portions of the river than the nearshore areas. This is expected as sediment transport in nearshore areas might also be affected by other factors (e.g., local flow features near structures and prop wash) that are not explicitly represented in the model. The revised Phase 2 calibration results are detailed in the Revised Phase 2 Recalibration Results for the Hydrodynamic Sedimentation Model (WEST and Tetra Tech 2009).

HST Model – Flood Simulation

In 2009, the LWG fully modified the sediment transport portion of the HST model. The primary HST model application for the RI is to examine the potential for contaminated subsurface sediment re-exposure due to a major flood event in the lower Willamette River.

The 2009 HST model was used to predict the bed elevation changes (i.e., the areas and magnitude of erosion and deposition in the Study Area) that would result from five different high-flow scenarios. A range of high-flow simulations were run because bed response can be a function of the long-term hydrographic conditions that exist leading up to the flood event. Figure 3.1-19 shows the simulated hydrograph for the flood event that produced the largest overall riverbed elevation changes (note that this hydrograph includes a simulation of the 1996 flood following five years of high flow). Map 3.1-9a shows the net bed elevation changes, both erosion and accretion, following the simulated high-flow event. For comparison, Map 3.1-9b shows the maximum erosion levels predicted for each model cell during this simulated high-flow event; this map is a mosaic of maximum erosion per cell at any point during the simulation, and so shows the maximum extent of erosion for each cell regardless of backfilling that might occur on the falling limb of the hydrograph. The flood event maximum erosion map (Map 3.1-9b) shows that 38 percent of model cells in the Study Area undergo erosion at any point during the simulated flood; most of these cells (85 percent) undergo erosion of 30 cm (1

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ft) or less. Overall, 6 percent of Study Area cells undergo maximum erosion greater than 30 cm (up to 192 cm or ~6.4 feet) and, therefore, are predicted to exceed the 30-cm project-defined surface sediment layer during the modeled flood event. This erosion of deeper, "subsurface" sediments (greater than 192 cm) is localized in three regions of the Study Area (see the three darkest shades of blue cells in Map 3.1-9b):

- The navigation channel from RM 10 to 11.8, particularly upstream of RM 10.7
- The navigation channel from about RM 5.2 to 6.8 and adjacent eastern nearshore zone cells between RM 6.1 and 6.7
- An isolated cell in the eastern nearshore at RM 3.1.

These more deeply eroded areas correspond to areas that are predominantly sandy in texture which tend to be erosional when flows seasonally peak in the spring.

Beyond these areas, the HST flood simulation predicts that most areas of erosion will occur within the navigation channel. Much of the navigation channel will experience erosion on the order of 15 to 30 cm. Most nearshore or off-channel (e.g., Swan Island Lagoon) areas are not predicted to erode. Similarly, several portions of the navigation channel (i.e., RM 1.7 to 3.0), most of RM 4 to 5, and the western half of the channel from RM 7.3 to 9.2, also are not predicted to be erosional.

[KEY ISSUE FOR DISCUSSION WITH EPA]

3.1.5.2.6 Sediment Transport Regimes

In the deeper, offshore areas of the harbor (i.e., the navigation channel and adjacent areas in the main stem of the lower Willamette River deeper than about –20 ft NAVD88, see Map 3.1-5), the movement of water and sediment appears to be controlled in large part by the physical shape of the river, both the cross-sectional area and anthropogenic alterations such as borrow pits, dredged areas, and structures (e.g., bridge footings). In the off-channel, nearshore areas, especially areas less than –20 ft (NAVD88) in depth, the sediment dynamics are complicated by local riverbank morphology, seasonal changes in water levels, bank treatments, and other anthropogenic factors such as prop wash. Map 3.1-10 shows several cross-sectional channel profiles from RM 1 to 13 and illustrates the variability of the river morphology throughout the Study Area. The cross-sectional profiles include both the 2002 (blue) and 2009 (red) bathymetry and show where deposition and erosion have occurred. It should be noted that in the nearshore areas where the contamination mostly occurs, there is relatively little difference between the two lines indicating that there is a net zero (i.e., neither erosion nor deposition) occurring in these areas. Select sediment-profile images from the 2001 SPI survey are included on Map 3.1-10 to show how river

bed surface textures and sediment shear strength (as indicated by the depth of the SPI camera prism penetration; SLA 20026) vary in accordance with the river's cross-sectional area and depositional setting. Finally, the plan view 2002 to 2009 bathymetric change data (Map 3.1-7) is included as the background layer on Map 3.1-10 to provide the reader with a comparison of variation in cross sections with bathymetric elevation changes.

Map 3.1-13 shows predicted (HST model) bottom shear forces in the lower Willamette River from RM 24 (the upstream end of the 2009 HST model domain) to the Columbia River (RM 0) under a relatively high flow regime (160,000 cfs); this was the flow condition observed in the lower Willamette River in late January 2004 when the Columbia River stage was relatively low. The combination of high flows in the Willamette River coupled with a low Columbia River stage is expected to produce the greatest bottom shear forces in the lower Willamette River. With the exception of the area from approximately RM 15 to RM 17, Map 3.1-11 shows that narrower upriver areas from RM 12 to RM 24 experience much higher near-bottom shear forces than occur within Portland Harbor (RM 12 to the Columbia River at RM 0).

Table 3.1-5 summarizes some of the key hydrodynamic and sediment transport characteristics of the lower Willamette Rover by major reaches with a focus on the distinct variations observed in subsections of the Study Area. The hydrodynamic character and sediment transport regimes of the lower Willamette River may be broadly described in terms of the ten reaches discussed in the following subsections.

Upriver Reaches

There are two reaches upstream of the Study Area that are summarized in Table 3.1-5 and described below:

Upriver (RM 26 to RM 15.3)

The upriver segment includes the stretch of the river from Willamette Falls to the upstream end of Ross Island (approximately RM 26 to RM 15.3). Here the river is relatively narrow and flows through suburban areas under largely natural conditions, with the exception of the control structure (USACE Locks) at the Willamette Falls (approximately RM 26). Much of the river bottom consists of exposed basalt bedrock (GeoSea Consulting 2001). Bed shear stresses through this area are generally high (averaging 5.8 N/m^2), with the highest shear stresses occurring in the bend between RM 23 and 24 (>40 N/m^2), Map 3.1-11. Sustained current speeds in this reach appear to prevent all but the coarsest material from settling in the main stem of the river. Some low to moderate shear stresses occur in the smaller bifurcated channels, embayments, and sheltered nearshore areas. The most extensive relatively low-energy area occurs at the downstream end of this reach from approximately RM 15 to RM 17 and includes the river channel that runs behind (east of) Ross Island; predicted shear stresses here range from 0.4 to 4 N/m^2.

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Downtown Reach (RM 15.3 to RM 11.8)

The downtown segment of the lower Willamette River extends from the upstream end of Ross Island (RM 15.3) to the upstream end of the Study Area at RM 11.8. Like the upriver reach, this is also a relatively high-energy segment of the river, where the main channel of the river is narrow (average cross-sectional area estimated at 34,000 ft^2) with steep channel margins that are largely constrained by upland bulkheads along both riverbanks. The deepest areas of the channel are found on the outer edges of bends in the river below Ross Island, and in the dominant bifurcation channel west of Ross Island. Relatively high bed shear stresses (averaging 3.4 N/m^2) occur in the main portions of the channel, while lower shear stresses occur in the channel east of Ross Island and in shallower nearshore areas associated with some bends in the river (Map 3.1-11).

The high-energy environment of the main channel is evidenced by the observed bedded sediment texture, which consists primarily of gravels and sands (SEA 2002a). Localized areas of exposed bedrock occur, particularly near bridges where scouring appears related to footing structures (GeoSea Consulting 2001). Fine-grained deposits are observed in some nearshore areas sheltered from the main flow of the river (SEA 2002b). The SPI image from RM 12.4 (figure ??) illustrates the high energy setting of this area, showing an apparently small-scale transgressive, well-sorted fine to medium brown sand bedform overlying and advancing over a poorly sorted gray, silty, fine sand (Map 3.1-10; SEA 2002b). The 2002 to 2009 bathymetric change data (Map 3.1-7) show limited sediment accretion throughout this reach, particularly downstream of RM 14, where areas showing no change and small-scale deepening (≤1 ft) are dominant (Integral 2004a).

RI Study Area

The Study Area extends from RM 1.9 to 11.8 and the lower Willamette River -40 ft CRD authorized federal navigation channel nearly overlaps it, extending upstream from the Columbia River to RM 11.7 (Broadway Bridge).

Map 3.1-12 juxtaposes on a single panel the contoured surface grain-size patterns, the measured bathymetric change from 2002 to 2009, and the HST-predicted net riverbed elevation changes following a major flood event for the Study Area. The overlap of certain elements of these features across the Study Area as well as the physical and hydrodynamic conditions observed and measured within the Study Area helps support the discussions provided below.

RM 11.8 to RM 10

The cross-sectional area of the river begins to increase in this segment as the river broadens in a downstream direction, but the hydrodynamic energy in this segment of the Study Area remains relatively high (Maps 3.1-10 and 3.1-11) and comparable to the upriver reaches (e.g., see high-flow bed shear values in Table 3.1-8). This is evidenced by the high potential bed shear stresses, particularly in the eastern portion of the main

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channel where the channel bank is steep ([redacted]), and by the observed bed sediment texture, which is dominated by sand ([redacted]). The lower bed shear stresses predicted to occur along the eastern channel flank at RM 11.5 at the Goldendale Aluminum facility (Map 3.1-11) is supported by the historical dredging that has been required to maintain that facility's docking berth (CH2M Hill 2001a).

The off-channel, nearshore areas of this reach are narrow, and show a nearly equal proportion of small-scale deepening, shoaling, and no-change areas (Integral 2001a). The channel through this reach has generally undergone minor net deepening over the study period (on the order of 30 cm [1 ft], or less), though small areas have deepened more substantially. Deposition on the order of several feet has occurred in the deep areas of previously dredged holes (borrow pits) on the western side of the channel (Map 3.1-12). These are the farthest-upstream areas of significant net deposition in the lower Willamette River surveyed bathymetrically (i.e., from the Columbia River to the upper end of Ross Island) as part of the Portland Harbor RI/FS. Sand waves are evident migrating along the western portion of the channel between RM 11 and 11.7 (Map 3.1-7).

The 2009 HST model flood scenario predicts areas of deep (>100 cm) erosion occurring in some central portions of the navigation channel between RM 10.7 and 11.6 in this reach (Map 3.1-9b), but deposition reduces the extent of net deepening, or even dominates, in other portions of the channel, and dominates in nearly all off-channel areas (Map 3.1-9a). However, the observed changes in bathymetry (Map 3.1-7) contradict the models predictions showing the limited applicability of the model to accurately predict erosion and deposition in this reach of the river.

RM 10 to RM 9.2

The river becomes predominantly depositional as it widens significantly around RM 10. The increase in cross-sectional area reduces flow velocities, as reflected by the lower predicted bed shear stresses (Table 3.1-5) from the 2009 HST model, particularly along the broad western flank of the channel (Map 3.1-8), and the widespread sediment accumulation predicted by the 2009 HST model in this area (Map 3.1-9a). The observed changes in bathymetry (Map 3.1-7) show that there is more widespread sediment accumulation than predicted by the model, especially on the west bank of the river and extending into the navigational channel. An extensive shoaling on the order of 60 to 150 cm (~2 to 5 ft) in extent is evident along the broad western flank of the channel here.

Observed bed sediment textures reflect the cross-channel energy differences, with coarser-grained deposits dominating the eastern portion of the riverbed and finer-grained deposits occurring along the western portion (Map 3.1-2). The SPI image taken at RM 9.3 (station STA66F; Map 3.1-10) shows the riverbed to be composed of a thin silt layer overlying well-sorted medium sand, evidence that this eastern nearshore location undergoes alternating periods of sediment transport, when the fines are

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winnowed from the sands, followed by quiescent periods that allow deposition of the silt (SEA 2002b).

The 2009 HST model predicts erosion to depths of approximately 30 cm in the navigation channel in this reach during the flood event (Map 3.1-9b), but net results show deposition dominating in the nearshore areas and reducing or eliminating the net erosion in some parts of the channel (Map 3.1-9a). However, the observed changes in bathymetry (Map 3.1-7) show that there is more deposition in the navigational channel and less deposition in the nearshore areas, especially on the east side of the river.

RM 9.2 to RM 6.9

This reach is the broadest segment of the Study Area with a relatively wide cross-sectional area (Map 3.1-10), estimated at an average of 63,000 ft^2, and moderate to low bottom shear stresses (Table 3.1-5). The reach is dominated by fine-grained surface sediments (Map 3.1-2). The depositional nature of the majority of this reach is seen in the areas of shoaling observed in the channel between RM 7.8 and 9.2 and along the eastern (directly downstream of Swan Island) and western channel-edge areas downstream to RM 6.9 (Map 3.1-7). Maintenance dredging has been required historically along the western shoreline of this reach (see Section 3.2.5.2). The large off-channel areas in this reach (e.g., Swan Island Lagoon) are characterized by very low bed shear but little or no sediment deposition (Map 3.1-12). Isolated areas of deepening observed in Swan Island Lagoon and at Willbridge Terminal are likely the result of anthropogenic factors such as prop wash and dredging. Dredging of sediments along the Willbridge Terminal piers occurred between winter 2002 and winter 2009 (Map 3.1-7).

RM 6.9 to RM 5

The river again narrows in this reach to an average cross-sectional area of approximately 57,000 ft^2 (Map 3.1-10). This stretch of river is a relatively high-energy sediment transport zone with high-flow bed shear rates (4.2 N/m^2) that approach the values predicted upstream of RM 10. Predicted maximum bed shear stresses are moderate to high (Map 3.1-11 and Table 3.1-5) indicating that more erosion and less sedimentation is likely to occur.

The high-energy nature of this segment of the river results in predominantly sandy surface sediments (Map 3.1-2). Examples of this are illustrated in the SPI photos in Map 3.1-10. The riverbed surface in the SPI snapshot from RM 6.9 (STA 47C) is composed of fine to medium, brown sand; the tan silt lenses within the sand matrix are evidence of active sediment transport (SEA 2002b). The riverbed seen in the SPI snapshot at RM 5.5 (STA 36B) is composed of poorly to moderately sorted, fine to medium sand, and also appears to be undergoing sediment transport (SEA 2002b).

The 2002 to 2009 bathymetric change (Map 3.1-7) shows that the channel in this reach is a mosaic of no change, small areas of sediment accumulation (mostly associated with

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channel depressions), and some small-scale scour. Localized areas of exposed bedrock have been noted, particularly on the west side of the river near the St. Johns Bridge. Sand wave migration is evident along the central portion of the channel between RM 5 and 6. Outside the channel, the narrow eastern nearshore area and the nearshore western area from RM 6.5 to 6.9 is dominated by scour, while the narrow western nearshore zone shows sediment accumulation between RM 5 and 6.5.

The 2009 HST modeled flood scenario predicts relatively deep (61 to 152 cm, 2 to 5 feet) erosion occurring in portions of the thalweg (i.e., the deepest area of the channel) and, to a lesser extent (less than 61 cm), in adjacent channel margin areas (Map 3.1-9b). Some of the deeper portions of the navigation channel downstream of RM 5.5 and some off-channel areas predict net deposition following the high-energy event (Map 3.1-9a). This includes the outer portions of Willamette Cove and narrow swaths along the eastern and western nearshore areas from RM 5 to RM 5.5 and from RM 5.8 to RM 6.1.

RM 5 to RM 3

The river widens again below RM 5 to an average cross-sectional area of 65,000 ft^2 (Map 3.1-13). The bathymetry is dominated by a deep (up to –70 ft NAVD88) dredged area on the eastern half of the channel between RM 4 and 5, which gradually shoals to the typical -40 ft depth CRD downstream of the International Terminal Slip (RM 3.6 east). The time-series bathymetry indicates that the majority of the riverbed in the main channel undergoes minor net shoaling (30 cm or less) with swaths of more significant sediment accumulation along east and west channel edges and nearshore areas, especially between RM 4 and 5 (Map 3.1-7). The isolated areas of scour that are evident in some nearshore areas are likely due to anthropogenic factors; some dredging is also evident at the Port's Terminal 4 slips located between RM 4 and 5 on the eastern shore of the river. The hydrodynamic model predicts low to moderate bed shear stresses, with relatively lower bed shear in the deeper upstream portion of this river segment and along the channel margins (Map 3.1-11 and Table 3.1-5).

Surface sediments are dominated by silts (60 – 80 percent fines) with some exceptions. The International Terminal Slip is mostly sand with very little fines (0 – 40 percent fines), most likely due to anthropogenic factors (e.g., prop wash) (Map 3.1-2). The mid channel at RM 4 and a cross-channel swath at RM 3.2 leading into Multnomah Channel are also dominated by sandy surface sediments.

The 2009 HST modeled flood scenario predicts erosion on the order of 30 cm (1 ft) in portions of the navigation channel and in the channel margin and nearshore areas downstream of RM 3.4 (Map 3.1-9b). Up to 61 cm of erosion is predicted for an isolated cell in the eastern nearshore at RM 3.1. However, deposition during the flood event is predicted to reduce or eliminate the net erosion observed in many cells in this reach (Map 3.1-9a). Model results show net deposition exceeding 30 cm in much of the channel and nearshore area from RM 4 to 5, and to a lesser extent in the RM 3 to 4 segment, including small depositional zones along the western nearshore area just

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upstream of Multnomah Channel and just upstream of RM 3 in the eastern nearshore zone (this is a predicted nearshore shoal that continues to RM 1.5).

RM 3 to 1.9

A significant fraction (up to 50%) of the downstream lower Willamette River flow moves down the Multnomah Channel; the reduced discharge volume of the lower Willamette River downstream of Multnomah Channel results in a markedly reduced bottom shear bed values (Maps 3.1-8 and 3.1-11). In addition, the main stem of the lower Willamette River continues to widen in this reach as it bends to the northeast, to an average cross-sectional area of approximately 67,000 ft^2 (Map 3.1-10). Maximum bed shear values are approximately half what they were just upriver from Multnomah Channel (Table 3.1-5) and are particularly low on the inside curve of the bend (Map 3.1-11). This is the lowest energy main channel reach in the Study Area. This is reflected in the observed surface sediment texture, which is predominantly fine-grained, and in the shoaling observed in the channel and east of the channel throughout this reach between 2002 and 2009. The area to the west of the channel boundary in this reach shows little net change over this time period. The 2009 HST modeled flood scenario predicts very little erosion, with deposition dominating the area virtually from bank to bank (Maps 3.1-9a and b). This is inconsistent with the time-series bathymetry (Map 3.1-7), which shows that deposition is occurring at the inside bend of the river on the eastern shore and is in dynamic equilibrium (i.e., neither deposition nor erosional) at the outside bend of the river on the western shore.

Downstream Reaches

There are two reaches downstream of the Study Area that are briefly described below:

Downstream Reach (RM 1.9 to RM 0)

The remaining river segment downstream of the Study Area extends to the Willamette's confluence with the Columbia River. Bed-shear stresses are low to moderate (Table 3.1-5), increasing from about RM 1.6 downstream as the river narrows and becomes more dynamic as it reaches the Columbia River (Map 3.1-11). Net shoaling (greater than 60 cm, 2 ft) was observed along the eastern channel edge and east of the channel to around RM 1.5 (Map 3.1-7). This is a continuation of the pattern seen upstream of RM 1.9; this is the furthest downstream extent of significant sediment deposition in the lower Willamette River channel. Net deepening (60 cm or less) occurred from 2002 to 2009 in a narrow strip outside the channel along the western nearshore area, particularly in the final one mile of this reach, possibly representing natural channel migration along the outside bend of the river.

Surface sediments transition from silts to sands at approximately RM 1.5 and remain predominantly coarse-grained to the Columbia. The 2009 HsT modeled flood scenario predicts erosion to occur throughout most of this area, generally up to 30 cm, but up to 61 and 152 cm in areas downstream of RM 1 (Map 3.1-9b). Some net deposition is predicted to occur in this reach in the center of the navigation channel just upstream of

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RM 1 and along the eastern shoreline (Map 3.1-9a). This is consistent with the observations from the time-series bathymetry.

Multnomah Channel (Lower Willamette River to the Sauvie Island Bridge)

Multnomah Channel between the lower Willamette River and Sauvie Island Bridge (~1/2 mile downstream) sees relatively high flows and bottom shear forces. The channel is much narrower (~1/3 the width) than the main stem of the lower Willamette River, and the flow moving down the channel is constrained by dikes (Map 3.1-5). Sandy sediments dominate the channel and the area immediately adjacent to it in the lower Willamette River (Map 3.1-12). Time-series bathymetric change data is not available for the Multnomah Channel since the bathymetric studies were only conducted for the main channel of the lower Willamette River. The 2009 HST modeled flood scenario includes the entrance and uppermost portions of the Multnomah Channel and indicates little or no change in the riverbed elevations in this area.

3.1.6 Surface Features

3.1.6.1 Topography

Elevation in Portland Harbor varies from 0 to 300 feet (0 to 90 m), with buttes as high as 650 feet (200 m). Portland Harbor is a geological depression bordered to the east by the Tualatin Mountains (also known as the West Hills or Southwest Hills of Portland), which are a spur of the Northern Oregon Coast Range and includes a portion of the Boring Lava Field (Allen 1975), and to the west by a 120-foot-high natural bluff that runs along the northeast border of the site (Figure ??).

The West Hills date from the late Cenozoic era, and range up to over 1,000 feet (300 m). Composed mainly of basalt, the mountains were formed by several flows of the Grande Ronde basalt flows that were part of the larger Columbia River basalts. Much of the northern portion is undeveloped land within the 5,000 acres (20 km^2) Forest Park. The landscape, inside and outside the park, is predominantly forested. The steep slopes of the hills, rising relatively steeply at about 1.5H:1V to 3.5H:1V, are subject to periodic landslides; most slides are small and shallow.

Most of the lowlands on either side of the Willamette River within Portland Harbor is located on a terrace with elevations that range between 30 and 50 feet above sea level, mostly comprised of fill material. The lowlands extend for approximately 0.5 to 1 mile from the river before reaching the confining features of the Tualatin Mountains to the east or the a 120-foot-high natural bluff that runs along the northeast border of the site.

3.1.6.2 Bathymetry

An initial bathymetry study was conducted by DEA between December 13, 2001 and January 14, 2002, during the winter period of relatively high water. The primary goal of the survey was to develop an accurate, baseline, riverbed elevation database for this portion of the lower Willamette River. A smaller survey was also conducted by the LWG in February 2007 that focused only in Multnomah Channel.

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Three additional major multibeam bathymetric surveys were conducted by the LWG in July-September 2002, May 2003 and February 2004. Another multibeam survey of the lower Willamette River was conducted by NOAA in January 2009. Comparison of these time-series bathymetry survey results with the initial survey allows areas of riverbed that shoaled or scoured to be identified. A discussion of these comparisons is provided in Section 3.1.5.2.2.

The vertical accuracy of the water depth measurements in the bathymetric surveys was specified at less than or equal to 0.5 foot (NAVD88), and the horizontal accuracy was set at less than or equal to 1 meter. The data were processed using a 1-meter grid size to generate a digital terrain model, and the survey results were plotted in both three-dimensional (3-D) color-graded (i.e., "hillshade") and contour formats. The most recent survey results (NOAA 2009) is presented in Maps 3.1-5.

, Map 3.1-5 shows that most of the Study Area is from –30 to –50 ft CRD (–25 to –45 ft NAVD88) and is dominated by the authorized federal navigation channel, which runs from RM 0 (Columbia River) to RM 11.7 (Broadway Bridge) and extends nearly bank-to-bank from RM 4 to 6 and again from RM 8 to 11.7. Elevations in the federal navigation channel are generally –40 to –50 ft CRD. Except along the western channel edge from RM 8 to 10 where extensive shoaling has occurred, these portions of the Study Area have very narrow and steeply sloped off-channel areas. Broader off-channel areas with shallow benches (–10 to –30 ft CRD) occur from RM 1 to 4 along the outside curve of the river, including across the head of Multnomah Channel, between RM 6 and 8, and at the head of Swan Island Lagoon. There are a number of off-channel areas, such as Swan Island Lagoon, Willbridge Terminal, Willamette Cove, Terminal 4, and International Slip, that vary widely in depth as a function of their history and current land use (e.g., actively dredged berths). Finally, there are several deep areas in the harbor that extend from –60 to –80 ft CRD. These are historical borrow areas that were dredged to create the adjacent uplands; the two most extensive ones are in the eastern portion of the channel from RM 4.3 to 5 and RM 9.2 to 10. Map 3.1-6 shows the long-term bathymetric changes that occurred in the lower Willamette River between 1888 and 2001 and illustrates the large-scale deepened, diverted, and filled areas.

3.1.6.3 Manmade Structures

3.1.6.3.1 Bridges

There are five bridge structures within the Study Area: the St. Johns Bridge (RM 5.8) is a suspension bridge that was constructed in 1931, the Burlington Northern Railroad Bridge (RM 6.8) is a swing bridge (i.e., bridge has a swing span, which pivots on its base to allow for the passage of taller ships) that was constructed in 1906, the Fremont Bridge (RM 11.2) is a steel tied arch design that was constructed in 1973, the Broadway Bridge (RM 11.5) is a truss with double-leaf rall-type bascule lift span design that was constructed in 1913, and the Steel Bridge (RM 12.2) is a double-deck swing-span

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bridge that was constructed first in 1880 (rail only) with an expansion in 1888 (auto addition) and completely replaced in 1912.

3.1.6.3.2 Piers, Marinas, Docks, and Floating Home Moorages

About 525 acres of the lower Willamette River are occupied by piers, marinas, docks, and floating home moorages. The following provides a general discussion of the location of these structures throughout the site. Map 3.2-20a-f provides more specific location of these structures.

Western Shoreline Structures

- RM 0 (confluence with Columbia River) to RM 3 (Multnomah Channel), Sauvie Island - There are some small personal use boat docks (5), abandoned pilings, and pile dikes.
- RM 3 to RM 3.2 (PGE Harborton) - There are no in-water structures.
- RM 3.2 to RM 4.1 – There are existing in-water structures include pilings, dolphins, dock and loading facilities associated with supporting upland uses (barges, tank farms, plywood mill, wood chips).
- RM 4.1 to RM 4.8 - There are no in-water structures.
- RM 4.8 to RM 11.2 – Existing floating facilities include wharfs, pilings and piers for handling cargo, boat construction, tug and barge moorage, and launching facilities.
- RM 11.2 to RM 12.2 – Existing in-water facilities and structures include pilings and piers over water at McCormick Pier residential complex, Old Albers Mill office, Centennial Mills, and Fremont Place office complex. Floating structures include River Queen restaurant, McCormick Pier private marina, and Station "L" Rowing Club dock and barge.

Eastern Shore Structures

- RM 0 to RM 0.9 (Columbia Slough), Kelly Point Park – There are no in-water structures.
- RM 0.9 to RM 5.8 – Existing in-water structures include wharfs, piers, bulkheads, and solphins needed for ship and barge moorage.
- RM 5.8 to RM 6.8, Cathedral Park – In-water structures include a public boat ramp, fishing pier, abandoned hull at old St. John's shipyard site, and abandoned pilings.
- RM 6.8 to RM 7.8 – There are many deteriorating in-water structures, including piling structures, docks, and miscellaneous man-made structures.

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- RM 7.8 to RM 8.2 – There are no in-water structures.
- RM 8.2 to RM 9.2, Swan Island Lagoon – The east side includes smaller dock structures and floating boathouse. There is a public boat ramp at the southern end of the lagoon (RM 9.2) The western shore is a continuous piling structure used for ship tie-up.
- RM 8.2 to RM 9.2, west side of Swan Island – There are three dry docks at the head of Swan Island (including the largest floating dry dock in the Pacific Rim – 87,000 tons which was removed in 2001), and numerous ship repair berths.
- RM 9.2 to RM 10 – There are no in-water structures.
- RM 10 to RM 12.2 – In-water structures include bulk loading facility, abandoned pilings, concrete foundations, warehouse pilings and bulkheads. There is also log raft storage in this area.

3.1.7 Habitat

The majority of the Study Area is industrialized, with modified shoreline and nearshore areas. Wharfs and piers extend out toward the channel, and bulkheads and riprap revetments armor portions of the riverbank. Active dredging has produced a uniform channel with little habitat diversity. However, some segments of the Study Area are more complex, with small embayments, shallow water areas, gently sloped beaches, localized small wood accumulations, and less shoreline development, providing some habitat for a suite of local fauna.

This section describes the general types and quality of aquatic habitat available to ecological species in the lower Willamette River.[13] The habitats for each ecological receptor group are described in greater detail in the BERA (Appendix G).

3.1.7.1 Open-Water Habitat

The lower Willamette River is characterized by a developed navigation channel and shoreline. The river historically had large amounts of off-channel habitat in the form of floodplain lakes such as Ramsey, Doane, and Guild's lakes. After industrialization, only a few shallower backwater sites (e.g., Willamette Cove, Swan Island Lagoon, individual slips), as well as a tributary (Columbia Slough) and a secondary channel (Multnomah Channel) remain (Map 3.1-15). The deep open water provides foraging habitat for fish and wildlife that feed in the water column. Piers and other structures in the open water provide additional habitat for certain species such as smallmouth bass. Shallow-water habitats provide refuge for juvenile salmonids and other fishes, as well

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as greater foraging opportunities for birds and mammals. Friesen et al. (2004) found that juvenile salmon were present in every month sampled from May 2000 to July 2003. Juvenile salmon were captured more frequently during winter and spring than during other seasons. Coho and steelhead were generally present only during winter and spring.

Historically the lower Willamette River was dominated by shallow water habitat, with approximately 80 percent of the river with depths less than 20 ft CRD. Dredging and alteration of the river channel have reversed these ratios, and the river is now 20 percent shallow water and 80 percent deep (Map 3.1-16; City of Portland 2009b). Shallow-water habitats, such as those preferred by some foraging wildlife (e.g., otter and mink), are now largely limited to the narrow strip between the shoreline and the navigation channel, which generally is vulnerable to disturbance and anthropogenic alteration due to its proximity to shore. Remaining pockets of shallow water habitat include areas such as Willamette Cove, Swan Island Lagoon, International Terminals Slip, Wheeler Bay, Shaver, Balch Creek Cove, Triangle Park, the mouth and channel of Multnomah Channel, and the Sauvie Island shoreline.

There are three types of benthic habitats in the open water of the lower Willamette River:

4. Unconsolidated sediments (sands and silts) in the deeper water (greater than approximately 20 ft CRD) of the navigation channel and lower channel slopes
5. Unconsolidated sediments (sands and silts) in shallow water depths (less than 20 ft CRD) in gently sloping nearshore areas (e.g., beaches and benches) and on the upper channel slopes
6. Developed shoreline (e.g., rock riprap, sheet pile, bulkheads, piers).

In addition, very limited areas of rock and rock outcrop are present in the lower Willamette River. The navigation channel habitat is subject to variable (daily [tidal], seasonal, and annual) hydrodynamic forces, the impacts of navigation, natural sediment deposition, bed load transport/erosion, and periodic navigational dredging. These forces vary spatially through the system, largely as a function of the channel cross-sectional area, resulting in the presence of both relatively stable and unstable sedimentary environments and patchy infaunal and epibenthic communities that are characteristic of the local physical regime. The physical sedimentary regimes are a function of the local riverbank morphologies, and sheltered areas away from anthropogenic disturbance should support well-developed infaunal invertebrate communities that are characteristic of large river systems. Conversely, exposed nearshore areas, particularly around berths, docks, and boat ramps, likely have limited benthic communities due to the greater physical disturbance in these areas. Tidal and seasonal water level variability and nearshore disturbances (e.g., boat wakes) have a much larger effect in shallow water than they do in deeper water. The hard surfaces of the developed shoreline provide habitat for an epibenthic community.

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[KEY ISSUE FOR DISCUSSION WITH EPA] The groundwater sampling stations used to quantify groundwater contaminant discharges to the river have limited spatial coverage relative to the size of the Study Area. Knowledge of the temporal variation in groundwater contaminant concentrations discharged to the river is also limited. Combined, these two factors create uncertainties in the estimated effects of groundwater contaminants on ecological uses of the site. There are at least localized areas within the Study Area where contaminants from industrial activities have been released in upland areas and have been transported via groundwater to the river at concentrations that would adversely affect ecological uses of benthic habitat. These effects are further evaluated in the BERA.

3.1.7.2 Bank and Riparian Habitat

The most common bank types occurring in the Study Area are riprap, sandy and rocky beach, unclassified fill, and seawall (Map 3.1-17).[14] In 2008, the City of Portland reported that vegetated riprap (25 percent), unclassified fill (21 percent), and beach (23 percent) were the dominant bank types in the North Reach (Broadway Bridge to the Columbia River; City of Portland 2008a). The riprap or rocky bank type is usually fairly steep with no or very narrow adjacent shallow water habitat present. These areas are usually exposed to heavy wave action and strong currents. The sandy bank type with little to no vegetation is characterized by gently sloped beaches (i.e., sand banks are rarely steep). However, this bank type is often adjacent to steep riprapped shorelines or developed uplands that are frequently exposed to heavy wave action and faster moving water. The rocky or sandy bank types with a mix of native and invasive vegetation are common within the Study Area. These bank types range from gently to steeply sloped beaches and, similar to the sandy bank type without vegetation, are often adjacent to steep uplands, although the uplands are either of sandy or rocky substrate. The rocky or sandy bank types are generally located in areas with less development and a lack of bank hardening, such as in Swan Island Lagoon, the Multnomah Channel, Kelley Point Park, and Sauvie Island.

The type of riverbank present in the Study Area is expected to influence fish species occurrence and use of a given area. Riverbanks with large woody debris and riparian vegetation that provides cover and creates small shallow pools will likely be used by juvenile salmonids and other small fish species (Bjornn and Reiser 1991, Sedell and Froggatt 1984). Areas with limited wood accumulations include the beach adjacent to Freightliner Corp., Kelley Point Park, and Mar Com. Friesen et al. (2004) found that in the lower Willamette River, coho preferred beach habitat and rock outcrops and avoided riprap and artificial fill, and the abundance of all species was low at seawall sites.

The riprap and rocky substrate are the preferred habitats of sculpin and smallmouth bass (Farr and Ward 1993, SEA et al. 2003, Wydoski and Whitney 2003). Sculpin are predominately present in the shallow water habitats, and smallmouth bass are present in

[14] Classifications on Map 3.1-17 are based upon an ODFW 2000–2003 study (Vile and Friesen 2004) and are known to be outdated or incorrect in some locations.

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areas with moderate current. The shallow backwater pools and slow-moving areas of the river provide habitats for juvenile largescale suckers (yearling and subyearling) and peamouth (Wydoski and Whitney 2003). The peamouth remains nearshore during winter months and moves to deeper waters in the summer months. The shallow waters with abundant plants and woody debris available for cover are the preferred habitats for largemouth bass.

Numerous aquatic and shorebird species such as cormorants and spotted sandpipers use the habitats in the lower Willamette River. The upland environment near the lower Willamette River is primarily urban, with fragmented areas of riparian forest, wetlands, and associated upland forests (Map 3.1-18). Historical development and filling of channels and wetlands has left only small strips or isolated pockets of riparian wildlife habitat, with the exception of areas such as Harborton Wetlands, Oaks Bottom, Forest Park, and Powers Marine Park. Therefore, although isolated wildlife habitat areas along the lower Willamette River corridor exist, linkages to the larger landscape, such as Forest Park, are limited to a few areas. Forest Park, the largest of these upland habitat areas, is generally isolated from the lower Willamette River by the industrial corridor with the exception of a few small controlled watercourses. The barrier presented by the industrial corridor is unlikely to significantly inhibit the movement of birds between the river and the upland forest; however, it poses a significant barrier to the movement of other types of wildlife, such as reptiles, amphibians and small mammals, which, as a result, experience limited or no connectivity to the river.

Urban nesting sites, such as bridges and chimney roosts; bluff areas; grasslands at Powell Butte; native oak assemblages; bottomland hardwood forests; and wetlands have been identified in the vicinity of the Study Area (City of Portland 2008a).

Potential general wildlife habitat areas in the Study Area are shown on Map 3.1-19. These include the sites identified by the City of Portland (Adolfson et al. 2000) or were based on field observations made during the shorebird habitat reconnaissance (Windward 2004, pers. comm.) or site bathymetry. In the City of Portland's inventory (Adolfson et al. 2000), 15 sites of habitat value for fish, reptiles, amphibians, and wildlife were identified. These habitat sites are known to be utilized by numerous aquatic birds and semi-aquatic mammals. Notable habitat sites in the Study Area included the South Rivergate corridor at the north end of the Study Area, the Harborton forest and wetlands, Willamette Cove, the railroad corridor, and the Swan Island beaches and lagoon on the southern end (Adolfson et al. 2000). Other habitat sites identified in the general area were Kelley Point, at the confluence of the Willamette and the Columbia rivers, and the Ross Island and Oaks Bottom Complex around RM 16.

The following provides some more notable habitat features throughout the site:

Western Shoreline Habitat Features

- RM 0 (confluence with Columbia River) to RM 3 (Multnomah Channel), Sauvie Island - Riverbank is an earthen levee with variable width beaches, some natural vegetation, and occasional riprap.

- RM 3 to RM 3.2 (PGE Harborton) - Shoreline is a combination of riprap and rubble overgrown with vegetation making it natural appearing. Some excellent wildlife habitat.

- RM 3.2 to RM 4.1 – The shoreline character is a mixture of natural-appearing and man-made conditions including riprap, rubble and piling structures.

- RM 4.1 to RM 4.8 – Natural-appearing riverbank and shoreline covered with cottonwoods and brush with narrow beach area.

- RM 4.8 to RM 11.2 – Shoreline conditions range from riprap and rubble to pier and pilings, although there are some isolated natural-appearing areas.

- RM 11.2 to RM 12.2 – The shoreline consists of riprap along the entire segment.

Eastern Shore Habitat Features

- RM 0 to RM 0.9 (Columbia Slough), Kelly Point Park – Largely natural-appearing with large cottonwood trees, beach and shoreline.

- RM 0.9 to RM 5.8 – Shoreline conditions varies ranging from some vegetation and beach to bulkheads.

- RM 5.8 to RM 6.8, Cathedral Park – Natural-appearing riparian areas and beach.

- RM 6.8 to RM 7.8 – A small area of natural-appearing shoreline vegetation adjacent to the railroad bridge. Articulated block on beach at McCormick and Baxter site with new plantings in riparian area. Remainder of shoreline is riprap or rubble. Small cove in front of Triangle Park property.

- RM 7.8 to RM 8.2 – Natural-appearing with brush and cottonwoods. Steep riverbank with man-made alterations by the railroad.

- RM 8.2 to RM 9.2, Swan Island Lagoon – Shoreline character ranges from man-made piling structures to natural-appearing, though most is modified. Important wildlife habitat area along east site of lagoon. The extreme south end of the lagoon is currently undeveloped but has been filled to prohibit the Willamette River from flowing through channel creating Swan Island Lagoon.

- RM 8.2 to RM 9.2 - Entire shoreline is riprap.

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- RM 9.2 to RM 10 – Shoreline is riprap, but has sandy beach area.

- RM 10 to RM 12.2 – Shoreline has been heavily modified with little natural vegetation, but some existing beach area. Between the Fremont Bridge and the Steel Bridge, the shoreline is heavily modified with riprap.

- **Critical Habitat**

  The Endangered Species Act (ESA) requires the federal government to designate "critical habitat" for any species it lists under the ESA; in this case, salmon and steelhead. "Critical habitat" is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.

- The ESA protects threatened and endangered species in several ways. Under Section 7, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat. These complementary requirements apply only to federal agency actions, and the latter only to habitat that has been designated. A critical habitat designation does not set up a preserve or refuge, and applies only when federal funding, permits, or projects are involved. Critical habitat requirements do not apply to citizens engaged in activities on private land that do not involve a federal agency.

- Critical habitat has been designated for four species of salmon and steelhead by NFMS in the lower Willamette River and proposed for one species. Depending on the species, juvenile salmonids may spend from a few hours to several years in freshwater areas before migrating to the ocean. On their journey, juveniles must migrate downstream through every riverine and estuarine corridor between their natal lake or stream and the ocean.

- Juvenile salmonids need abundant food sources, including insects, crustaceans, and other small fish. They need places to hide from predators (mostly birds and bigger fish), such as under logs, root wads and boulders in the stream, and beneath overhanging vegetation. They also need places to seek refuge from periodic high flows (side channels and off channel areas) and from warm summer water temperatures (coldwater springs and deep pools). Returning adults generally do not feed in fresh water but instead rely on limited energy stores to migrate, mature, and spawn. Like juveniles, they also require cool water and places to rest and hide from predators.

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3.2 During all life stages salmon and steelhead require cool water that is free of contaminants. They also require migratory corridors with adequate passage conditions (timing, water quality, and water quantity) to allow access to the various habitats required to complete their life cycle.**HUMAN USE**

3.2.1 Demography

3.2.1.1 Multnomah County

The Portland Harbor Study Area is located in Multnomah County. As of the 2010 census (US Census Bureau 2010), there are 735,334 people residing the Multnomah County, most of which reside within the City of Portland (see Section 3.2.1.2) and half (50.5%) are women. The population density is approximately 1,705 people per square mile with a per capita income of $29,544 (2011 dollars). Approximately 16.5% of the population is below poverty level.

There are 326,227 housing units with a median value of $281,900 and a 55.2% ownership rate. Each household is comprised of approximately 2.34 persons and a median household income of $50,726. The majority of the population (70%) is between the ages of 18 and 65, with 20% below the age of 18 and 10% above the age of 65.

The census reported the county as 81.2% White (597,091 people), 11.1% Hispanic or Latino (81,622), 6.7% Asian (49,267), 5.7% Black or African American (41,914), 1.5% Native American (11,030), and 0.6% Native Hawaiian or other Pacific Islander (4,412); 4.3% of the population reported belonging to two or more racial groups (31,619) and 14 % were foreign born (102,946). Reportedly, 19.5% of the population (143,390) over the age of 5 speaks a language other than English at home.

The total number of firms[15] in Multnomah County in 2007 (2007 Economic Census) was 75,230. Of those, the census reports ownership as 86.8% White (65,300), 6.2% Asian (4,664), 3% Black (2,257), 3% Hispanic (2,257), 0.8% Native American (602), and 0.2% Native Hawaiian or other Pacific Islander (150). Women owned firms comprised 31.6% (23,773) of the total firms.

The 2007 Economic Census data on the manufacturing sector[16] of Multnomah County reports manufacturer's shipments at $10.5 million, merchant wholesaler sales at $22 million, retail sales at $9.9 million, and accommodation and food service sales at $2 million.

3.2.1.2 City of Portland

[15] A firm may operate one place of business or more, such as a chain of restaurants, or have no fixed business location, such as the firm represented by a self-employed carpenter or salesperson. A firm contrasts with an establishment, which is a single physical location at which business is conducted. Most other data from the Economic Census are reported on an establishment basis rather than a firm basis.

[16] Establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products.

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The City of Portland is located in Multnomah County at the upper bound of the Portland Harbor Study Area. The City is the largest city in the state of Oregon and the 29th largest city in the U.S. As of the 2010 census, there are 583,776 people residing in the City of Portland (US Census Bureau 2010) and half (50.5%) are women. The population density is approximately 4,375.2 people per square mile. There are 265,439 housing units with a median value of $292,800 and a 54.2% ownership rate. Each household is comprised of approximately 2.27 persons and a median household income of $50,177.

The median income for a household in the city is $40,146, and the median income for a family is $50,271. The per capita income for the city is $22,643. 13.1% of the population and 8.5% of families are below the poverty line.

The census reported the city as 76.1% White (444,254 people), 9.4% were Hispanic or Latino (54,875), 7.1% Asian (41,448), 6.3% Black or African American (36,778), 1.0% Native American (5,838), 0.5% Native Hawaiian or Pacific Islander (2,919), 4.7% belonging to two or more racial groups (24,437) and 5.0% from other races (28,987).

The age distribution was 21.1% under the age of 18 (123,177 people), 10.3% from 18 to 24 (60,129), 34.7% from 25 to 44 (202,5700, 22.4% from 45 to 64 (130,7660, and 11.6% who are 65 years of age or older (67,718). The median age is 35 years.

The total number of firms in the City of Portland in 2007 (2007 Economic Census) was 76,485. Of those, the census reports ownership as 86.2% White (65,930), 6.7% Asian (5,124), 3.1% Black (2,371), 3% Hispanic (2,294), 0.8% Native American (612), and 0.2% Native Hawaiian or other Pacific Islander (153). Women owned firms comprised 31.9% (24,399) of the total firms.

3.2.2 The 2007 Economic Census data on the manufacturing sector of the City of Portland reports manufacturer's shipments at $8.4 million, merchant wholesaler sales at $20.6 million, retail sales at $8.2 million, and accommodation and food service sales at $1.8 million.**Land Use**

Land uses within the lower Willamette River watershed in the vicinity of Portland and its suburbs are urban/industrial, residential and rural/agricultural. Many of the state's heaviest industrial users are present in the lower Willamette watershed. Land uses in the basin upstream of Portland include timber production, grazing, irrigated and dryland agricultural and urban areas.

The east side of the lower Willamette River is relatively flat with little elevation change; consequently, the east side has been almost completely developed. The steeper slopes in the West Hills on the west side of the river developed more slowly. With a few exceptions, such as the Oaks Bottom complex, most of the natural riparian areas and wetlands on both sides of the river were filled over the past 150 years. The west side also has significantly more parks and open space, primarily because of Forest Park.

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Portland Harbor and the lower Willamette River have served as a major industrial water corridor for more than a century. Industrial use of the Study Area and adjacent areas has been extensive. The majority of the Study Area is currently zoned for industrial land use and is designated as an "Industrial Sanctuary" on the Portland Comprehensive Plan Map (City of Portland 2006b). The Portland industrial sanctuary policy is designed to encourage the growth of industrial activities in the city by preserving industrial land. In addition to industrial use zoning designation, the City of Portland citywide zoning map (January 2009) displays several other zoning designations for smaller portions of the Study Area including: open space (e.g., Cathedral Park and Willamette Cove); general employment (mixed use allowed though primarily an industrial use focus); and multi-dwelling residential (e.g., University of Portland). The zoning codes apply to lands along the river and not to the actual river itself.

As shown in Map 3.2-22a-e, the Guild's Lake Industrial Sanctuary Plan (GLISP), which covers one portion of the Study Area zoned for industrial use, is intended to preserve and enhance industrial land in the Guild's Lake area, generally bounded by Vaughn Street on the south, the St. Johns Bridge on the north, Highway 30 on the west, and the Willamette River on the east (City of Portland 2001a). Over many decades, public and private investments in infrastructure, such as marine, rail, and highway facilities, as well as investments in industrial physical plants, have occurred within this area. The stated purpose of the GLISP is to maintain and protect this area for heavy and general industrial uses. The plan's objectives were adopted as part of Portland's Comprehensive Plan to ensure preservation of this land use over the next 20 years.

3.2.2.1 Historic Development of the Lower Willamette River

This section summarizes the major historical land use, fill placement, and shoreline and overwater operations. Historical aerial photographs were reviewed to evaluate general trends in land use along the Willamette River waterfront. Mosaic images created by the Port of Portland from scanned historical aerial photographs of the river and waterfront were also reviewed, as were more recent aerial photographs (see Maps 3.2-13a–f). The oldest historical aerial photographs available for this harbor-wide review were taken in 1936. Based on the pace of land development observed during the preliminary review of all of the aerial photo mosaics, six of the photo mosaics (1936, 1948, 1961, 1974, 2000, and 2007) were selected for broader-scale depiction of changes in land usage (Maps 3.2-14 through 3.2-19). For most years selected, aerial photo images were available for the entire river waterfront from the Columbia River to Ross Island.

Fill placement is shown on Maps 3.2-20a–f. Detailed information on the fill placement activities can be found in Table 3.2-1. Information used to construct this table was obtained from the aerial photographs, information collected by the LWG during the Remedial Investigation, and the City of Portland. The descriptions of subsurface soils in site investigation reports suggest that much of the fill placed in these areas consists of

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Willamette River sediment/sand/gravel dredged offshore of the respective facilities or in the immediate vicinity. Other sources of fill include dredged material from Multnomah Channel and the Columbia River. The source of the fill, if known, is identified in Table 3.2-1.

Overwater structures, such as wharfs, piers, floating docks, and pilings, were built largely to accommodate or support shipping traffic and remain common. These structures along the shoreline are clearly visible in the aerial photographs provided in Maps 3.2-21a–t.

In summary, industrial and commercial development along the river began in the mid- to late-1800s in scattered areas such as downtown Portland, St. Johns, Linnton, and Macadam. Portland Harbor remained largely undeveloped through the late-1800s, but as urban development in the downtown area at the beginning of the 20th century pushed industrial development downriver, businesses began to relocate to the current industrial area of the harbor. The west side of the river was settled and developed first.

The most notable changes for the major reaches in the Study Area are described in the following subsections. These reach breaks are defined based on changes in the lower Willamette River's physical characteristics. General land use changes for the east and west banks of each reach are discussed, including historic riverbank fill placement and changes in overwater structures.

RM 9.5 to 11.8

In 1936 the waterfront hosted a lumber mill, grain elevators, cargo docks, oil and coal exporters, and ship building and ship repair facilities. Rail yards between RM 10 and 12 were present on both sides of the river in 1936 and were more fully developed by 1948 (Map 3.2-13a). By 1961, industrial development had expanded on both sides of the river and log storage areas were present along riverbanks (Map 3.2-13b). Relatively few changes occurred from 1961 to 2000, with the exception of the completion of Interstate 5 and Interstate 405 (Maps 3.2-13c–e). By 2007, dock structures were added along the west bank and a few parcels were converted from commercial to industrial or residential use (Map 3.2-13f).

From approximately RM 9.5 to 10, the original shoreline on the east bank formed a cove. In the 1970s this area was filled (Map 3.2-2c). Significant channel narrowing due to infill on the west bank is observed from 1888 to 1936 (Map 3.2-2a). Beginning on the east side, the riverside area near RM 11.2 to 11.4 where Glacier NW is currently located (plus adjacent nonriparian properties) was the site of the former Albina Engine and Machine Works property, where ship construction and repair was conducted for the U.S. Navy and the War Shipping Administration (see Map 3.2-3). Albina Engine and Machine Works was founded in 1904 as a riverfront repair yard. During WWII, the shipyard facility was expanded to encompass 16.8 acres and included six shipways, welding and pipe shops, paint storage and shops, warehouses, two outfitting docks, plate storage yards, burning slabs, and a pickling plant.

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The shipways were filled beginning in the 1950s and completed by 1963. Most of the riverside buildings associated with the shipyard were demolished. The first new buildings on the former shipyard property appeared in the late 1970s. A portion of the former shipyard was used for expansion of the Pacific Power and Light Albina Substation beginning in the late 1940s.

Docks have been located in the area of the Albina Rail Yard (RM 10–11) and the Glacier facility (RM 11.3) from 1936 to the present day. From the review of aerial photographs, it appears the existing docks at the CDL Pacific Grain facility (RM 11.4) were constructed sometime between 1957 and 1966 (Map 3.2-20f). A large overwater structure called the Irving Dock was present at this location prior to construction of the present-day CDL Pacific Grain dock, as shown in both the aerial photographs and 1924 Sanborn maps reviewed by Integral. A large dock first appears in the 1961 aerial photo at RM 11.8E.

Along the west bank from RM 9.8 to 10.3, encompassing the present-day Terminal 2 and Sulzer Pumps properties, WISCO operated a shipyard for an unknown period up until 1949 (Map 3.2-3). In 1941-1942, the WISCO facility was expanded with public funds from the Defense Plant Corporation. The reconfigured facility was 79 acres in total area, with government ownership of approximately 36 acres. Combined, these facilities provided a complete shipyard for launching and outfitting steel ships. Many of the manufacturing operations associated with the shipyard were located on the current Sulzer property (RM 10.3), which included outfitting operations, a sheet metal fabrication shed, a cable storage building, a machine shop, a paint shop, a coppersmith shop, and the main industrial building. WISCO operations consisted of three shipways with four attendant craneways located at the southern (upstream) end of the property; these shipways were subsequently filled.

Significant changes occurred along the west bank with dredging of a slip at the WISCO shipyard in the mid-1940s (RM 10); the creation of the Albina Ferry slip (Slip No. 1) at Municipal Terminal 1 (RM 10) in 1914 and Slip No. 2 in 1923; filling of the western shoreline downstream of Terminal 2 (RM 10.6) in the 1950s and 1960s; filling of the Terminal 1 South slip in the early 1900s; and filling of the Terminal 2 upstream slip by 1987 (Map 3.2-13e). Beginning with the 1936 aerial photograph, a large tank appears on the west bank at RM 12, but is no longer there in photographs taken after 1957.

Overwater features in this reach include the docks along the western shoreline at the former Municipal Terminal 1 and current Terminal 2 (RM 10 and 10.6), and an oil transfer pipeline (south of present-day Sulzer Pumps) at RM 10.4 (Map 3.2-20e). The oil transfer pipeline was used by Portland General Electric for transferring Bunker C oil from vessels to tanks at a nearby power plant. Some of these docks remain in place but are no longer in use. Most overwater activity associated with the docks in this reach appears to have occurred in the 1940s and 1950s, when the docks were used for loading lumber, paper products, grain, gravel, and coal. From the 1930s through the 1960s, log moorage rafts were present at approximately RM 9.2 and RM 10.

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RM 8 to 9.5

This stretch of the river has undergone significant change through the years, as is shown in the six photo mosaics (Map 3.2-13a–f). Swan Island (RM 8.3 to 9.2 on the east bank) was originally a sandbar and marsh separated by two channels of the Willamette River. Prior to 1920, the eastern channel was the river's main channel. The eastern channel was deeper than the western channel, which was wide and shallow with a shoal that hindered boat passage. In the early to mid 1920s, the west channel was deepened and widened in places to facilitate navigation (the west channel was opened to navigation in 1926). In 1927, the diversion of the river's main channel from the east side to the west side of the island was completed through the construction of a causeway at the island's upstream end (creating a lagoon out of the east-side channel called Swan Island Lagoon). The filling of Swan Island, performed by the Port of Portland, was mostly completed by the 1920s before construction began on the airport in 1926.

Mocks Bottom is located in the upland area east of the Swan Island Lagoon. Once a swampy slough, Mocks Bottom was filled by the Port and the U.S. Army Corps of Engineers (USACE) to build roads and facilitate industrial development. About half of Mocks Bottom had been filled by 1961 and filling was complete by 1974 (Map 3.2-20d). Although some industrial facilities had developed along the shoreline by 1961, less than half of the area had been developed prior to 1974. The area was fully developed by 2007 with industry related to truck manufacturing, shipping and transportation, marine salvage, and military uses.

The Swan Island peninsula has a long history of commercial and industrial operations that continue today. The Swan Island Municipal Airport functioned until operations moved in 1940 to a location that is now part of the Portland International Airport. Between 1942 and 1949, the U.S. Maritime Commission leased Swan Island from the Port of Portland and contracted with the Kaiser Company to construct a shipyard and associated facilities. The shipyard facilities were used to build T-2 tankers used during WWII. A Kaiser affiliate, Consolidated Builders, Inc., conducted ship dismantling between 1947 and 1949. After the war, the area was redeveloped and used for ship repair purposes. The redeveloped facilities were used by various ship repair contractors and their subcontractors. In addition, facilities were leased to a number of industrial tenants who conducted a range of activities, including steel fabrication and storage, wood products manufacturing, equipment manufacturing, maritime supply sales, printing, chemical and soap storage, war surplus storage, fire extinguisher service and storage, paint storage, aluminum oil tank manufacturing, service station operation, sheet metal work, roofing supply storage, and general office storage. The eight shipways constructed during the military era were filled with dredged materials between 1950 and 1962. The current configuration of dry docks at the end of the peninsula and berths along Swan Island Lagoon and the Willamette River was largely completed by 1979. Some filling also occurred in the northwestern portion of the shipyard area in the late 1970s.

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Up until the 1960s the west side of the river was mostly undeveloped and was used for log raft storage. The present-day Shell Equilon dock occupied the west bank at RM 8.8 in 1936. Operations at Gunderson (RM 8.7 to 9.2) began as early as 1942, and most of the present-day site was constructed by 1966 (Map 3.2-20d); activities have generally included barge and rail car manufacturing. Ship building operations began at Gunderson in the 1960s and are still in operation today. During the 1960s and 1970s, a portion of the Gunderson facility was used by American Ship Dismantlers for ship scrapping. Overwater activities occurred at the barge launchways in Area 2 and the outfitting dock in Area 3. A dock structure and an oil transfer pipeline were located historically at the McCall Oil site (RM 8.2) prior to filling in the late 1960s. Fill was placed along the Gunderson shoreline beginning in the 1950s.

On the west side of the river in this reach, Guild's Lake was a shallow, marshy area located from the present-day Guilds Lake Railroad Yard (otherwise known as "Lake Yard") westward to St. Helens Road. Map 3.2-1 shows the location of the lake in 1888. Filling of Guild's Lake began in approximately 1879 and was partially completed in 1913 by private entities using soil hydraulically sluiced from nearby hillsides, providing space for the rail yard and an industrial center (Oregon Historical Society 2002). The Port of Portland continued filling in the 1920s, using materials dredged from the Willamette River. The filling of the Guild's Lake area was planned in connection with the West Swan Island project, where the channel was diverted from the east to the west side of the island. Construction of the Guilds Lake Yard, which is owned by PTRR, began in 1916.

RM 5 to 8

The 1936 photo mosaic (Map 3.2-13a) shows that the east side of the river was largely undeveloped from RM 5 to approximately 5.7 until the period between the 1960s and 1970s. Early features include docks at M&B (RM 7), Willamette Cove (RM 6.7) and downstream of Mar Com (RM 5.7). The eastern bank between RM 6.5 and 6.9 was primarily filled in the 1910s and 1920s to create the central and eastern parcels of the Willamette Cove upland facility. Upstream of RM 6.9, the eastern bank remained relatively unchanged until the 1970s, when the downstream end of the property presently known as Triangle Park (RM 7.4) was filled to create a dock and berth area. From 1888 to 1936, shoreline development is most notable from RM 5.9 to 6.4, due to the construction of the St. Johns Bridge at RM 5.9 and timber processing facilities on the eastern bank at RM 6.2 and on the western shore at RM 6 and 6.4. From 1888 to 1936 the eastern bank shows widening due to development in the vicinity of timber processing plants, including the M&B site (RM 7.1), and narrowing due to installation of the railroad crossing at RM 6.9 (Map 3.2-2a).

The Mar Com facility, which ceased operations in 2004, was situated on land that had been used for ship building and vessel repair since approximately 1905. The central parcel of the Willamette Cove facility was also used for ship repair on dry docks and related ship maintenance between 1903 and 1953. Upland shops and structures and

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in-water dry docks were used by independent contractors working for various vessel owners. During wartime, U.S. Government contractors utilized the dry docks for military ship outfitting and repair. Several of these dry docks have since been removed from this stretch of the river (e.g., Mar Com, Willamette Cove). Dock structures at the former M&B facility were removed during the recent Superfund cleanup of this site.

The 1936 photograph of the west side of the river (Map 3.2-13a) shows the Willbridge Terminal (RM 7.5), U.S. Moorings (RM 6), and Gasco (RM 6.2) facilities with very little other development. Most of the shoreline change occurred on the west side of the river from the 1940s to the 1960s. Fill was placed along the eastern shoreline of RM 5 to 5.7 from the 1950s through the 1970s. By 1975, fill was also placed along the western shoreline and a larger low-lying area at what is present-day Siltronic (RM 6) and Gasco property. Fill materials for both sides of the river included quarry discards and dredge materials. At the Gasco and Siltronic properties, MGP materials were also included in the fill. At the Arkema site (RM 7.2), fill consisted of plant debris composed of asphalt, concrete, pipe, soil, and fill from other sources.

The historic 80-acre Doane Lake[18] and associated wetlands were situated in the upland area of this western stretch of the river (see Map 3.2-1). The lake was divided in 1908 when the Railroad Bridge and southbound rail lines were constructed, and again in 1968 when the northbound rail line was constructed. The 6-acre lake area between these two rail lines is called North Doane Lake. The portion of the lake north of the Railroad Bridge was filled between the 1960s and 1970s for industrial development. The portion of the lake south of the Railroad Bridge was used for waste disposal by adjacent industries, such as battery casings (Gould Industries), pesticide and herbicide manufacturing wastes (Rhone Poulenc), and foundry waste (ESCO). Fill material began to be placed in this remnant lake in the 1960s, and it was almost completely filled by the late 1990s when the Gould Superfund site completed remediation.

The western shore shows narrowing from RM 6.9 to 7.4 due to upland development and installation of the railroad crossing. Arkema maintained two dock structures for receipt of evaporated sea salt, which contained sodium chloride, and shipping of inorganic chemicals produced onsite. Operations ceased in 2001, and the facility has been dismantled, but the dock structures remain. Petroleum products have been loaded and unloaded at the Willbridge Terminal since the early 1900s.

RM 3 to 5

Major facilities on the east side of the river started in the early 1920s and included cargo handling, a flour mill, warehousing, and bulk fuel storage. Tank farms were developed on the west bank in approximately 1918 (present-day Kinder Morgan Linnton Terminal) and were expanded in the 1960s to be the predominant land use. The Owens-Corning Linnton facility installed several petroleum product tanks for use in their asphalt production in 1981. Other early west-shore industries included lumber mills, toy manufacturers, a creosote plant, and lumber storage. The PGE Harborton

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substation at RM 3.1W was constructed in 1985. Both sides of the river were fully industrial by the 1970s.

The most important shoreline changes in this reach occurred along the eastern shoreline from RM 4.2 to 4.6 (Map 3.2-20b). In the late 1910s and early 1920s, the mouth of Gatton Slough was filled (discussed in the following section), and three slips were dredged forming the Municipal Terminal No. 4 area (present-day Slips 1 and 3 and Wheeler Bay). Between approximately 1948 and 1958, the middle slip (Wheeler Bay) at Terminal 4 (which was never completed) was backfilled and Slip 3 was widened. The Port of Portland's auto storage facility at Terminal 4 was developed in the 1960s and the early 1970s, by placing sand fill to bring the site up to an elevation above the flood level. In the early 1970s, the sand fill was graded and the automobile storage yard and the steel dock and steel yard were constructed (Integral et al. 2007).

The Burgard Industrial Park (RM 4E) was the location of a large shipyard operated by the Oregon Shipbuilding Corporation. The deep-draft International Terminal Slip was created during the 1940s, and portions of the marshy, low-lying areas on the site were filled. Ship breaking activities were reported in 1946 (Oregonian 1946). The year in which shipyard was dismantled has not been presented in documents reviewed, but the shipways were filled between the early 1960s and 1972. Post-shipyard industrial uses included metal fabrication, log rafting, and upland log storage. The property was converted for use in 1972 as a metals scrap yard. Automobile shredding operations began in 1980.

Conspicuous historical overwater features within this reach include docks associated with ship building and repair, lumber mills, petroleum product distribution, moorage, and cargo unloading. Port of Portland Terminal 4 tenants that currently (or historically) handle soda ash, new automobiles, and liquid bulk materials from their docks are located on the eastern shoreline. Metal scrap delivery occurs at docks in the International Terminal Slip (RM 3.7). Along the western shoreline, there are bulk petroleum distribution docks (ARCO; RM 4.9) and sand and gravel unloading/loading overwater activities (Columbia River Sand & Gravel; RM 4.5).

RM 1 to 3

Little change to the shoreline occurred in this vicinity of the river until fill materials were placed at the present-day EOSM site (RM 2.1E) from the early 1940s to the 1960s; additional filling of the riverbank occurred in the 1970s using EOSM slag materials, onsite soils, dredge material, and imported materials (Map 3.2-20a). Within the larger Rivergate industrial area, approximately 500 acres of the historic Ramsey Lake, located between Smith and Bybee lakes and the Willamette, were filled with dredge material from the 1960s to the 1980s. As shown on Map 3.2-1, this lake and floodplain historically covered approximately 650 acres and included a seasonal stream called Gatton's Slough that flowed west to the Willamette and a channel connecting it to the Columbia Slough to the east (USC&GS 1888). A dredge/fill map compiled from

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USACE data shows dredge material from the Post Office Bar and the mouth of the Willamette being placed in the Rivergate industrial area (Port of Portland 1981; USACE 1973).

The primary overwater features along the eastern shore of this reach are docks for distribution of chemicals and petroleum products. From 1936 until the 1960s, the eastern shoreline was utilized for log raft storage. In the 1940s, a dock was constructed at what is now the EOSM site for the transport of oil and bilge water to an upland oil sump. The current dock at Ash Grove is first present in the 1966 aerial photograph (Map 3.2-13c). By 1975, new docks associated with EOSM, JR Simplot, and Port of Portland Terminal 5 are present along the RM 1 to 3 reach.

The only industrial feature on the western bank of the river in this area is Alder Creek Lumber Company (RM 2.9).

Multnomah Channel

Besides the Alder Creek lumber yard at the mouth of the Multnomah Channel, the only other predominantfacilities in this stretch of the channel are Fred's Marina, the Multnomah Yacht Club, and the ESCO landfill.

Since 1959, floating logs have been delivered to the dock area at the Alder Creek Lumber property near the mouth of the channel. Houseboat and boat moorages and marinas line Multnomah Channel's southern bank, opposite the ESCO landfill, forming a continuous string that extends as far as one mile. Approximately 200 of these houseboats and sailboats are used as permanent residences (ESCO 2009a).

Fred's Marina has occupied its site since the 1940s (Parson Brinckerhoff 2004). Presently, the marina contains a boat ramp, fuel dock, a boat trailer storage area, and over 200 slips. A designated dredged material disposal site is located upland directly east of the marina. This disposal site is for the containment of material dredged from the marina and vicinity that is deemed suitable for upland placement. The Multnomah Yacht Club has been in operation since 1961; prior uses of the property are unknown. The ESCO landfill does not have any operations on the shoreline. No further information on historical shoreline and fill placement activities was found.

3.2.2.2 Current Land Use

Portland Harbor is located within a broader region characterized by commercial, residential, recreational, and agricultural uses. A portion of the land adjacent to Portland Harbor is located within the Guild's Lake Industrial Sanctuary Plan (City of Portland 2001a) area (from the St. Johns Bridge at RM 5.8 to 10.7, along the west shore). Land use along the Willamette River within the harbor includes marine terminals, various manufacturing facilities, and commercial operations, as well as public facilities, parks, and open spaces. As shown on Maps 3.2-22a–e residential areas on the west side include the Linnton neighborhood in pockets west of St. Helens Road

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between RM 4.3 and 5W, and in the mixed use Pearl District neighborhood in the vicinity of RM 12W. Most of the residential land use on the east side is above the bluff, except for the St. Johns neighborhood, which extends closer to the river between RM 5.7 and 6.8E.

Maps 3.2-22a–e illustrate current land use zoning within the lower Willamette River and upper Multnomah Channel and show sites located within Study Area drainage basins. Waterfront properties are also labeled. Current and previous facility names for these sites are listed in Table 3.2-2.

The current overwater structures, such as wharfs, piers, floating docks, and pilings, were built largely to accommodate or support shipping traffic. These structures along the shoreline are clearly visible in the aerial photographs provided in Maps 3.2-21a–t. Numerous public and private outfalls, including stormwater and CSO outfalls, enter both shores of Portland Harbor, and are described further in Section 3.2.4.

The St. Johns Town Center is a mixed-use district that extends to the waterfront on the east side of the Willamette River at the St. Johns Bridge. The recent St. Johns/Lombard Plan (City of Portland 2004) includes a proposed redevelopment of this area near the Willamette River. The Riverfront Subdistrict included in the St. Johns/Lombard Plan is currently zoned as Open Space and as a Central Employment (EX) zone. The development standards of the Central Employment (EX) zone are intended to ensure that the Riverfront Subdistrict is developed in a manner consistent with adjacent areas and to support existing industry by limiting uses that may be less compatible with industry (City of Portland 2004).

Submerged lands are primarily owned by the Oregon Department of State Lands (DSL) and leased to upland property owners for uses such as construction of overwater structures, moorage, etc. The DSL submerged lands boundary can be ordinary high water (OHW), ordinary low water mark (OLW), or arbitrary deed lines specific to each riverfront property. Notable exceptions to DSL ownership include portions of the submerged and submersible lands at the Port of Portland Terminal 4, most of the dry dock area and riverside berths at Swan Island, which are owned by Shipyard Commerce Center LLC, and the International Terminal Slip owned by Schnitzer Steel Industries. DSL owns approximately 94 percent of the submerged lands in the Study Area. There are also areas within the Study Area below OLW not owned by DSL or the Port (DLA 2013).

3.2.3 Site Use

This section describes the current understanding of the physical and biological setting of the Study Area as it pertains to potential human uses, including specialized groups that may use the river for various activities. Most of the demographic information

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relating to the Study Area is based on historical background and documented human uses. This information is used to determine potential receptor populations and to develop the general CSM.

3.2.3.1 Commercial and Industrial

This section provides an overview of Portland Harbor's waterfront land and harbor use. Over the past 100 years, major physical alterations have modified the river hydrodynamics and changed the configuration of the river. Map 3.2-1 shows the configuration of the river and the existence of nearby lakes in 1888 (USC&GS 1888). Shoreline changes are presented by decade on Maps 3.2-2a–e. The first map shows the 1888 shoreline and the remaining maps represent a series of nine historical snapshots of the shoreline starting in the year 1936 and ending in 2007. The land use along the lower Willamette River is currently highly urbanized and industrialized. Some remnant natural areas remain and support habitat for aquatic and terrestrial wildlife.

Significant physical modifications to the river coincided with the development and industrialization of the harbor. Modifications included redirection and channelization of the main river, draining of seasonal and permanent wetlands and lakes in the lower floodplain, extensive filling of wetlands along the shoreline, conversion of agricultural lands, and periodic dredging to maintain harbors and the navigation channel.

Commercial and industrial development in Portland Harbor accelerated in the 1920s and again during World War II, which reinvigorated industry following the Great Depression. Before the war years, industrial development primarily included sawmills, manufactured gas production (MGP), bulk fuel terminals, and smaller industrial facilities. During the war years, a considerable number of ships, minesweepers, and tankers were built at military shipyards located in Portland Harbor. Additional industrial operations located along the river during the shipyard years, including wood-treatment, agricultural chemical production, battery processing, ship loading and unloading, ship maintenance and repair (e.g., sandblasting, scaling, repair, painting, refueling), and rail car manufacturing. Many of these operations continue today. Coincident with the development and use of Portland Harbor for these industrial purposes were a number of fires that occurred at wood products industries, manufacturing plants, or other waterfront facilities that were constructed predominantly of wood (Oregonian 1958, 1966a,b, 1967).

The development of the harbor centered on several industrial sectors, which are described in the following sections. Each sector discussed below contains a map showing the historical and current facilities included in the industrial sector (Maps 3.2-2 through 3.2-12). The approximate location of facilities is shown on the maps, based on the current ownership of the property. Mapping of actual facilities or operations was not attempted. Only a few sites in each category are discussed.

<u>Ship Building, Dismantling, and Repair</u>

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Ship-related activities in Portland Harbor include ship building (1800s–present), ship repair (1800s–present), and ship dismantling (1960s–1979). In the early 1900s, ship building plants in the harbor constructed various types of wooden and steel vessels, including ocean-going and river boats. A 1919 Dock Commission map (CPD 1919) lists seven facilities producing wooden boats, four facilities producing steel boats, and two outfitting companies. The Grant Smith-Porter shipyard at the present-day Mar Com North parcel launched 25 wooden cargo ships in 1918 to support the Emergency Fleet Corporation (EFC) during World War I. This shipyard was the most prolific company in the EFC wooden ship program at this time. Prior to WWI the steel ship building industry in the Pacific NW was not extensive due to the distance from steel-producing centers. Only one shipyard, just upstream from the Portland Harbor area, the Columbia River Shipbuilding Yard at RM 14W, produced steel ships for the EFC effort (Hopkins 1994). By 1935, the number of ship building facilities decreased to two: Albina Engine and Machine Works at RM 11E, and Willamette Iron and Steel Company (WISCO) at RM 10W (CPD 1935).

Ship building accelerated again during the World War II years. Map 3.2-3 shows the general location of historical shipyards visible on aerial photographs taken between 1936 and 1969. Approximate areas of the former shipyards include RM 4E (Oregon Shipbuilding Corp.), RM 5.6E (U.S. Shipping Board), RM 6.7E (St. Johns Dry Docks, also called the Port of Portland Dry Docks on the CPD [1935, 1945] maps), RM 7.4E (Peninsula Ship Building Co.), RM 9E Swan Island (U.S. Maritime Commission), RM 9W (American Ship Dismantlers), RM 10W (WISCO), and RM 11E (Albina Engine and Machine Works).

As the demand for new ships increased, industrialist Henry Kaiser built two large shipyards, including the Oregon Shipbuilding Corp. shipyard at the present-day International Slip and the Swan Island shipyard. The Gunderson Brothers Engineering Group (RM 8.5–9.2W) also increased its plant's capacity to build small vessels. Besides Liberty ships, these facilities built small aircraft carriers, T-2 tankers, and a variety of landing craft that delivered troops, tanks, trucks, and supplies to combat zones. The population of Portland increased by a third as people moved into the city to work in the shipyards (Portland Tribune 2009; Oregon Historical Society 2002).

After the war ended, the salvaging of Liberty ships continued to fuel Portland's economy. Zidell Exploration Company salvaged many of the Liberty ship parts, except for the bows which were reinforced with concrete when they were built. Many of these ship bows were buried along the west side of the Willamette just north of the Broadway Bridge. Ship dismantling and scrapping also took place at other facilities in Portland Harbor, such as Consolidated Builders, Inc., a Kaiser affiliate, which scrapped decommissioned troop landing ships at Swan Island for a short time, and American Ship Dismantlers located at the present-day Gunderson site (Portland Tribune 2009) and in the International Slip.

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Ship repair also occurred at several facilities. Ship repair and related maintenance was conducted at the former St. Johns Dry Docks (aka Port of Portland Dry Docks) at Willamette Cove between 1903 and 1953, at Albina Engine and Marine Works between 1904 and 1971, and at Mar Com between 1905 and 2004. Other sites with historical ship repair activities include the Triangle Park and U.S. Moorings sites.

Ship-related activities continue at a much smaller scale in Portland Harbor today, with most work focused on ship maintenance and repair. At Vigor Industrial on Swan Island (formerly Cascade General), current activities at the dry docks include hull repair, maintenance, painting, and other dry lay-up ship repair tasks. The U.S. Moorings site (RM 6W) continued to do vessel repair until 2008. More than 2,000 marine vessels have been built at the Gunderson facility (RM 10.5W) since the 1960s, including ocean-going barges, conventional deck barges, double-hull tank barges, railcar/deck barges, dump barges, and barges for aggregates and other heavy industrial products.[19] Houseboats and sailboats are currently being built at RM 5.8W.

Chemicals such as volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), petroleum aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), copper, zinc, chromium, lead, mercury, phthalates, and butyltins are identified as common contaminants associated with ship building, salvaging, and repair in studies by the National Shipbuilding Research Program (NASSCO 1999) and EPA's Office of Compliance (EPA 1997a), as well as EPA's Industrial Stormwater Fact Sheet Series (EPA 2006e). The anti-fouling paint applied to ships during World War I contained significant amounts of both zinc oxides and mercury oxides (Williams 1911). In modern times, antifouling paints are formulated with toxic copper, organotin compounds, or other biocides—special chemicals which impede growth of barnacles, algae, and marine organisms. In the 1960s and 1970s, commercial vessels commonly used bottom paints containing tributyltin (TBT), which has been banned by the International Maritime Organization (IMO 2002) due to its serious toxic effects on marine life.

Wood Products and Wood Treating

The wood product industry has a long presence in Portland Harbor and has included wood-treating facilities (1944–1991), sawmills (1800s–1977), and plywood manufacturers (1905–2001), each with its own unique COIs. A 1919 Dock Commission map (CPD 1919) shows eight docks in the harbor devoted to lumber, the largest of which was Peninsula Lumber Company located at RM 7.4E on the McCormick and Baxter site and a portion of the Triangle Park site. Wood products created during this time included wooden barrels and box shooks (or box parts), which were shipped to fruit-growing areas or filled with local produce and railed to their destinations. The lumber industry grew exponentially during the war years, when barges pulling floating logs were a common sight in Portland Harbor. By 1977, the last sawmill in Portland was dismantled (MacColl 1979).

[19] Gunderson Marine: http://www.gbrx.com/Marine_Barges_Home.php?expandable=2.

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Lumber mills and wood treatment facilities operated at various locations within the Study Area historically, primarily RM 6.9 to 7.2E (Map 3.2-4). One of the largest sites was McCormick and Baxter, which produced treated wood for over 45 years. Other facilities that had wood-treating operations include West Oregon Lumber Co. (located at the Owens Corning-Linnton site) and Kingsley Lumber (at the Georgia Pacific-Linnton site). Wood-treating products used at these facilities include creosote/diesel oil mixtures, pentachlorophenol (PCP)/diesel oil mixtures and associated dioxin contaminants, and a variety of water- and ammonia-based solutions containing arsenic, chromium, copper, and zinc (Integral and GSI 2005a,b,c; EPA 2004a, 2006d).

The present-day Georgia-Pacific Linnton facility (RM 3.6W) was formerly occupied by a sawmill, creosote plant, a lumber storage facility, and, before the site was mothballed in 1997, a wood chip transfer facility. The historic sawmill was owned by the Kingsley Lumber Company and ceased operations in the late 1960s. A sawmill also operated at the current Mar Com South property for almost 50 years. An additional sawmill operated in the central parcel of the Willamette Cove site from the 1950s until the early 1960s (Integral et. al 2007). The Alder Creek Lumber Company in the Multnomah Channel has been the site of lumber-related activities (log storage, sawmill, lumber, planing) since its development in 1959 (Integral and GSI 2005a,b,c). While most of the byproducts of these operations were organic materials, contaminants typically associated with saw mills include wood preservatives (e.g., arsenic compounds, copper compounds, chromium compounds, pesticides, fungicides, biocides, borates, pentachlorophenol, creosote, etc,), solvents, heavy metals, acid/alkaline wastes, benzene, TPH (oil, grease, diesel, gasoline), and PAHs (EPA 2006d).

Various pesticides and fungicides have been used in glues and surface treatments in the plywood manufacturing process (Stellman 1998). The first plywood panels to be manufactured from western woods were made in St. Johns, Portland, at the Plywood Manufacturing Co. in 1905 (PPA 1967). The last plywood manufacturer in the harbor, Linnton Plywood, closed in 2001. The St. Johns Lumber Company (aka Portland Lumber Mill, Portland Manufacturing Co.) operated on the present-day Crawford Street and BES Water Pollution Control Laboratory (WPCL) sites from the 1930s until 1974 when the mill was demolished (Integral and GSI 2005a,b,c). A plywood manufacturing plant was also located on the west parcel of Willamette Cove upland facility (RM 6.3E) from 1901 until 1963 when it became a lumber mill. Building materials such as lumber, plywood, and laminated veneer lumber products were produced at Linnton Plywood and the western parcel of Willamette Cove. Linnton Plywood used phenol-formaldehyde resin, sodium hydroxide, and petroleum hydrocarbons, such as oil, diesel, and kerosene in its plywood manufacturing process (Integral and GSI 2005a,b,c). Contaminants associated with plywood manufacturing include VOCs, SVOCs, TPH, and metals (EPA 2006d). Transformers associated with the operations can include the potential for PCB releases and the use of boilers can result in dioxin/furan releases from burning waste fuels. Additionally, solvents, heavy metals, acid/alkaline wastes, benzene, TPH (oil,

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grease, diesel, gasoline), and PAHs can be associated with ancillary operations, such as maintenance and repair, at the facility.

Chemical Manufacturing and Distribution

Within the Study Area, some facilities manufactured chemicals and some stored, repackaged, and/or distributed chemicals. Chemical plants, including Arkema and Rhone Poulenc (RM 6.8–7.5W) that manufactured pesticides and herbicides, were in place as early as 1941 (Map 3.2-5). The Arkema facility was an organic and inorganic chemical manufacturing facility that produced sodium chlorate, potassium chlorate, hydrochloric acid, perchlorate and DDT at various times until operations ended in 2001. At the former Rhone Poulenc facility, fertilizers and organic and inorganic pesticide formulations, sodium arsenite liquids, organochlorine insecticides and chlorophenoxy herbicides, acid/esters, and bromoxynil products were produced during its 49-year history (1942 – 1991).

The Great Western Chemical Company (aka Quadra Chemicals Western and Brenntag Pacific on the present-day McCall Oil site) at RM 7.9W produces water treatment chemicals, dry and liquid industrial cleaning agents and sanitizers, oxygen scavengers, and steam-line treatment chemicals (Integral and GSI 2005a,b,c). Other manufacturers in the Study Area included Premier Edible Oils (edible oil), West Coast Adhesives (phenolic resins), JR Simplot (urea), Ash Grove Cement (cement), Master Chemical (janitorial cleaners), Mammal Survey & Control Service (rodenticides), Mt. Hood Chemical Corp. (cleaning supplies), and McWhorter Inc. (varnish, paint, and resins). These sites are also identified on Map 3.2-5.

A number of facilities packaged, stored, and/or distributed chemicals. Van Waters & Rogers (aka Univar) handled a wide range of industrial chemicals, including organic solvents, acids and bases, ammonia, and other materials, until it ceased operations in 1988. Other chemical distributors included Great Western Chemical at RM 9.2W on the Chase Bag site (chemicals unknown), Wilbur Ellis (pesticides and herbicides), Ashland Chemical (primarily solvents), and McKesson (Mt. Hood Chemical Property – food additives, pharmaceuticals, and mineral acids).

Contaminants associated with chemical manufacturing operations can vary, depending on the operations, but could include pesticides, herbicides, VOCs, SVOCs, dioxins/furans, and metals (EPA 2008). Transformers associated with the operations can include the potential for PCB releases and the use of boilers can result in dioxin/furan releases from burning waste fuels. Additionally, solvents, heavy metals, acid/alkaline wastes, benzene, TPH (oil, grease, diesel, gasoline), and PAHs can be associated with ancillary operations, such as maintenance and repair, at the facility.

Metal Recycling, Production, and Fabrication

Recycling, production and fabrication, and plating of metals occurred at several locations within the Study Area.

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Metal salvage and recycling facilities operated in the Study Area (Map 3.2-6) at RM 4E (Schnitzer Steel – auto and appliance dismantling), RM 5.8W (Marine Finance), RM 7.2W (Gould/NL Lead), RM 7.3W (Schnitzer-Doane Lake), RM 8.5W (Calbag Metals), RM 8.8W (Gunderson – auto dismantling), RM 9.5E (Portable Equipment Salvage), RM 9.7W (Schnitzer Steel Recycling Yard on NW Yeon), RM 9.8W (Nudelman & Son), and RM 10.3W (Calbag-Nicolai). The metals recycling business includes cutting, torching, segregating, storing, and distributing metals, as well as recovering metals from wire. The Gunderson facility has manufactured and refurbished rail cars since 1913. Rail cars were also refurbished at the ACF Industries property (RM 3.7W) for almost 23 years (Integral and ESI 2005a,b,c).

Metal production and fabrication currently takes place in the Burgard Industrial Park, and several sites in the RM 8 to 10.3W reach, including Dura Industries, NW Copper Works, American Machine & Gear (RM 9.8W), and two non-ECSI sites, Portland Bolt & Manufacturing (RM 9.6W) and The Willard Storage Battery Company, which manufactured storage batteries at the Chase Bag site from approximately 1952 to 1958.

Contaminants associated with metal recycling, production, and fabrication industries are dependent upon the activities conducted, but generally include PCBs, oil and grease, lubricants, paint pigments or additives, ionizing radioactive isotopes, transmission and brake fluids, fuel, battery acid, lead acid, antifreeze, benzene, chemical residue, heating oil, petroleum products, solvents, infectious/bacterial contamination, asbestos, cyanide, phthalates, and heavy metals (EPA 2006g,h,i,j). Ancillary operations, such as repair and maintenance, can produce the contaminants from hydraulic fluids, oils, fuels, grease and other lubricants, chemical additives, and PCBs, fuel additives, antifreeze (ethylene glycol), battery acid, and products of incomplete combustion, battery acid, heavy metals (e.g., arsenic, zinc, copper, lead, cadmium, chromium, mercury) and hydraulic fluids, chlorinated solvents, mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.

Manufactured Gas Production

Manufactured Gas Production operations took place between 1860 and 1955. Portland Gas & Coke constructed an oil MGP facility, known as Gasco at RM 6.5W (Map 3.2-7) operated between 1913 and 1955. The plant initially produced town gas and pressed lampblack briquettes that were sold in the Portland area as fuel. In 1923, the gasification process was modified to optimize aromatic generation and light oil recovery for use as motor fuel. Tar recovery and refining were incorporated into the process in 1925 to provide tar for use as a road binder. During the 1930s, the plant expanded, and in 1941 a coking plant began production of electrode grade coke and high BTU gas (Integral et al. 2007). The Pintsch Compressing Company Gas Works at RM 11.7W operated between 1890 and the mid-1930s and manufactured compressed gas from crude oil for railroad train lighting. Just upstream from the Study Area, the Portland MGP site operated at RM 12.2W between 1860 and 1913. As the wastes produced by former manufactured gas plants are persistent in nature, they often (as of

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2009) still contaminate the site of former manufactured gas plants: the waste causing the most concern today is primarily MGP tar (mixed long-chain aromatic and aliphatic hydrocarbons, a byproduct of feedstock carbonization), while purifier waste (comprised of "purifier beds" made up of either lime or wood chips impregnated with iron filings and contaminated with sulfur and cyanide compounds from passing the gas through it).Contaminants associated with manufactured gas operations include VOCs (BTEX), SVOCs, PAHs, TPH, metals, and cyanide (Integral et al. 2007).

Electrical Production and Distribution

Electrical transformers and capacitors are associated with nearly all of the major industries in the harbor. Transformers and capacitors historically contained and may continue to contain PCBs. There are seven current substations and one historical substation in the Study Area (Map 3.2-8). The Portland General Electric (PGE) Harborton Substation at RM 3.3W currently consists of an operating 115-KV switchyard and distribution substation for electrical power regulation and transmission (Integral and GSI 2005a,b,c). PGE also operates Substation E (RM 10.4W), and other substations at Swan Island (RM 9.3E), Siltronic (RM 6.4W), and Willbridge Terminal (RM 7.5W). The PacifiCorp Albina substation is located at RM 11E, which is associated with a high-voltage cable crossing at RM 11.3. The remaining active substation is operated by Schnitzer Steel (RM 4E, near the International Slip). BPA operated a substation at the Arkema site and conducted site cleanup after decommissioning the substation.

Electrical equipment repair, servicing, and salvaging operations occurred on the east bank from RM 11.3 to 11.5, including the Tucker Building (former electrical distribution and limited small transformer repair), Westinghouse (former transformer repair and servicing), and PacifiCorp Albina Substation Properties (Block 71, 81, and 82; electrical distribution only), at RM 3.7W (ACF Industries), RM 9.5E (Portable Equipment Salvage), RM 9.5W (GE Decommissioning), and RM 10W (GE facility at NW 28th Ave). The GE Decommissioning facility handled dielectric fluids containing PCB concentrations greater than 50 ppm. These fluids were drained from customer-owned equipment into temporary aboveground holding tanks or drums. Often these fluids were returned to the equipment following service or repair (Integral et al. 2007). The GE facility at RM 10W conducted repairs from the mid-1990s to 2001, including decommissioning of custom transformers. Contaminants associated with electrical production and distribution include PCBs, TPH, and PAHs (Traffim and Ziegler 2006).

Bulk Fuel Distribution and Storage and Asphalt Manufacturing

Bulk fuel facilities have a long history in Portland Harbor. By 1936, most of the facilities currently in place between RM 4 and 8 on the west side of the river had already been established (Map 3.2-9). These facilities include ARCO's BP Terminal, Kinder-Morgan, Willbridge Terminal, Christenson Oil, ExxonMobil, Texaco Equilon, and Foss/Brix Maritime. Five additional facilities were located on the east side of the

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river in the RM 3 to 5 reach; Time Oil owned and operated at two facilities, and three facilities were located at the Port of Portland Terminal 4. .

These facilities have handled a variety of petroleum products, including lubricating and specialty oils, bunker fuel, diesel fuel, gasoline, ethanol, gasoline additives (e.g., methyl tert-butyl ether [MTBE], ethylene dibromide [EDB], ethylene dichloride [EDC], lead), aviation fuel, and various lubricants. Petroleum product pipelines are also found throughout the Study Area.

Another petroleum product, asphalt, is manufactured at several facilities on the west side of the river, including Owens Corning Linnton (RM 3.8W), GS Roofing (RM 7.5W), McCall Oil (RM 7.9W), Chevron Asphalt Refinery (RM 8W), and Trumbull Asphalt (RM 9.1W). The Municipal Paving Plant at RM 10.9E was constructed in 1928 and operated intermittently until its permanent closure in 1966.

Contaminants typically associated with bulk fuel storage operations and asphalt operations include VOCs (benzene), SVOCs, PAHs, TPH (oil, gas and diesel fuels), and metals (EPA 2006k). Additionally, gas/diesel fuel, fuel additives, oil/lubricants, heavy metals, brake fluids, transmission fluids, chlorinated solvents, and arsenic can be associated with ancillary operations, such as maintenance and repair, at these facilities.

Steel Mills, Smelters, and Foundries

Since the early 1900's, metal foundries have been located in Portland Harbor (Map 3.2-10). For the first 30 years, these foundries served as suppliers of cast steel alloy products for the logging, construction, and pulp and paper industry throughout the Pacific Northwest. Today, these foundries manufacture products for a multitude of industries, including mining, highway and heavy construction, utilities and general construction, power generation, aerospace, defense, dredging, forestry, rigging, conveying, as well as many other industrial applications. Steel foundries are located at RM 2.8E (Consolidated Metco), RM 9.7W (Schmitt Forge), RM 10.4W (ESCO Main Plant) and RM 10.5W (ESCO Plant 3) and RM 11.4W (Gender Machine Works). Lead smelters were located at RM 7.2W (Gould), at RM 9W (National Lead/Magnus Smelter), and at RM 11.6W (RiverTec Property). In addition to lead smelting, facility operations at the Gould site included lead-acid battery recycling, zinc alloying and casting, cable sweating, and lead oxide production. The present-day Wilhelm Trucking site at RM 9.6W was the former location of a lead bearing rehabilitation plant. Steel mills were located at RM 2.4E (Evraz Oregon Steel Mills [EOSM]) and at RM 8.3W (former Oregon Steel Mill operation at Front Ave LP). Only the EOSM property is currently operating, confined to steel production, steel processing, and related ancillary operations.

Besides metals, other contaminants associated with these types of operations include TPH (from oil, gas, and diesel fuels) and PAHs. PCBs were a component of hydraulic fluid for high temperature applications (machining, die casting) where fire resistance

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was important. PCBs were also a component of heat transfer fluid used in big applications like heat exchangers and recirculating cooling systems (EPA 2004b, 2006h). Additionally, gas/diesel fuel, fuel additives, oil/lubricants, heavy metals, brake fluids, transmission fluids, and chlorinated solvents can be associated with ancillary operations, such as maintenance and repair, at these facilities.

Commodities Maritime Shipping and Associated Marine Operations

At the turn of the 19th century, Portland Harbor accommodated steamboats that transported farm products and natural resources from Idaho, eastern Washington, and Oregon. This cargo was then loaded onto sailing ships for markets in Asia, the eastern and western United States, and Europe. Portland Harbor also served as the gateway for incoming trade goods to the region. On the 1919 Dock Commission map (PPD 1919) there were docks dedicated to the distribution of shingles, cans, asphalt, sand and gravel, cereal, flour, grain, and vegetable oil.

The Port of Portland facilities have had a prominent presence in the maritime commodities shipping industry in Portland Harbor since 1891. Over the years, export/import of agricultural products, dry/liquid bulk products, forest products, and other bulk commodities have passed through Port facilities (Terminals 1, 2, 4 and 5). Currently, the Port operates two deep-water marine terminals, Terminals 4 and 5, within the Study Area that handle thousands of tons of cargo each week. Major exports handled at Terminals 2 and 4 (Map 3.2-11) include pencil pitch, wheat, soda ash, potash, and compressed hay. The Port's operations in Portland Harbor constitute the third-largest export center for grain in the world and the largest wheat export port in the United States (Williams 2007). Major imports include automobiles, steel, and limestone.

Other privately owned commodity shipping facilities in the harbor include or have included the grain handling operations at CDL Pacific Grain (RM 11.4E) and Centennial Mills (RM 11.3W), edible oils at the former Premier Edible Oils facility (RM 3.6E), scrap metal export at International Terminals (RM 4E), cement import and distribution at Glacier NW (RM 11.3E), as well as other non-ECSI sites. JR Simplot in the South Rivergate Industrial Park (RM 3E) has been distributing anhydrous ammonia and solid and granular urea to the Pacific Northwest since 1968. Goldendale Aluminum at RM 10E was used as an offloading facility (alumina, electrode binder pitch, and grain) from 1957 until 2001 (Integral and GSI 2005a,b,c). Sand and gravel operations have occurred at the Ross Island Sand & Gravel facility at RM 11.1E since at least 1919 (LWG 2007).

Contaminants for the commodities maritime shipping industry include spillage of raw materials during transport to and from vessels; butyltins, copper and zinc from ship hull paints; and oil, lubricants and grease from overwater transport equipment (EPA 2006). Supporting maritime activities include over-water tug and barge moorage, maintenance

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and repair facilities, overwater bunkering and lightering, tug-assisted and independent maneuvering of vessels in and around marine facilities, and stevedoring (loading and discharging) product at vessels. Contaminants such as gas/diesel fuel, fuel additives, oil/lubricants, heavy metals, brake fluids, transmission fluids, and chlorinated solvents can be associated with these support activities (EPA 2006).

Rail Yards

In addition to the construction of commodity shipping facilities, railroads were constructed in the early 1900's to support the overland transport of farm products and natural resources from Idaho, eastern Washington, and Oregon. Rail tracks, yards, and terminals are located in the Portland Harbor area. Rail yards are found on the eastern side of the river at approximately RM 9.8 to 11.1 (Union Pacific Railroad [UPRR] Albina Yard), and RM 4.6 (UPRR – St. Johns Tank Farm) and on the western side of the river from RM 8.6 to 9.5 (Portland Terminal Railroad [PTRR] Guilds Lake Yard), and RM 8.1 (Burlington Northern Santa Fe Railway Co. [BNSF] Willbridge Switching Yard), (Map 3.2-12). These rail yards support the interstate railroads, BNSF and UPRR.

Primarily operating as switching yards, some rail yards offer locomotive fueling and servicing, railcar maintenance, and trailer-on flatcar storage. Railcar switching yards (RM 8.1W – BNSF Willbridge Switching Yard) are locations where trains are assembled and disassembled (and this type of operation typically does not result in releases or produce waste streams.) Historical rail yard operations were also located on the western side of the river at RM 11.6 (BNSF Hoyt Street Railyard, and UPRR Union Station operations). BNSF owned and operated the Hoyt Street Railyard from the early 1900s until 1988. The rail yard has been abandoned and dismantled, and much of the site has been developed as condominiums and commercial businesses. Historical rail car maintenance operations were also located at RM 3.7W (ACF Industries).__

Contaminants associated with rail yards generally include PCBs, oil and grease, lubricants, paint pigments or additives, ionizing radioactive isotopes, transmission and brake fluids, fuel, battery acid, lead acid, antifreeze, benzene, chemical residue, heating oil, petroleum products, solvents, infectious/bacterial contamination, asbestos, cyanide, phthalates, and heavy metals (EPA 2006m). Ancillary operations, such as repair and maintenance, can produce the contaminants from hydraulic fluids, oils, fuels, grease and other lubricants, chemical additives, and PCBs, fuel additives, antifreeze (ethylene glycol), battery acid, and products of incomplete combustion, battery acid, heavy metals (e.g., arsenic, zinc, copper, lead, cadmium, chromium, mercury) and hydraulic fluids, chlorinated solvents, mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze. Contaminants associated with fueling activities and freight car repair operations at rail yards could include VOCs, SVOCs, TPH, PCBs, and metals (EPA 2011; DEQ 2011a).

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Conveyance Systems

This section describes the historical and current conveyance systems in the Study Area, including both municipal and non-municipal systems. Non-municipal systems are either private or part of other public systems, such as Oregon Department of Transportation (ODOT) or the Port of Portland.

General Description of Conveyance Systems

There are three types of conveyance pipes in Portland Harbor. The following is a description of the types of flows each pipe carries and its discharge points.

Sanitary Pipes: These pipes convey sanitary wastes from domestic and industrial sources, and may also carry industrial wastewater. Flows in these pipes discharge to the Columbia Boulevard Wastewater Treatment Plant (CBWTP), which discharges to the Columbia River at two discharge points (RM 105.5 and 105.6), approximately 4 miles upstream of the Willamette River confluence. Sanitary pipes are typically part of the City's collection system, although there are sanitary pipes on private property that connect to the municipal system.

Stormwater Pipes and Other Point Discharges: Stormwater conveyance systems typically consist of ditches, swales, storm drains, inlets and catch basins connected to an outfall through pipes or lines. Flows in these pipes typically discharge to the river, although some may discharge to lakes or infiltration facilities. Stormwater pipes can be part of the municipal collection system or part of a non-municipal system.

Combined Pipes: Combined pipes convey sanitary wastes from domestic and industrial sources and stormwater, and may also carry industrial wastewater. Historically, these flows typically discharged to the river. After combined pipes were connected to the sanitary interceptors, the outfalls draining these pipes were either converted to combined sewer overflow (CSO) outfalls or to storm-only outfalls. Historically, combined pipes were both municipal and non-municipal, but currently most combined systems are part of the City's collection system. Additional detail on how combined pipes function and the types of CSO outfalls is provided below.

Outfalls

Within the Study Area, outfalls have been installed by a variety of entities, including private landowners, the Port of Portland, the State of Oregon, and the City of Portland.

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Most of the outfalls currently convey primarily stormwater, although historically some also conveyed industrial and sanitary discharges.

Some outfalls also currently convey nonstormwater discharges. Some nonstormwater discharges, such as noncontact cooling water, must be permitted, while other nonstormwater discharges, such as landscape irrigation, are exempt under federal regulation. As discussed below, some outfalls include a CSO component as well.

The City of Portland identified over 400 potential public and private outfalls along both shores of the Study Area (City of Portland 2006c). Using site-specific information and field reconnaissance, the LWG independently verified these outfalls and researched areas that potentially had additional outfalls. Incorporating results of the field reconnaissance, a total of 436 total outfalls were identified; of these approximately 313 are active, 44 are inactive, 30 are abandoned, 15 have been removed, 27 are unknown outfalls, and 7 were determined to not be outfalls (Integral 2008h).

The types of outfalls are defined as follows:

Active = outfall is currently in use

Inactive = outfall pipe exists, and is not filled, plugged, or disconnected, but discharge is presently not occurring

Abandoned = outfall pipe exists but it is filled, plugged, or disconnected, and discharge is not occurring

Removed = outfall pipe has been removed

Unknown = despite best efforts, the status of some outfalls cannot be determined.

Attributes for some outfalls in the data set remain flagged despite repeated attempts by LWG to verify during field work or due to conflicting information from the facility and the City. The location and status of the outfalls within the Study Area are shown on Maps 3.2-23a–m.

Stormwater Runoff

Stormwater enters the river via stormwater conveyances, overland flow, and infiltration to groundwater. Stormwater conveyance systems typically consist of ditches, swales, storm drains, inlets, and catch basins connected to the outfall through pipes or lines.

Overland flow of stormwater occurs at some locations immediately adjacent to the river. In many of these areas, the extent to which rainwater falling on pervious ground near the river shoreline results in runoff versus infiltration into the ground is unknown. In some impervious shoreline areas, stormwater appears to be transported to the river

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via overland flow, with little chance for infiltration into the ground. A preliminary assessment of outfall drainage basins conducted for the Round 2 Report indicated that the area drained by overland flow appears to be relatively small compared to the area in which stormwater is discharged via outfalls. Given the difficulties of defining all stormwater conveyance drainage basins along the river, the proportion of overland flow to the river has not been further quantified for this RI. Nevertheless, this pathway may represent a significant contaminant transport pathway route, especially as it relates to riverbank erosion.

Additionally, stormwater can enter the river indirectly via infiltration into pervious ground (or through dry wells, sumps, and other infiltration facilities), where it is then mixed with groundwater and discharged to the river as groundwater. Groundwater discharges are further discussed in Section 3.1.3 and Section 4.

Most of the stormwater from the west side of the river drains from Forest Park, an area which consists mostly of undeveloped parkland. Streams from Forest Park generally enter underground pipes at the base of the West Hills, near U.S. Highway 30. At this point, the highway stormwater drainage often enters these same conveyance systems. This runoff is comingled with industrial stormwater runoff as it moves through industrial properties between the park and the river. On the east side of the river, there are few open channel drainages, and most of the stormwater is discharged via conveyance systems. Most properties adjacent to the river on both sides do not discharge through shared conveyance systems but directly discharge to the river via their own stormwater conveyance systems and outfalls or overland flow.

Just under half of the stormwater drainage to the Study Area is through shared conveyance systems; open space comprises about 60 percent of these basins. These systems are further discussed in Section 4.4.1.3 and include shared conveyance systems owned by the City, by Burgard Industrial Park, and by ODOT; multiparty outfalls with unknown ownership; and Saltzman Creek. In some locations, stormwater is captured by the City of Portland combined conveyance systems and is routed to CBWTP.

Section 4.4.1.2 further discusses the stormwater basins and the types of stormwater discharges, including a map showing a categorization of the different drainage types within the Study Area (i.e., shared conveyances, direct discharge, no discharge, and uncertain drainage).

Figure 3.2-5 shows the hydroboundary, the approximate overall area draining stormwater to the Study Area. The delineation of the overall drainage basin area between RM 1 and 11.8 was provided by the City of Portland (2006d). An analysis of stormwater flow contributions to overall river flows estimated that the Portland Harbor area runoff volume contributions are between 0.06 percent for the wet year conditions (1997) and 0.08 percent for dry year conditions (2001) of the total Willamette River flow. The average annual runoff volume for the Portland Harbor is 0.06 percent of the total Willamette River flow (City of Portland 2006d).

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Municipal Conveyance Systems

This section summarizes information regarding the City of Portland's (City) municipal conveyance system development in the Study Area. There are four major time periods discussed below. The initial period (1880–1947) was when most of the conveyances were combined systems. From 1948 to 1955, interceptors were installed and connected to most of the City's combined system (converting these outfalls to CSOs) and some separated systems were constructed. The period from 1956 to 1990, when sanitary service was extended to the northwest area and more separated systems were created. The final period is for current conveyance systems for system development changes after 1990.

These pipe types are currently configured into three general types of conveyance systems in the Study Area, as shown in Figure 3.2-1: 1) separated systems, 2) combined systems that discharge to the CBWTP (with no discharge to the river), and 3) combined systems with overflow diverters designed to reduce discharge to the river to a maximum of four times per winter and once every three summers (City of Portland 2001b). Separated systems have stormwater-only lines that discharge to the river and sanitary-only lines that discharge to the treatment plant. In combined systems, the stormwater and sanitary lines join and flow in a combined line. Most of the Study Area is currently served by separate storm lines and separate sanitary sewers. Only a limited portion of the area is served by the combined system, and not all of the combined system has the ability to overflow to the river (see Section 3.2.4.4). Stormwater and combined systems are further described below.

Historically, municipal and non-municipal combined and storm pipes discharged directly to the river. When sanitary interceptors were constructed, parallel to the riverbanks, they intersected the municipal combined trunk lines. The combined trunk lines were connected to the interceptor system. Diversion structures in the combined pipes, essentially dams, direct flows that exceed the interceptor capacity to overflow to the river as illustrated in Figure XX.

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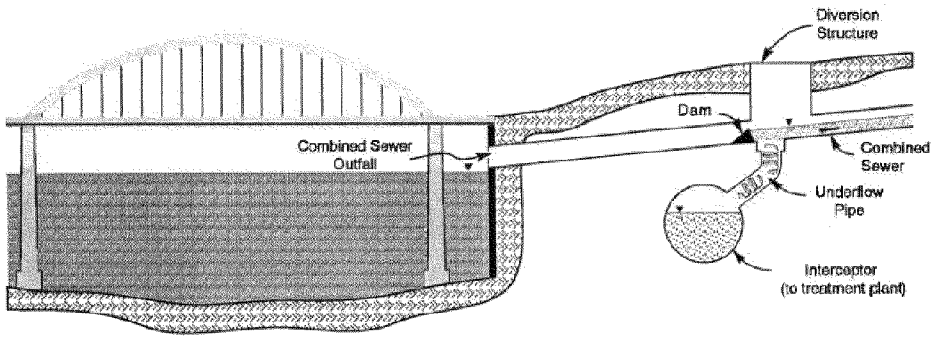

The overflow system was built to prevent the interceptor system from being overwhelmed during a storm event. This overflow system allows flows to breach the diversion dams and discharge the combined storm and sanitary sewage flows through an outfall to the Willamette River. Any sewer connections at points in the trunk lines above the diversion structures would overflow to the river only when rainfall caused an exceedance of the approximately three-times-dry-weather flow capacity of the system (City of Portland 1969). Discharges to connections at points in the trunk line downstream of a diversion or connections directly to the interceptor could not overflow to the river during a CSO event. On average, a typical CSO contains about 80 percent stormwater and 20 percent wastewater. Once the interceptors were put in place, the outfalls were referred to as CSO outfalls (CH2M Hill 1992; City of Portland 1952a, 2001b; Stevens & Thompson 1964).

Diversions from the combined system to the river (i.e., CSO events) occur before flows reach the interceptor. Once flows have entered the interceptor, these flows are directed to the treatment plant. During construction of the interceptor system, pump stations were added, some of which included emergency overflow lines that were connected to outfalls, which are known as sanitary sewer overflow (SSO) outfalls. Thus, after the interceptor connections were made, any sewer connections made directly to the interceptor pipe could not overflow to the river unless there was an emergency failure at a pump station. Figure 3.2-2 shows the location of the interceptors and the SSO outfalls.

1880–1947

The first municipal sewers in Portland Harbor were constructed by the cities of Portland, Linnton, and St. Johns, starting in the 1880s. These sewers were located in the downtown areas of each of these cities. The Linnton and St. Johns outfalls were transferred to the City of Portland when these cities were annexed into Portland, in 1905 and 1915, respectively. These combined sewers collected both surface drainage and sanitary wastes (including domestic and industrial discharges) and, as all private and public sewers did during this time period, discharged directly to the Willamette River (City of Portland 1966).

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In 1936, 48 municipal outfalls directly discharged to the Willamette River (City of Portland 1936), located between RM 17 and RM 4. Nineteen outfalls discharged within the Study Area; these were located in the downtown core (between RMs 9.6 and 11.8 on both sides of the river), in the St. Johns area (between RMs 5.2 and 5.9 on the east shore), and in the Linnton area (between RMs 4.3 and 5.3 on the west shore).

During and immediately after WWII, the City operated six additional combined conveyance systems. Two of these were constructed by the City to serve residential-only areas in St. Johns (OFs 48 and 49). Two were constructed by the Federal Housing Authority, built to serve temporary housing for wartime workers (OFs 18 and 19). Two were constructed by private parties to drain their site and then were transferred to the City under Public Works permits (OFs 20 and 21). OF-20 was abandoned in 1949 and flows were redirected to OF-19. Table 3.2-3 identifies the locations of outfalls, including those constructed during this time period.

Initial scoping of the Sewage Disposal Project included several interceptor sewers and a treatment plant discharging to the Columbia River (Smith 1936). Construction of this project began in 1947 (City of Portland 1952a).

1948–1955

During this time period, the CBWTP and the northeast and downtown interceptors were constructed, and combined flows from the municipal trunk lines were connected to the interceptors. As shown in Table 3.2-3, within most of the City CSO basins in the Study Area, industrial areas were separated so that industrial wastewater would not overflow to the river during CSO events. The exception to this was the industrial area in the north part of downtown on the west shore, where separation was more difficult because the area had already been heavily developed. Primary treatment (solids removal) was also added to the two Linnton outfalls as part of the effort to reduce loading to the river. Also during this time period, the City constructed new outfalls or accepted existing outfalls.

In 1947 the City Sewage Disposal Project began the construction of two interceptor lines (the east side and the west side) and a treatment plant (Oregon State Sanitary Service Authority; OSSA 1964). Construction of the interceptor lines diverted most flows to the newly-constructed CBWTP.

The interceptor system in Portland Harbor, as of 1952, is presented on Figure 3.2-3 (City of Portland 1952a); additional work that continued through 1954 is not shown in this figure. The first unit of the interceptor sewer system (serving northeast Portland) was completed in 1947. The CBWTP and the interceptor system on the east side of the Willamette River were completed in 1952. The eastside interceptor system extended from the southern limits of the city north to the treatment plant but did not include the Rivergate area, which was outside the city limits at that time (City of Portland 1952b). Of the eastside CSO outfalls, OF-43 through OF-53 discharged to the Portland Harbor

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Study Area.[22] During construction of the interceptor system, the City separated the sewers serving most of the industrial areas near the riverfront by building separated sanitary and industrial wastewater sub-basins connected directly to the interceptor, and separated stormwater systems that discharged directly to the river.

Some of these outfalls still had a combined system upgradient of the nearshore industrial separated area that served primarily residential areas. After the interceptors were installed, some properties that formerly discharged through private outfalls directly to the river had the opportunity to connect to the City's sanitary system (either to the new sanitary system installed or directly to the interceptor).

Also during this time, the City constructed a local treatment facility to provide primary treatment (solids removal) for the two Linnton outfalls (OFs 23 and 24) that served primarily residential areas (City of Portland 1999).

By September 1955, the City had completed construction of the westside (including downtown) interceptors incorporating outfalls designated OF-1 through OF-17 (OSSA 1953, 1954a,b; 1955). Of these west side outfalls, OF-11 through OF-17[23] discharge to the Portland Harbor Study Area. Portions of the industrial area that had been connected to the combined system were connected to a separate sanitary sewer that discharged directly to the interceptor.[24] The areas with no separate storm and sanitary systems available continued to discharge to the combined system or discharged directly to the river. The interceptors and associated facilities reduced the volume of untreated sewage discharging to the Willamette from the City's combined system.

1956–1976

Once the eastside and downtown interceptors were installed, the only areas not served by City sanitary sewer system in Portland Harbor were the northwest (from Guild's Lake to Linnton), Swan Island, Mocks Bottom, and Rivergate areas (see Figures 3.2-3 and 3.2-4). The latter two areas were mostly undeveloped except for a few shoreline facilities. Conveyance systems in the northwest area were operated by private and City systems, and conveyance systems in the Swan Island area were operated by the Port of Portland.

During the time period of 1956 to1976, the City implemented a number of system changes to further reduce combined sewer discharges to the river, including programs to assure that properties connected to the City system were discharging to the appropriate pipe. The City constructed several separate sanitary and storm systems in areas that were undeveloped or were served by non-municipal combined systems. Also during

[22] OF-43 is at RM 11.4 and OF-53 is at RM 5.2

[23] OF-11 is at RM 11.4 and OF-17 is at RM 9.6

[24] Based on City as-built drawings for the interceptor and other separation projects. As-built drawings are available on the City's website: http://PortlandMaps.com

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this period, the City completed the northwest interceptor system, which separated stormwater and sanitary sewers in the northwest industrial areas and converted the Linnton neighborhood service areas to CSO areas. By 1975, the City's service area included both separated systems and CSO systems, including new separated systems in the Mocks Bottom/Swan Island and St. Johns areas to support industrial development.

Although the east side interceptor was operational by 1952, studies performed by the OSSA in 1953 identified three outfalls upstream of Portland Harbor where bypass of sewage to the river occurred during dry weather periods (Stevens & Thompson 1964). For example, Stevens & Thompson (1964) estimated as much as 17 million gallons a day (dry weather flows) discharged from diversion structures south of the Sullivan Gulch Pumping Station upstream of Portland Harbor. After completion of the eastside and downtown interceptors, the City implemented a number of efforts to further reduce discharges to Portland Harbor, including the following (City of Portland 1966b):

- Expanding existing systems
- Adding pumping stations to pick up low areas below the interceptors
- Reconstructing or adjusting diversion structures (e.g., raising dams, adjusting orifice diameters, raising or lowing weirs)
- Re-routing combination sewers to discharge above rather than below diversions, thus eliminating dry-weather (sanitary) flows from entering the river
- Where separated systems were constructed, requiring property owners to separate and reroute site sanitary and storm discharges to the appropriate system
- Requiring installation of pretreatment systems for industrial wastes
- Design of the Linnton-Guild's Lake sewerage system to provide facilities for diversion of dry weather flow for existing public sewers and to allow industry to connect to the City system, thus eliminating private industrial and sanitary outfalls to the river
- Design of a stormwater and sanitary system on Swan Island to replace the existing combined system.

In those areas where the City provided separate sanitary and stormwater systems, most properties rerouted their sanitary and stormwater discharges to the appropriate City conveyance. In 1967, the City established additional efforts to ensure compliance with the City's requirements for the separation of storm and sanitary wastes and connection to an approved sewer (City of Portland 1967a). These efforts included review of connection and plumbing records, field inspections, and dye testing to verify that property owners had appropriately rerouted their discharges within the City system. Only stormwater and uncontaminated cooling water could be discharged to the storm system, and only sanitary waste and approved industrial wastewater could be discharged to the sanitary sewer system. For example, in the fiscal year 1967-1968, 77 properties were investigated in Portland Harbor and 23 of these were required to reroute

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either their stormwater or wastewater (City of Portland 1969). By 1976, investigations and rerouting of wastewater from storm lines to the sanitary sewer was completed (City of Portland 1976).

In the 1960s, the City replaced an existing non-municipal system with a separated sanitary and storm system on Swan Island and Mocks Bottom. In 1969, the City constructed sanitary lines to the International Slip area. In 1972, the City also built a storm system in the St. Johns area to allow development to occur in a previously undeveloped area (depicted in as-built drawings on Portland Maps).

A 1964 study by Stevens & Thompson focused on the sewer systems in the Guild's Lake-Linnton area in northwest Portland and in the area served by the east side interceptor (Stevens & Thompson 1964). Eight combined sewage/stormwater collection systems were identified in the Guild's Lake-Linnton area on the west side of the Willamette River, all within the current Study Area of the Portland Harbor Superfund Site. Most of the collection systems were noted to drain areas dominated by industrial and commercial activities and discharge directly to the Willamette River. This area encompassed drainage to outfalls currently designated OF-17 through OF-24A. Stevens & Thompson also indicated that there were 12 private outfalls in this area discharging industrial wastes (several discharging only cooling water) directly to the Willamette (Stevens & Thompson 1964).

Stevens & Thompson estimated future volumes in the system to assess design parameters for the needed new diversion structures. The analysis compared the 1964 capacities for different interceptor lines/areas against population and flow projections for 1980. Stevens & Thompson determined that increased flows in the southeast and northwest sections, roughly comprising outfalls OF-11 through OF-17 (west side, in the Study Area) and OF-26 through OF-38 (east side, upstream of the Study Area), respectively, would exceed capacity of the interceptors during periods of maximum flow in the future. However, Stevens & Thompson determined that other sections of the system would be overloaded even if the volume of sewage allowed to bypass diversions in these outfalls were reduced (i.e., if more sewage was diverted to the treatment plant). Based on the results of this study, Stevens & Thompson recommended new and renovated facilities to alleviate overloading and meet the Sanitary Authority's capacity requirements (Stevens & Thompson 1964).

In 1968, the City initiated sewer projects to direct sanitary sewage discharges directly to the CBWTP, including industrial wastewater discharges that were discharging directly to the river in the Guild's Lake-Linnton area. The 1968 projects included construction of a pumping station, the Portsmouth Tunnel, which crossed under the river to the CBWTP, and the northwest interceptor. Construction was completed the following year for the tunnel, pump station, and a portion of the northwest interceptor (from Guild's Lake to the railroad bridge) (City of Portland 1968). By 1973, the northwest interceptor (from the railroad bridge to Linnton) had been completed.

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In summary, all City outfalls served by the northwest interceptor were separated, except for the two small residential combined basins in Linnton. Much of this northwest area was not previously served by City outfalls but rather discharged industrial waste directly to the river or to Doane Lake. The interceptor provided a means for industries to eliminate discharges to water bodies by routing their wastewater to the interceptor, although some industries continued to discharge to the river, including some under permits from the State.

1977–1990

During this time period, the City conducted studies to determine design parameters for future CSO controls and continued implementing programs to detect illicit connections. The City also constructed additional stormwater systems to provide storm service for areas that were being redeveloped or to improve existing drainage. The City incorporated into the municipal system some existing storm and sanitary lines in the newly annexed Rivergate area.

In 1972, the City estimated that the amount of combined sewage overflowing to the Willamette River and Columbia Slough was over 10 billion gallons per year (City of Portland 2001b).

In 1977, the CRAG undertook a study of the greater Portland area to evaluate municipal and industrial wastewater and urban stormwater, including the quality of the overflows from the City of Portland CSO system (CRAG 1977). The study provided a baseline for reevaluating Portland's CSO system. (Several of the reports cited below state different numbers of outfalls in the combined system; this most likely is due to the combination of two outfalls into one or the elimination of some outfalls during the time these reports were completed.) At the time of the CRAG study, there were 43 CSO outfalls in the City's entire Willamette River CSO system (25 on the east side and 18 on the west side), each draining a basin. Of the 43 outfalls discharging to the Willamette River, 16 discharged within the Study Area, and 27 were upstream of the Study Area up to RM 17.2. The resulting report contained descriptions of each outfall drainage basin, including acreage served, land-use type, pipe size, interceptor, diversions, and details on specific diversions, where applicable. The report also distinguished, in acreage, the type of collection system for each drainage area/outfall. Table 3.2-4 summarizes that information (CRAG 1977).

The CRAG study calculated the average annual runoff of suspended solids, settleable solids, biological oxygen demand (BOD), ammonia, phosphorus, and bacteria from CSOs in the City's entire CSO system, based on historical rainfall data. The study area focused on municipal outfalls discharging to the Willamette River that were within the City of Portland's boundary, and provided discharge estimates for 1975 and projected land use and conditions for the year 2000. Table 3.2-5 lists the 1975 results for suspended solids from the lowest downstream location to the highest upstream location measured.

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In 1986 the City issued a Sewer Outfall Report, the purpose of which was to gather information to design future pollution abatement programs (City of Portland 1986). In the 1986 report, the City stated that the CSO system included 57 CSO outfalls, with 44 of the CSOs discharging to the Willamette River (16 of which were in the Portland Harbor Study Area), and 13 discharging to the Columbia Slough (City of Portland 1986). An outfall inspections program was instituted to include observations of the outfalls during the dry season to identify the condition of the outfall and to determine if the dry weather flow had any sanitary component. Dry weather flows could include groundwater infiltration, permitted and non-permitted process water (such as cooling water discharges and landscape irrigation), or illicit connections of sanitary discharges downstream of diversions. These dry weather flows were, and continue to be, analyzed for bacteria to determine if there is any sanitary contribution, and flow volumes are estimated where dry weather flows were evident (City of Portland 1986).

1990 – Present

Sanitary interceptor lines run south to north through the main trunk lines, paralleling the riverbanks. Interceptors are large lines that collect sanitary and combined flows and direct them to the treatment plant. Some combined lines have diverters that allow excess flow to discharge to the lower Willamette River during heavy storms for a portion of the rainfall event; this is called a CSO. The diverters are designed to protect the interceptor from excess stormwater inflow by diverting the peak portions of the flow. Combined systems without CSO diverters direct all sanitary and stormwater flow to the treatment plant.

In 1991 the City began to further reduce the CSO events to the Willamette from about 100 events per year to four events per year in winter and one event every three summers by 2011 (City of Portland 2001b). Gene, hard to say if the Port will have problems with this deletion/

In 1994, it was estimated that the CSO system discharged an average of 4.8 billion gallons of stormwater (~80 percent) and untreated sewage and pretreated industrial waste (~20 percent) to the river between RM 4 and 17 (CH2M Hill 1994). The discharges occurred through 42 outfalls to the Willamette River, some of which overflowed nearly every time it rained (150 days), while others only overflowed 30 days per year (City of Portland 2001b). The City estimated an average of 50 CSO events (encompassing up to a total of 112 days) per year in the entire CSO system (City of Portland 1998).

Around this same time, it was determined that dry weather discharges of untreated sewage (including pretreated industrial wastewater discharges) were also still occurring in some portions of the City system due to periodic failure of the system to function properly, vandalism, illicit discharges, blockages caused by a variety of sources, and groundwater infiltration, which resulted in the discharge of untreated sanitary sewage through CSO outfalls directly to the Willamette River. These dry weather discharges

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involved relatively small volumes and are different than wet weather CSO events, which occur when the combined sanitary sewage and stormwater flows exceed the system's capacity during rain events. The City completed improvements to the CSO system between 1992 and 1996, and signed a SFO with DEQ in 1996 in which it agreed to eliminate the dry weather discharges by [insert date] (DEQ 1996).

In 1994, the City prepared a CSO Management Plan with recommendations to address wet weather overflow discharges, including the following:

- Implementation of "Cornerstone Projects" focused on reducing the volume of stormwater to the system;
- Implementation of storage and treatment facilities to eliminate the CSO discharges to the Columbia Slough as required in the SFO; and
- Implementation of storage and treatment facilities along the Willamette River ("Big Pipe project") to control the CSO discharges as required by the ASFO.

The City completed for the 20-year project in 2011 (City of Portland 2008a). As described in Table 3.2-3, the CSO abatement projects include one or more of the following for each outfall:

- Completely separating storm and sanitary to create stormwater-only outfalls with stormwater treatment prior to discharge, where possible;
- Completely sealing and abandoning outfalls or diversions to prevent overflows;
- Reducing stormwater flows to the CSO system to minimize flow through the system during a storm event, such that the system meets the AFSO standard; and
- Increasing the storage capacity for the CSO system to reduce the frequency of overflows to meet the AFSO standard.

The primary means for increasing the storage capacity was through construction of the West Side Tunnel (completed in 2006) and the East Side Tunnel completed in 2011). The also controled 16 CSO outfalls by 2006 and all remaining CSO outfalls by 2011. The goal of the abatement projects was to meet the design standard to control CSO discharges to an average of four events in the winter (November 1 to April 30) and one event in three summers (May 1 to October 31; City of Portland 2005a). Since completion of the West Side CSO Tunnel Project in 2006 there have been three winter seasons and a total of five events for all Willamette River outfalls that were controlled by 2006—fewer than an average of two events per winter since completion of construction of the West Side tunnel. The overflow points in the Study Area were outfalls OF-11 and OF-47.

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The abatement projects, including the West Side Tunnel and the final selected design for the East Side Tunnel, are projected to meet the current CSO system demands and design standard by 2011 and continue through the year 2025. This projection is based on the assumption that other City programs will continue to implement mitigation measures to reduce stormwater flow to the overall CSO system by initiating additional projects (e.g., infiltration basins, green roofs, and other such stormwater reduction measures). The City has noted that additional efforts would be required to control CSO demands beyond 2025 (City of Portland 2005a). The configuration and dates of the abatement project for the separate and combined sewer systems is shown on Figure 3.2-2.

The location and status of CSO outfalls, including a summary of abatements completed and planned within the Study Area (City of Portland 2008a), is provided in the Table 3.2-3 and shown in Map 3.2-23a–m.

Table 3.2-3 also identifies whether storm water from a fully separated CSOs (i.e., where sanitary waste water is sent to the CBWTP and storm water is discharged to the lower Willamette River) was diverted to a different outfall or still utilizes the form CSO outfall; whether a partially separated CSO system conveys the combined sanitary and industrial wastewater and significantly reduced stormwater to the CBWTP except during extreme wet weather events when a portion of the combined flow overflows to the Willamette River due to capacity limitations; and shows the combined or CSO outfalls that were abandoned before the City's 20-year abatement program was initiated.

Private Conveyance Systems

As described in Section 3.2.2, most historical industrial development occurred along the shoreline. At least through the 1960s, very few shoreline facilities were connected to the municipal systems; nearly all managed their own stormwater and wastewater. Most of these discharges were combined (i.e., included stormwater and sanitary and/or industrial wastewater) (OSSA 1950; DOT 1967; Stevens & Thompson 1964). Figure 3.2-4 shows the areas not served by the interceptors in 1963; these areas were predominantly shoreline properties (OSSA 1963). Many of the non-municipal conveyance systems served a single property, but there were several larger shared conveyance systems noted in historical reports such as the Oregon Terminals (currently International Slip) (OSSA 1963) and Swan Island (CH2M Hill 1957).

The Rivergate area was undeveloped until about the 1960s. Separate sanitary and storm systems were installed by the Port of Portland to provide conveyance services to this developing area. The Rivergate area was annexed into the City of Portland beginning in 1979 and was completed in 1989, and some of these conveyance systems were transferred to the City after annexation.

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The Oregon State Sanitary Authority conducted several surveys of industrial dischargers in the Harbor (OSSA 1963, 1966) and beginning in 1967, required waste permit applications to be submitted by dischargers (OSSA 1967a). Additional information about the State discharge permits is provided in Section 4.3.1.4.

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National Pollutant Discharge Elimination System (NPDES) Permits

The Clean Water Act prohibits anybody from discharging "pollutants" through a "point source" into a "water of the United States" unless they have an NPDES permit. The permit will contain limits on what you can discharge, monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality or people's health. In essence, the permit translates general requirements of the Clean Water Act into specific provisions tailored to the operations of each person discharging pollutants.

The National Pollutant Discharge Elimination System (NPDES) Stormwater Program, which commenced in 1992, regulates stormwater discharges from three potential sources: municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. Most stormwater discharges are considered point sources, and operators of these sources may be required to receive an NPDES permit before they can discharge. The State of Oregon is authorized by EPA Region 10 to implement the NPDES Stormwater Program and administer their own stormwater permitting programs.

Current discharges to the lower Willamette River within the Study Area are regulated by a variety of NPDES permits, including multiple general NPDES stormwater permits (e.g., 1200-Z, 1200-C); the City of Portland, Port of Portland, and Multnomah County Municipal Separate Storm Sewer System (MS4) NPDES discharge permits; the City of Portland NPDES wastewater discharge permit (primarily for the discharge from the CBWTP to the Columbia River, but also including combined sewer overflows and sewer system overflows into the lower Willamette River); individual stormwater NPDES permits; and individual wastewater NPDES discharge permits. The Oregon Department of Transportation (ODOT) also has its own MS4 NPDES discharge permit for runoff from state highways. These permits are described further in Section 4.4.1.4. Many stormwater discharges are not regulated through MS4 or NPDES permits.

Federal Navigational Channel

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Congress authorized the lower Willamette River as a federal navigation project through the Rivers and Harbors Act in June 1878. Its purpose was to deepen and maintain parts of the Columbia and Willamette rivers to a 20-ft minimum depth. The USACE maintains the channel for both rivers, both of which have been deepened at various intervals since that time. Most significantly, the authorizations affecting the lower Willamette River depth occurred as follows: –25 ft CRD in 1899, –30 ft CRD in 1912, –35 ft CRD between 1930 and 1935, and, finally, –40 ft CRD in 1962.

The current project authorization, as modified by Congress in 1962, encompasses 11.7 miles of the Willamette River in Portland and 103.5 miles of the Columbia River below Vancouver, Washington. Work on the authorized –40-ft-deep CRD channel from Portland and Vancouver to the Pacific was completed in 1976. The Willamette River channel from the Broadway Bridge (RM 11.7) to the mouth (RM 0) varies in width from 600 to 1,900 ft, with an average width of approximately 1,700 ft.

In 1999, Congress authorized the Willamette River (and Columbia River) deepening to –43 ft CRD. The existing 600-ft-wide, 40-ft-deep Willamette River navigation project channel would be deepened from RM 0 to RM 11.6 (USACE 1999a).

Dredging and Capping Activities

This section presents Portland Harbor dredging and capping activities since 1997. This date corresponds to the oldest data used in the presentation and evaluation of analytical data in this report. This section also notes ongoing and upcoming dredging projects in Portland Harbor.

In certain areas of Portland Harbor, periodic dredging is necessary to maintain the authorized depth of the navigation channel, as well as to maintain operational depths at docks and wharfs. Major changes in the river's bathymetry from 1888 to 2001 are depicted on Map 3.1-6. This map shows how the original shoreline was altered and filled, where material was excavated to create new uplands, and how most of the original channel has been deepened by at least 10 to 20 ft to reach the authorized federal navigation channel depth of –40 ft CRD. Historically, periodic dredging was needed to maintain this depth in two major shoaling areas, between RM 8 and 10, particularly in the western half of the channel, and from RM 2 to 2.5 in the eastern portion of the channel. The navigation channel has not been dredged since January 1997, although dredging at various docking facilities has occurred on an as-needed basis (Map 3.2-24).

Currently, maintenance dredging has been suspended until issues are resolved regarding dredging within the boundaries of the Portland Harbor Superfund Site. The lack of maintenance dredging over the past 10 years has resulted in significant shoaling of the channel. Many areas of the channel are now less than 40 ft deep, which is a significant navigation hazard to large cargo ships that require a minimum draft of 40 ft. A critical area of shoaling in the river that needs immediate attention is Post Office Bar at RM 2. According to the USACE (2010a), this dredging is proposed to take place in the summer of 2011.

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Dredging projects undertaken since 1997 by the Port of Portland, USACE, the City of Portland, and private parties are listed in Table 3.2-6. This table is an update of a similar compilation provided in the Programmatic Work Plan (Integral et al. 2004) and the Round 2 Report. The dredging projects that are italicized in the table indicate recent projects for which a USACE public notice has been issued, but specific information about dredging dates and amounts was not available in time for this report. Note that the issuance of a permit does not mean that the project was implemented or that the volume of dredged material indicated in the table was dredged. Furthermore, the table does not distinguish between single events and multi-year permits. Map 3.2-24 shows the locations of dredging and capping operations between RM 1 and 11.8, since the most recent USACE-sponsored dredging of the federal navigation channel in January 1997.

Since 1997, the Port of Portland has performed maintenance dredging at its marine Terminals 2, 4, and 5 (see Table 3.2-6). Maintenance dredging has also been performed by Schnitzer Steel Industries, Inc. (Schnitzer berths in International Terminal Slip, RM 4), Chevron (Willbridge Terminal, RM 7.5), the City of Portland (Portland Fire Bureau Station 6 Dock, RM 9.7), the former Goldendale Aluminum Company (Goldendale Aluminum facility dock, RM 10), and CDL Pacific Grain (Irving Elevator Terminal, RM 11.4). The City of Portland project also included cap placement, as noted below. Brief descriptions of these dredging projects are provided below:

- Schnitzer performed maintenance dredging of its berths located inside the International Terminal Slip in 2004 under two separate permits. Approximately 77,000 yd^3 of material was dredged from Berths 1, 2, and 3 under Permit #199100099. Maximum target dredge depths were –42, –38, or –24 ft CRD, depending on the location within the slip. Outside the slip, Schnitzer dredged approximately 61,000 yd^3 of material from Berths 4 (to –42 ft CRD) and 5 (to –36 ft CRD) under Permit #199200812. The permits for both projects allow for biannual maintenance dredging through January 31, 2009 (USACE 2004a,b).
- In 2001, Chevron Products removed approximately 15,000 yd^3 of material from both sides of its pier at Willbridge Terminal. The dredging was performed under a maintenance dredging permit issued in 1997. Sediments were removed to a target dredge depth of –40 ft CRD (PNG 2001).
- The former Goldendale Aluminum Company conducted maintenance dredging at its dock in 2000. Dredging volumes were not provided, but material was removed to –38 ft CRD (CH2M Hill 2000).
- The City of Portland performed maintenance dredging of the Portland Fire Bureau Station 6 Dock in 2005. The area approaching the dock was dredged to –12 ft CRD, and the area adjacent to the dock was dredged to –10 ft CRD. Altogether, 4,130 yd^3 of dredged material was removed. In accordance with the permit, both areas were capped to bring the bottom grade to between –10 and

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–11 ft CRD. Approximately 1,190 yd^3 of capping material was used (CH2M Hill 2005).

- CDL Pacific Grain performed maintenance dredging at two separate locations at the Irving Elevator Terminal in 2009. The dredge volume was approximately 1,430 yd^3 (NRC 2009). In 2001, approximately 5,000 yd^3 was removed to a permitted depth of –40 ft CRD (Harding ESE 2001).
- The dock area offshore of Glacier NW (RM 11.3E) was dredged in 2004, but no as-built drawings are available to determine the volume removed and the exact footprint.
- As part of the Terminal 4 Early Action removal, approximately 13,000 yd^3 of contaminated sediments were dredged from Slip 3 in 2008 (discussed further below).

Maintenance dredging is planned for the dock areas offshore of Gunderson, the Portland Shipyard (Cascade General), and at ConocoPhillips and Chevron properties in the Willbridge Terminal complex.

Dredging and/or capping have also been completed or are in process as part of remedial actions at selected Portland Harbor locations. Interim removal action activities at Terminal 4 are underway and are scheduled to occur in two phases. The first phase, which was completed in the fall of 2008, included dredging of approximately 13,000 yd^3 of contaminated sediment and placement in an offsite disposal facility, isolating contaminated sediment in the back of Slip 3 with a cap made of an organoclay-sand mix, and re-contouring the slope of the bank along Wheeler Bay and planting native vegetation to minimize erosion and improve stability. The second phase of the Terminal 4 project includes a combination of dredging, capping, and monitored natural recovery (MNR) in areas not completely addressed by the first phase, as well as construction of a confined disposal facility in Slip 1. The second phase design and implementation of the Terminal 4 removal action will be implemented after the Portland Harbor Record of Decision (Port of Portland 2011).

At the ARCO BP terminal, a new steel sheetpile wall was installed in 2007 to stabilize the facility and prevent migration of contaminants to the river. The following year, the concrete revetment riverward of the new sheetpile wall was removed, along with 13,293 yd^3 of underlying and nearshore contaminated sediment, which was disposed of offsite. Clean fill was placed in the excavated area (DEQ 2010a).

Two in-river sediment capping projects (M&B and Gasco) have taken place since 2003. M&B was a remedial action project following a CERCLA Record of ODecision, and Gasco was an interim removal action. Both projects are described below.

Sediment cap construction activities at McCormick and Baxter, a former wood treating facility, were completed in September 2005. (Subsequent modifications to the cap were performed in October 2005 and July 2007.) The cap's shoreward boundary extends

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from the south end of the property north into Willamette Cove (RM 6.8). Its offshore boundary extends up to approximately 700 ft from the shoreline. In Willamette Cove, the cap extends offshore up to approximately 600 ft. Approximately 23 acres of contaminated sediments were capped with 2 ft of sand. More highly contaminated areas were capped with 5 ft of sand. In addition, multiple areas of the cap overlying seeps were constructed with a total of 600 tons of organoclay, a bentonite or hectorite clay altered to be hydrophobic. The cap design incorporated different types of armoring (i.e., articulating concrete block mats and rock) in the nearshore areas to reduce erosion (DEQ 2005).

In 2005, pursuant to an EPA Administrative Order, approximately 15,300 yd^3 of tar and tar-contaminated sediment were removed by dredging from the riverbank and nearshore area adjacent to the Gasco facility and disposed of at the Chemical Waste Management landfill in Arlington, Oregon. After the removal action, an organoclay mat was placed along an upper-elevation band of the shoreline dredge-cut. This mat was secured with placement of cap sand and quarry spalls over the clay mat. The remainder of the removal area (0.4 acres) received 1 ft of cap sand and 0.5 ft of erosion protection gravel. In addition, 2.3 acres of the area surrounding the removal area received 0.5 ft of "fringe cap" sand material. The removal action also created a depression into which potential seepage could be captured and localized for future response. Construction activities took place between August and October 2005 (Parametrix 2006).

3.2.3.2 Cultural Resources

3.2.3.3 Recreational

The lower Willamette River provides many natural areas and recreational opportunities, both within the river itself and along the riverbanks. The Oregon State Administrative Rules, OAR 340-041-0340, Table 340A, the designated beneficial use of the lower Willamette River includes hunting, fishing, boating, and water contact recreation. Adults and children use the lower Willamette River for boating, water skiing, swimming, and other water activities. Recreational fishing is conducted throughout the lower Willamette River basin and within the Study Area, both by boaters and from locations along the banks.

Within the Study Area, Cathedral Park, located under the St. Johns Bridge, includes a sandy beach area and a public boat ramp and is used for water skiing, occasional swimming, and waterfront recreation. Recreational beach use also may occur within Willamette Cove, which is a riverfront natural area; in Swan Island Lagoon; and on the southern end of Sauvie Island, which is within the Study Area. Swan Island Lagoon

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includes a public boat ramp. Additional recreational beach areas exist on the northern end of Sauvie Island and in Kelley Point Park, both of which are downstream of the Study Area. Willamette Cove is currently used by transients and recreational beach users that approach the area by uplands access or by boat, but is planned to be turned into an open greenspace that will serve as an extension of the Willamette River Greenway. Potential human use beach areas in the Study Area are shown in Map 3.2-25.

3.2.3.4 Transients

Transients have been observed along the lower Willamette River, including some locations within the Study Area. The observation of tents and makeshift dwellings during RI sampling events confirms that transients were present along some riverbank areas. Transients are expected to intermittently utilize this area in the future. Transients may be using the lower Willamette River as a source of drinking water. Conversations were conducted with transients about their consumption of fish or shellfish from the Willamette River as part of a project by the Linnton Community Center (Wagner 2004, pers. comm.). The transients that were contacted reported harvesting and consuming various fish species as well as crayfish, mussels, and clams. It should be noted that the most common clam species in the Portland Harbor is an invasive species, the harvesting of which is illegal. Many of the individuals indicated that they were in the area temporarily, move from location to location frequently, or have variable diets based on what is easily available. However, the interviews did not quantify the frequency or duration of transient presence along the shoreline.

3.2.3.5 Diving

Diving activity also occurs in the lower Willamette River. In the Study Area, the majority of divers are expected to be commercial divers. Some diving for scientific purposes, including some aspects of site characterization for this RI, has occurred in the Study Area. Diving is done by several groups of people including: the public for recreation and gathering of biota for consumption; the sheriff's office for investigations and emergency activities; and, commercial divers for a variety of purposes, including marine construction, underwater inspections, routine operation and maintenance, and activities related to environmental work.

3.2.3.6 Commercial Fishery

The Oregon State Administrative Rules, OAR 340-041-0340, Table 340A, includes fishing as a designated beneficial use of the lower Willamette River. The exact extent to which commercial fishing occurs within the Study Area is currently not known. No reports of commercial fisheries for anadromous salmonids on the Willamette River have been found. A commercial crayfish fishery exists in the lower Willamette River.

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Crayfish landings must be reported to ODFW by water body and county. Per ODFW, the crayfish fishery is not considered a large fishery (Grooms 2008, pers. comm.). Based on ODFW's data for 2005–2007, no commercial crayfish landings were reported for the Willamette River in Multnomah County.

3.2.3.7 Drinking Water

Under Oregon State Administrative Rules, OAR 340-041-0340, Table 340A, the designated beneficial use of the lower Willamette River includes private and public domestic water supply after adequate pretreatment to meet drinking water standards. There are no known current or anticipated future uses of the lower Willamette River within Portland Harbor as a private or public domestic water supply. According to the City of Portland, the primary public domestic water source for the City of Portland is the Bull Run watershed, which is supplemented by a groundwater supply from the Columbia South Shore Well Field (City of Portland 2008a). In addition, the Willamette River was determined not to be a viable water source for future City of Portland water demands through 2030 (City of Portland 2008a). Upstream of Portland Harbor, the City of Wilsonville does use the lower Willamette River as a domestic water source following treatment.

3.2.3.8 Residential

Residential areas in the Study Area include the neighborhood districts of Linnton, Northwest, Pearl, Old Town, Overlook, University Park, Cathedral Park, Eloit, and Lloyd. Several of these communities have been established for decades, although the Pearl District is a recent name for a former warehouse and industrial area just north of downtown where many of the warehouses have been converted into lofts, and new multistory condominiums have also been developed on previously vacant land. Most of the residential areas in the study area are not located in the riparian zone adjacent to the river, with the exception of homes on Sauvie Island and some condominiums in the Pearl District.

3.2.3.9 Restoration

There have not been any restoration projects within the Portland Harbor Study Area, although there has been some planning for a restoration project at Alder Point at the former Alder Creek Lumber site on the southern tip of Sauvie Island. Despite the area's urbanization, the combination of existing stream channel and open space provide greater opportunity for watershed rehabilitation on the Willamette's west side.

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PORTLAND HARBOR RI/FS

APPENDIX LA

SEDIMENT TRANSPORT MODELING

DRAFT FEASIBILITY STUDY

DRAFT

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March 30, 2012

Prepared for
The Lower Willamette Group

Prepared by
Anchor QEA, LLC

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LIST OF ACRONYMS

µm	micrometer
2D	Two-dimensional
3D	Three-dimensional
ADCP	Acoustic Doppler Current Profiler
AEP	Annual Exceedance Probability
cfs	cubic feet per second
cm	centimeter
cm/yr	centimeter per year
DEA	David Evans and Associates
EFDC	Environmental Fluid Dynamics Code
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
g	gram
GSD	Grain Size Distribution
IACWD	Interagency Advisory Committee on Water Data
m	meter
m/day	meters per day
mg/L	milligrams per liter
MT/yr	Metric Tons per year
MVUE	Minimum Variance Unbiased Estimator
NOAA	National Oceanic and Atmospheric Administration
NSR	Net Sedimentation Rate
Pa	Pascal
RM	River Mile
Site	Portland Harbor Superfund Site
TOC	Total Organic Carbon
TSS	Total Suspended Sediment
USGS	U.S. Geological Survey
WSE	Water Surface Elevation

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EXECUTIVE SUMMARY

Appendix La presents the development and calibration of hydrodynamic and sediment transport models of the Lower Willamette River. These models provide transport and sediment flux information that are used as inputs for the chemical fate and transport model presented in Appendix Ha. The model domain includes the Lower Willamette River, Multnomah Channel, and a portion of the Columbia River, with the primary focus being on the Site, from river mile [RM] 1.9 to RM 11.8. A large of amount of Site-specific data was used to define system geometry, initial conditions, boundary conditions, bed properties and parameters used as input to the hydrodynamic and sediment transport models. Both of the models were successfully calibrated, with the sediment transport model using bed elevation change data collected during a multi-year period to evaluate model performance over a wide range of spatial scales. A sensitivity analysis was conducted to evaluate the effects of uncertainty in various model inputs on the predictive capability of the sediment transport model. The calibrated model was used to simulate a high-flow event (i.e., January 1996 flood) and a 45-year period.

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1.0 INTRODUCTION

1.1 STUDY OBJECTIVES

This report details the development of a hydrodynamic and sediment transport model of the Lower Willamette River downstream of River Mile (RM) 13 to the confluence with the Columbia River. The model was developed to support the draft Feasibility Study (FS) for the Portland Harbor Superfund Site (Site). The sediment transport model results were used as follows:

- As inputs for the contaminant fate and transport model of the system, which in turn was used to evaluate the current situation and potential remedial alternatives detailed in the main section of this report including the propensity for natural recovery of the system
- To understand the draft FS level designs for cap armoring to protect against current driven erosion (Appendix Hc)
- To evaluate the potential for erosion of buried contamination (see main text, Section 5.7)

1.2 OVERVIEW OF TECHNICAL APPROACH

The original version of the Lower Willamette River hydrodynamic model, developed and calibrated by WEST Consultants and TetraTech between 2004 and 2009, was used as a base for the hydrodynamic model presented in this report. Descriptions of the original hydrodynamic model are presented in WEST Consultants (2004, 2005a, 2005b, 2006) and WEST Consultants and TetraTech (2009). Some of the input parameters for the hydrodynamic model were refined, and the model was re-calibrated during this phase of the modeling study. The sediment transport model is based on the same framework as the hydrodynamic model (i.e., Environmental Fluid Dynamics Code [EFDC]) but was modified by Anchor QEA to incorporate the SEDZLJ algorithm for transport of cohesive and non-cohesive sediment. SEDZLJ is a sediment transport algorithm developed by Anchor QEA personnel over the course of more than 20 years of modeling practice.

The sediment transport model was calibrated using bathymetric data collected within the Study Area (RM 1.9 to 11.8) over a 7-year period between 2002 and 2008. The calibrated model was used to simulate high-flow events to analyze scour potential and also evaluate the potential for natural recovery over multi-year periods (i.e., 45 years). Uncertainty in the model results was analyzed through application of a sensitivity analysis.

This appendix is organized as follows. Section 2 includes a description of refinements to the hydrodynamic model, sediment transport model theory, and a description of model inputs and boundary conditions. In addition, it contains the model calibration procedure and a sensitivity analysis. Section 3 presents an analysis of bed stability during the high-

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flow event that occurred during the winter of 1996. This section also includes the results of a 45-year simulation. The results of the multi-year simulation were used to analyze the potential for natural recovery within different sections of the river, as described in Appendix Ha.

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2.0 MODEL DEVELOPMENT AND CALIBRATION

2.1 GENERAL DESCRIPTION OF MODELING FRAMEWORK

The mathematical modeling framework that was applied to the Lower Willamette River consists of hydrodynamic and sediment transport models that are linked together. The hydrodynamic model accounts for the effects of the following factors on water movement in the Lower Willamette River: freshwater inflow from the surrounding watershed, flow in the Columbia River, and tides. The hydrodynamic model is used to simulate temporal and spatial changes in water depth, current velocity, and bed shear stress. This information is transferred from the hydrodynamic model to the sediment transport model, where it is used to simulate the erosion, deposition, and transport of sediment in the Lower Willamette River. The sediment transport model is used to simulate temporal and spatial changes in suspended sediment concentrations in the water column, bed elevation changes (i.e., bed scour depth and net sedimentation rate [NSR]), and changes in sediment bed composition (i.e., relative amounts of clay, silt, and sand from different sources).

The modeling framework provides a deterministic approach for simulating sediment transport within the Lower Willamette River. The sediment transport model simulates the movement of sediment by suspended load (i.e., primarily clay, silt, and fine sand). Bedload transport of sediment (i.e., near-bed movement of coarse sand and gravel) is not simulated in this study because this mode of sediment transport is minimal within the Lower Willamette River. About 80 percent of the bed area in the Study Area is comprised of a cohesive (muddy) bed, and bedload transport is negligible within a cohesive bed. In addition, no formulations are available from the peer-reviewed literature for simulating bedload transport over a cohesive bed. Within the non-cohesive bed areas (i.e., about 20 percent of the Study Area), successful calibration of the model using bed elevation data demonstrates that the assumption of minimal bedload transport is valid.

The hydrodynamic and sediment transport models are constrained by governing equations that are based on the conservation of mass and momentum. Mechanistic formulations and algorithms are used in the sediment transport model to simulate deposition and erosion of cohesive and non-cohesive sediment. The formulations and algorithms used to simulate deposition and erosion are based on empirical information and data from a wide range of laboratory and field studies (see Section 2.3.2 for a discussion of the theory and equations used in the sediment transport model). In addition, site-specific data are used to determine various parameters used in the sediment transport model, which provides additional constraints on the model.

2.2 DEVELOPMENT AND CALIBRATION OF HYDRODYNAMIC MODEL

2.2.1 General Description

The hydrodynamic model that was applied in this study is EFDC, which is supported by the U.S. Environmental Protection Agency (EPA). EFDC is a three-dimensional (3D)

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hydrodynamic model capable of simulating time-variable flow in rivers, lakes, reservoirs, estuaries, and coastal areas. For this study, the two-dimensional (2D), depth-averaged hydrodynamic model within EFDC was used. The Lower Willamette River is a freshwater river so only vertical gradients in temperature can generate density-driven circulation. Continuous temperature measurements in 2001 and 2002 (Berger et al. 2004) show minimal vertical temperature gradients, which indicates that density-driven circulation in the river is negligible. Thus, use of a 2D, depth-averaged model is valid for the Lower Willamette River because the effects of density-driven circulation are minimal.

EFDC solves the conservation of mass and momentum equations, which are the fundamental equations governing the movement of water in a freshwater tidal river. The model has been applied to a wide range of environmental studies in large number of rivers, estuaries, and coastal ocean areas. A complete description of the model is given in Hamrick (1992).

2.2.2 Numerical Grid and Geometry

A curvilinear, boundary-fitted numerical grid was used to represent the geometry of the Study Area, with a total of 3,355 grid cells. Figure 2-1 presents the grid extent and the location of the Study Area and the boundary conditions. Cross-sectional variations in bathymetry within the Lower Willamette River are delineated using a range of 5 to 43 grid cells in the cross-channel direction depending on the river width. The upstream boundary of the numerical grid in the Lower Willamette River is located at RM 24. The downstream boundary of the numerical grid extends into the Columbia River so that hydrodynamic interactions between Columbia River and Lower Willamette River are realistically simulated. A one-dimensional grid (i.e., one grid cell-wide) is used in the Multnomah Channel, which extends to the confluence with the Columbia River near St. Helens, Oregon. Spatial variations in bathymetry (i.e., sediment bed elevation) within the Lower Willamette River were specified for input to the model using bathymetry collected during January 2002 (DEA 2002). Figure 2-2 presents the bathymetry projected on the model grid for the Study Area.

2.2.3 Hydrodynamic Model Inputs: Boundary Conditions and Bottom Roughness

The hydrodynamic model requires specification of the following time-variable boundary conditions: 1) inflow at upstream boundary in the Lower Willamette River; 2) inflow at upstream boundary in the Columbia River; 3) water surface elevation (WSE) at downstream boundary in the Columbia River; and 4) WSE at downstream boundary of the Multnomah Channel. Daily-average flow rate data collected at the U.S. Geological Survey (USGS) Portland gauging station were used to specify the inflow at the upstream boundary in the Lower Willamette River for the calibration and long-term simulations. Inflows at the upstream boundary during high-flow events were specified based on the results of a flood frequency analysis. A Log-Pearson Type 3 flood frequency analysis (Helsel and Hirsch 2002) of peak flow rate data from the 36-year historical record was

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conducted. The Log-Pearson Type 3 analysis is the recommended technique for flood frequency analysis (IACWD 1982). The analysis was conducted as follows:

- Instantaneous peak flow data collected between 1972 and 2007 were used.
- The logarithm of each peak discharge during the 36-year period was calculated.
- For the logarithms of peak discharge, these statistics were calculated: mean (M), standard deviation (S), and skewness (g).
- The peak discharge (Q_p) for a specific annual exceedance probability (AEP) was calculated using:

$$\log(Q_p) = M + KS \tag{2-1}$$

Where,

$\log(Q_p)$ = the logarithm of the peak discharge with an AEP of one in Y years and K is the frequency factor for a specific AEP as a function of skewness (g).

Tabulated values of K are presented in Helsel and Hisrch (2002). For example, AEP values of 10 percent and 1 percent correspond to high-flow events with return periods of 10 and 100 years, respectively. The analysis indicates that a 100-year flood has a flow rate of approximately 360,000 cubic feet per second (cfs). A summary of the estimated flow rates for high-flow events is presented in Table 2-1. For comparison, the annual average flow rate is 33,200 cfs.

Table 2-1. Estimated Lower Willamette River Flow Rates for High-flow Events

Flood Return Period (Years)	Flow Rate (cfs)
2	156,000
10	252,000
25	297,000
50	329,000
100	360,000
500	428,000

Notes:
cfs = cubic feet per second

The original hydrodynamic model specified time-variable WSE at the upstream and downstream boundaries in the Columbia River (WEST Consultants and TetraTech 2009). Initial evaluation of the original model indicated that this approach produced unrealistic circulation patterns in the Columbia River (Figure 2-3). This problem was resolved by specifying flow rate and WSE at the upstream and downstream boundaries in the Columbia River, respectively (Figure 2-4). The closest flow gauge at the upstream boundary of the Columbia River was the USGS gauge at Vancouver, Washington. However, flow rate data at this station were only available for the 4-year period between

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October 1965 and September 1969. The next closest USGS gauging station along the Columbia River is located 80 miles upstream at The Dalles, Oregon, where data have been collected since 1878. A correlation between measured flow rates at Vancouver and The Dalles was used to demonstrate that the flow rate at Vancouver can be estimated by adding 13,200 cfs to the flow rate at The Dalles. Thus, a long-term flow record at Vancouver was constructed using the flow rate data collected at The Dalles.

The specification of WSE at the downstream boundary in the Columbia River, and also in the Multnomah Channel, was not changed from the original hydrodynamic model. This boundary was defined using data collected at the National Oceanic and Atmospheric Administration (NOAA) tidal gauging station in St. Helens, Oregon. Boundary condition information (i.e., flow rates in Lower Willamette and Columbia Rivers, WSE at St. Helens) used for the 7-year period (2002 through 2008) to calibrate the sediment transport model is shown on Figure 2-5.

Model input files provided by WEST Consultants indicated that the original version of the model used spatially variable effective bed roughness (i.e., Z_0), as shown in Figure 2-6. In the original version of the model, the effective bed roughness was dependent on Manning's roughness coefficient and water depth using the following relationship (based on Equation 4.1 in WEST Consultants 2006):

$$Z_0 = \frac{H}{2.0\exp\left(\frac{\kappa}{\sqrt{gn^2/H^{1/3}}}\right)} \qquad (2\text{-}2)$$

Where,

Z_0 = effective bed roughness
H = water depth
n = Manning's roughness coefficient
κ = von Karman's constant.

An evaluation of hydrodynamic model predictions based on spatially variable of Z_0, as calculated using Equation 2-2, indicated that this methodology yielded unrealistic results. Thus, the original model was revised and a spatially constant effective bed roughness was used in the hydrodynamic model. This method is consistent with the approach used in many other hydrodynamic modeling studies (e.g., Blumberg and Mellor 1987). The effective bed roughness (Z_0) was adjusted during calibration of the hydrodynamic model, see Section 2.2.4.

2.2.4 Hydrodynamic Model Calibration Approach and Results

Calibration of the hydrodynamic model was achieved using data collected with an Acoustic Doppler Current Profiler (ADCP) in the main channel of the Lower Willamette River between RM 1 and 11. The ADCP data consisted of measurements of water depth, depth-averaged current velocity (magnitude and direction) during three different periods

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between 2002 and 2004. A summary of the three ADCP deployment periods is provided in Table 2-2. Two of the survey periods in 2002 and 2003 were conducted at or above mean flow rate (26,000 to 66,000 cfs). The survey conducted in January 2004 was conducted during an approximate 2-year flood event. Sixteen locations were surveyed between RM 1 and RM 11 during the 2002 and 2004 periods. In 2003, only four transects were surveyed near the confluence with the Multnomah Channel. At each location, the survey was made perpendicular to the river flow.

Table 2-2. ADCP Data Collection Summary

Survey Date	Lower Willamette River Flow Rate (cfs)	Survey Region	Number of Transects
April 19, 2002	66,000	RM 1 – 11	16
May 13, 2003	26,000	RM 2.5 – 4	4
January 31, 2004	139,000	RM 1 – 11	16

Notes:
cfs = cubic feet per second
RM = river mile

The model parameter that was adjusted to achieve the optimum agreement between predicted and observed water depth and current velocity was the effective bed roughness (Z_0) in the hydrodynamic model, which represents the total roughness due to form drag and skin friction. Generally, Z_0 ranges from about 0.1 to 10 centimeters (cm). A value of 1 cm for effective bed roughness produced the best agreement between observed and predicted water depth and depth-averaged current velocity during the calibration period. Figures 2-7 through 2-12 show examples of the model-data comparisons at three locations: RM 10, RM 6, and RM 3. These figures show that the model adequately predicts current velocity over a wide range of flow rates. A comparison of predicted and measured WSE at the USGS Portland gauging station during 2008 is presented in Figure 2-13. Model predictions of WSE are in good agreement with measured values during low-flow condition, but the model tends to underpredict WSE during high-flow conditions. The underprediction during high-flow conditions is primarily due to specification of WSE at the downstream boundary using the data collected at the St. Helens gauging station. The underprediction of WSE during high-flow conditions, however, will tend to produce conservative results because it will cause an overprediction of bed shear stress, which will produces higher erosion and lower deposition predicted by the sediment transport model. Overall, the calibration results indicate that the hydrodynamic model is able to adequately simulate WSE, water depth and current velocity in the Lower Willamette River for a wide range of river flow and tidal conditions.

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2.3 DEVELOPMENT AND CALIBRATION OF SEDIMENT TRANSPORT MODEL

2.3.1 Overview of Sediment Transport Model Structure and Capabilities

The sediment transport model used in this study, referred to as SEDZLJ, is capable of simulating erosion and deposition of sediment within cohesive (i.e., muddy) and non-cohesive (i.e., sandy) bed areas (Ziegler et al. 2000; Jones and Lick 2001; QEA 2008). The sediment transport model has the following characteristics and capabilities: 1) transport of suspended sediment in the water column; 2) use of Sedflume core data to specify erosion rate parameters in cohesive bed areas; 3) specification of spatially variable bed properties; and 4) inclusion of a sediment bed model that tracks temporal changes in bed composition.

The hydrodynamic model is linked to the sediment transport model via a coupling file, which transfers hydrodynamic transport information (e.g., current velocity, water depth) from the hydrodynamic model to the sediment transport model. For a particular time period, the hydrodynamic model is used to simulate circulation within the Site. During the hydrodynamic simulation, the relevant transport information is output to the coupling file every 15 minutes during the simulation. This frequency of output is necessary to accurately represent the effects of tidal circulation on sediment transport. The coupling file is used as input to the model during a sediment transport simulation. This process significantly reduces the time required to complete a sediment transport simulation because: 1) a larger time-step can be used than if the hydrodynamic and sediment transport models are running in parallel; and 2) the computational burden is lower because the hydrodynamic calculations do not have to be conducted every time a sediment transport simulation is repeated for a specific time period.

The coupling between the hydrodynamic and sediment transport models produces a limitation on the predictive capabilities of the modeling framework. This coupling is one-way, with no feedback between the two models. Changes in bed elevation predicted by the sediment transport model are not incorporated into the hydrodynamic model (i.e., bathymetry in the hydrodynamic model is assumed to remain constant with time). While this limitation may appear to reduce the reliability of the model predications, successful calibration and validation of the model indicate that this limitation in the modeling framework does not have a significant effect on the predictive capabilities of the sediment transport model in the Lower Willamette River.

2.3.2 Sediment Transport Model Theory and Formulation

2.3.2.1 Calculation of Bed Shear Stress

Erosion rate is dependent on bed shear stress, which is calculated using near-bed current velocity predicted by the hydrodynamic model. The bed shear stress calculated within the hydrodynamic model is the total bed shear stress, which represents the total drag on the water column by the sediment bed. The total bed shear stress (τ_{tot}) is the sum of shear stresses associated with skin friction (τ_{sf}) and form drag (τ_{fd}):

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$$\tau_{tot} = \tau_{sf} + \tau_{fd} \quad (2\text{-}3)$$

Skin friction represents the shear stress generated by sediment particles (i.e., small-scale physical features), whereas form drag corresponds to the drag generated by bedforms (e.g., ripples, dunes) and other large-scale physical features. When simulating erosion, skin friction is considered the dominant component of the bed shear stress for most applications. Thus, it is a reasonable approximation, and a standard approach, to use the skin friction component and neglect form drag for calculating bed shear stress for sediment transport simulations. This approach is consistent with accepted sediment transport theory (Parker 2004). Skin friction shear stress is calculated using the quadratic stress law:

$$\tau_{sf} = \rho_w C_f U^2 \quad (2\text{-}4)$$

Where,
ρ_w = the density of water
C_f = the bottom friction coefficient
U = the depth-averaged current velocity.

The bottom friction coefficient is determined using (Parker 2004):

$$C_f = \kappa^2 \ln^{-2}(11\ z_{ref} / k_s) \quad (2\text{-}5)$$

Where,
z_{ref} = a reference height above the sediment bed
k_s = the effective bed roughness
κ = von Karman's constant (0.4).

The reference height (z_{ref}) is spatially and temporally variable because it is equal to half of the water depth. Thus, the reference height properly incorporates temporal and spatial variations in water depth into the calculation of the bottom friction coefficient. The effective bed roughness is assumed to be proportional to the D_{90} of the surface sediment layer (Parker 2004; Wright and Parker 2004):

$$k_s = 2D_{90} \quad (2\text{-}6)$$

Grain size distribution (GSD) data were used to specify D_{90} values for the surface layer of Lower Willamette River sediments. The spatial variability of D_{90} in the Lower Willamette River was evaluated (see Section 2.3.4); accounting for potential spatial variation of D_{90} in the model produces qualitatively correct results (i.e., skin friction increases as bed roughness increases).

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The validity of the above approach for calculating the bottom friction coefficient is evaluated as follows. Bottom friction coefficients were calculated for the Lower Willamette River, using representative D_{90} values in the cohesive and non-cohesive bed areas (see Section 2.3.4) over a range water depths (see Table 2-3). The range of bottom friction coefficient values in Table 2-3 is consistent with expected values for cohesive beds (van Rijn 1993). This approach provides an objective method for estimating the effective bed roughness, which will decrease the uncertainty associated with subjective estimates of roughness.

Table 2-3. Bottom Friction Coefficient Values for a Range of Water Depths

Water Depth (m)	Bottom Friction Coefficient: Cohesive Bed (D90 = 280 μm)	Bottom Friction Coefficient: Non-Cohesive Bed (D90 = 1,480 μm)
1	0.0016	0.0024
2	0.0014	0.0020
3	0.0013	0.0018
4	0.0012	0.0017

Notes:
μm = micrometer
m = meter

For use in formulations presented below, a demonstrated accurate equation for bed shear velocity (u*) is defined as (van Rijn 1993):

$$u_* = (\tau_{sf} / \rho_w)^{0.5} \tag{2-7}$$

Current velocity in turbulent flow, which exists in the Lower Willamette River for all flow and tidal conditions, is the sum of two components: time-averaged mean velocity and turbulent fluctuations about the mean value. The bed shear velocity (u*) corresponds to the turbulent-fluctuation component of the current velocity. Thus, the skin friction shear stress is driven by the turbulent fluctuations in the flow, which are randomly variable with time. Random variation in turbulence along the sediment bed is the primary reason that a probabilistic approach to calculating deposition and erosion fluxes is necessary; use of probability of deposition (see Equation 2-8) and suspension (see Equation 2-28) formulations have been incorporated into the model to account for these turbulence effects.

2.3.2.2 Deposition Processes

The deposition flux for size class k sediment (D_k) is expressed as (Ziegler et al. 2000):

$$D_k = P_{dep,k} \, W_{s,k} \, C_k \quad {}_k \tag{2-8}$$

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where $P_{dep,k}$ is probability of deposition of class k, $W_{s,k}$ is settling speed of class k, C_k is depth-averaged suspended sediment concentration of class k, and $_k$ is the stratification correction factor for class k (i.e., ratio between the near-bed suspended sediment concentration and the depth-averaged suspended sediment concentration for class k). Deposition flux has units of mass per unit area per time (e.g., g/cm^2–s). The depth-averaged concentration (C_k) is calculated using the sediment transport model. The ratio $_k$ is calculated assuming a known vertical sediment concentration distribution for class k and the current hydrodynamic conditions.

Deposition flux has units of mass per unit area per time (e.g., gram[g]/cm^2–s). The depth-averaged concentration (C_k) is calculated using the sediment transport model.

Probability of deposition of cohesive sediment (i.e., class 1) is determined using the Krone formulation (van Rijn 1993):

$$P_{dep,k} = 1 - (\tau_{sf}/\tau_{cr,dep}) \quad \text{for} \quad \tau_{sf} < \tau_{cr,dep} \qquad (2\text{-}9)$$
$$= 0 \quad \text{for} \quad \tau_{sf} > \tau_{cr,dep}$$

Where
τ_{sf} = bed shear stress (skin friction)
$\tau_{cr,dep}$ = the critical bed shear stress for deposition

The relationship between the probability of deposition and bed shear stress for class 1 is shown in Figure 2-14.

For non-cohesive sediment (i.e., classes 2, 3, and 4), the probability of deposition depends on bed shear stress and particle diameter and is described by a Gaussian distribution (Gessler 1967; Ziegler et al. 2000):

$$P_{dep,k} = (2\pi)^{-0.5} \int \mathrm{EXP}(-0.5x^2)\, dx \qquad (2\text{-}10)$$

where the lower and upper limits of the integral are negative infinity and Y, respectively, and EXP corresponds to the exponential function with base e. The parameter Y is given by:

$$Y = 1.75\,(\tau_{c,k}/\tau_{sf} - 1) \qquad (2\text{-}11)$$

Where,
$\tau_{c,k}$ = critical shear stress for suspension of class k sediment, which is:

$$\tau_{c,k} = \rho_w\, u_{*,crs,k}^{\;2} \qquad (2\text{-}12)$$

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Where
$u_{*,crs,k}$ = critical bed shear velocity for initiation of suspension for class k:

$$u_{*,crs,k} = 4\ W_{s,k} / d_{*,k} \qquad \text{for } 1 < d_{*,k} \leq 10 \qquad (2\text{-}13)$$

$$= 0.4\ W_{s,k} \qquad \text{for } d_{*,k} > 10$$

and:

$$d_{*,k} = d_k\ [(s-1)g/\nu^2]^{1/3} \qquad (2\text{-}14)$$

Where,
d_k = particle diameter for class k
s = specific density of particle (i.e., 2.65)
g = acceleration caused by gravity
ν = kinematic viscosity of water.

The non-dimensional particle parameter ($d_{*,k}$) is commonly used in a wide range of sediment transport formulations (van Rijn 1993). The probability of deposition for classes 2 and 3 as a function of bed shear stress and particle diameter is presented in Figure 2-15.

Cohesive (i.e., class 1) particles in the water column aggregate and form flocs. Settling speeds of cohesive flocs have been measured over a large range of concentrations and shear stresses in freshwater (Burban et al. 1990). The Burban settling speed data for cohesive flocs in freshwater were analyzed to develop a formulation to approximate the effects of flocculation on settling speed. This analysis indicated that the settling speed is dependent on the product of the concentration (C_1) and the water column shear stress (G) at which the flocs are formed, resulting in the following relationship:

$$W_{s,1} = 3.3(C_1 G)^{0.12} \qquad (2\text{-}15)$$

where the units of $W_{s,1}$, C_1, and G are meters per day (m/day), milligrams per liter (mg/L), and dynes/cm^2, respectively. For a vertically averaged model, as used in this study, the relevant shear stress for use in Equation 2-15 is the skin friction shear stress ($_{sf}$). The near-bed concentration of suspended cohesive (class 1) particles is represented by the vertically averaged value, which is a valid approximation because of the relatively low settling speed of class 1 particles (i.e., 1 to 10 m/day).

For non-cohesive particles, numerous field and laboratory experiments have demonstrated that a physically realistic representation of the settling speed of a discrete particle is related to the particle diameter, representing size class k, as follows (Cheng 1997):

$$W_{s,k} = (\nu/d_k)\ [(25 + 1.5\ d_{*,k}^2)^{0.5} - 5]^{1.5} \qquad (2\text{-}16)$$

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The dependence of settling speed on particle diameter is shown in Figure 2-16.

Applying a 2D, vertically-averaged approximation for the vertical distribution of suspended sediment assumes that particles are uniformly distributed throughout the water column, which is a good approximation for cohesive sediments due to their relatively low settling speeds (i.e., about 1 to 10 meters per day [m/day]). The relatively high settling speeds of suspended sand causes significant vertical stratification to occur, with order of magnitude increases in suspended sediment concentration typically occurring between the top and bottom of the water column. Thus, simulation of suspended sand transport with a vertically averaged model necessitates the use of a correction factor ($_k$) to incorporate the effects of concentration stratification. Note that for cohesive sediment is always equal to one because of the low settling speed of that type of sediment.

The correction factor relates the vertically averaged concentration of size class k sediment (C_k), which is calculated by the sediment transport model, to the near-bed concentration ($C_{nb,k}$). The vertical distribution of non-cohesive sediment in the water column is calculated using (van Rijn 1984b):

$$C_{V,k}(z) = \begin{cases} C_{nb,k}\left[\left(\frac{a}{h-a}\right)\left(\frac{h}{z}\right) - 1\right] & , \quad \frac{z}{h} < 0.5 \\ C_{nb,k}\left(\frac{a}{h-a}\right)^{\zeta} e^{-4\zeta\left(\frac{z}{h}-0.5\right)} & , \quad \frac{z}{h} \geq 0.5 \end{cases} \tag{2-17}$$

where:

$C_{V,k}(z)$	=	vertical distribution of suspended sediment concentration, class ka
z	=	vertical coordinate ($z = 0$ at sediment bed and $z = h$ at water surface)
a	=	reference height (z=a)
h	=	water depth
	=	suspension parameter defined by (van Rijn 1984b):

$$\zeta = \frac{W_{s,k}}{u_* \beta_k} \tag{2-18}$$

where is von Karman constant (assumed to be 0.4) and the -factor, which is related to the vertical diffusion of sediment particles, is given by (van Rijn 1984b):

$$\beta_k 1 + 2\left(\frac{W_{s,k}}{u_*}\right)^2 \quad , \quad 0.1 < \frac{W_{s,k}}{u_*} < 1 \tag{2-19}$$

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The vertically-averaged concentration is defined as:

$$C_k = \frac{1}{h}\int_a^h C_{V,k}(z)dz \tag{2-20}$$

Using Equation 2-17 in the above integral yields:

$$C_k = \frac{C_{nb,k}}{h}\left(\frac{a}{h-a}\right)^{\zeta}\left\{\int_a^{0.5h}\left(\frac{h}{z}-1\right)^{\zeta}dz + \int_{0.5h}^{h} e^{-4\zeta\left(\frac{z}{h}-0.5\right)}dz\right\} \tag{2-21}$$

The integrals in this equation will be evaluated separately. The first integral does not have a closed form solution. Approximating the solution using the trapezoidal rule and three segments between $z = a$ and $z = 0.5\ h$ (i.e., z = (0.5h – a)/3) yields:

$$\int_a^{0.5h}\left(\frac{h}{z}-1\right)^{\zeta}dz = \frac{1}{3}\left[0.5\left(\frac{h}{a}-1\right)^{\zeta} + \left(\frac{h}{a+2\delta z}-1\right)^{\zeta} + 0.5\right] \tag{2-22}$$

The reference height (a) is calculated using:

$$a = MAX(0.01h, k_{nik}) \tag{2-23}$$

where h is water depth and k_{nik} is the Nikuradse roughness height:

$$k_{nik} = 33D_{90} \tag{2-24}$$

The second integral has the following solution:

$$\int_{0.5h}^{h} e^{-4\zeta\left(\frac{z}{h}-0.5\right)}dz = \frac{h}{4\zeta}\left(1-e^{-2\zeta}\right) \tag{2-25}$$

Inserting Equations 2-22 and 2-25 into Equation 2-21 and solving for $C_{k,nb}$ produces:

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$$C_{k,nb} = \Gamma_k C_k \tag{2-26}$$

where:

$$\Gamma_k = \left(\frac{h}{\alpha} - 1\right)^{\zeta} \left\{\frac{h}{4\zeta}\left(1 - e^{-2\zeta}\right) + \frac{1}{3}\left(0.5 - \frac{\alpha}{h}\right) X \left[0.5\left(\frac{h}{\alpha} - 1\right)^{\zeta} + \left(\frac{h}{\alpha + \delta x} - 1\right)^{\zeta} + \left(\frac{h}{\alpha + 2\delta x} - 1\right)^{\zeta}\right]\right\} \tag{2-27}$$

2.3.2.3 Erosion Processes: Cohesive Bed

Within sediment bed areas designated as cohesive, the following numerical algorithm is used to calculate the erosion flux of sediment from the bed to the water column, where it is transported as suspended sediment. The erosion flux for size class k sediment (E_k) from a cohesive bed is given by:

$$E_k = \rho_{dry}\, f_{AS,k}\, S_k\, P_{sus,k}\, E_{gross} \tag{2-28}$$

Where,
E_{gross} = the gross erosion rate
$P_{sus,k}$ = probability of suspension for size class k
S_k = the particle-shielding factor for size class k
ρ_{dry} = dry density of bed sediment
$f_{AS,k}$ = the fraction of size class k sediment in the active-surface layer.

Erosion flux has units of mass per unit area per time (e.g., g/cm^2–s).

Erosion of a sediment bed depends on a number of factors, including, but not limited to: shear stress, GSD, dry (bulk) density, total organic carbon (TOC) content, and gas content (Jepsen et al. 1997; Roberts et al. 1998). Factors such as TOC content, gas content, and bioturbation are implicitly incorporated into the cohesive erosion algorithm through the use of site-specific erosion rate data (i.e., Sedflume core data). The rate at which sediment is removed from the consolidated sediment bed and transported to a thin near-bed layer that exists between the consolidated sediment bed and the water column is termed the gross erosion rate (E_{gross}). Some of the eroded sediment in the near-bed layer is re-deposited to the consolidated bed; the rate of re-deposition is referred to as the gross deposition rate (D_{gross}). The remainder of the eroded material in the near-bed layer is transported to the water column; this rate is referred to as the net erosion rate (E_{net}). The near-bed layer discussed above is incorporated into a model of the sediment bed. Erosion rate data obtained from Sedflume testing (Sea Engineering 2006) were analyzed to develop an understanding of the erosion properties of Lower Willamette River cohesive bed sediment (see Section 2.3.4). The goal of that analysis was to develop a functional relationship between E_{gross} and other parameters that affect erosion rate. These

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relationships and parameters are incorporated into algorithms so that site-specific erosion properties measured for the Lower Willamette River can be represented in the model. Two parameters that affect E_{gross} are shear stress (τ) and bulk density (ρ; Jepsen et al. 1997). An evaluation of Sedflume data indicated minimal correlation exists system-wide between bulk density and erosion rate for Lower Duwamish Waterway sediment. Thus, it is assumed in this study that erosion rate is dependent on skin friction shear stress (Jones and Lick 2001):

$$E_{gross} = A\,\tau_{sf}^{n} \quad \text{for } \tau_{sf} > \tau_{cr} \qquad (2\text{-}29)$$
$$= 0 \quad \text{for } \tau_{sf} \leq \tau_{cr}$$

Where,
E_{gross} = gross erosion rate (cm/s)
τ_{sf} = skin friction shear stress (Pa)
τ_{cr} = critical shear stress (Pa), which is the shear stress at which a small, but measurable, rate of erosion occurs (generally less than 2 millimeters per hour).

The erosion parameters, A and n, are site-specific and may be spatially variable, both horizontally and vertically. Discussion of spatial variations in the erosion parameters in Equation 2-29 is presented in Section 2.3.4.

The erosion rate of each sediment size class is affected by the probability of suspension for that size class ($P_{sus,k}$), which is given by (Jones and Lick 2001):

$$P_{sus,k} = 0 \quad \text{for } \tau_{sf} \leq \tau_{c,k} \qquad (2\text{-}30)$$
$$= [\ln(\beta_1) - \ln(\beta_2)]/[1.39 - \ln(\beta_2)] \quad \text{for } \tau_{sf} \geq \tau \text{ and } \beta_1 \leq 4$$
$$= 1 \quad \text{for } \beta_1 > 4$$

and the non-dimensional parameters are:

$$\beta_1 = u_*/W_{s,k} \qquad (2\text{-}31)$$

$$\beta_2 = u_{*,crs,k}/W_{s,k} \qquad (2\text{-}32)$$

The formulation presented in Equation 2-30 was developed from the results of flume measurements of suspended and bedload transport of sand conducted by Guy et al. (1966). Jones and Lick (2001) analyzed the Guy et al. (1966) data, with Equation 2-30 resulting from their analysis. Probability of suspension as a function of bed shear stress is shown in Figure 2-17 for particle diameters of 130 and 540 μm. This figure shows that for a given shear stress value, the probability of suspension increases with decreasing particle size.

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The particle-shielding factor, which is a positive number with a maximum value of one, is used to reduce the erosion flux of smaller particles within a graded bed (i.e., bed with wide range of particle sizes) that are sheltered by larger particles. The particle-shielding factor (S_k) for size class k is formulated as follows (Karim and Kennedy 1981; Rahuel et al. 1989):

$$S_k = (d_k/d_m)^{0.85} \quad \text{for } d_k \leq d_m \qquad (2\text{-}33)$$
$$= 1 \quad \text{for } d_k > d_m$$

where d_m is the mean particle diameter in the active layer. The relationship between the particle-shielding factor and particle diameter, for three values of mean particle diameter, is shown in Figure 2-18. For a given particle diameter (d_k), the particle-shielding effect increases (i.e., S_k decreases) as the mean particle diameter increases. The particle-shielding factor is consistent with erosion processes within a graded bed, where voids between larger particles provide areas where smaller particles may be shielded (i.e., "hide") from the turbulence at the sediment-water interface that induces erosion. Thus, the particle-shielding factor is a mechanistic parameter that accounts for real processes that affect scour from a graded bed.

The sediment bed model used in the bed scour model is similar to the bed model described in Jones and Lick (2001). This bed model has been developed over the previous 20 years and used within the SEDZL and SEDZLJ algorithms (Ziegler and Lick 1988; Ziegler et al. 2000; Jones and Lick 2001; QEA 2008). The SEDZL/SEDZLJ bed model has been successfully used in over 30 sediment transport modeling studies, including: Lower Duwamish Waterway (Washington), Upper Hudson River (New York), Lavaca Bay (Texas), Grasse River (New York), Upper Mississippi River (Minnesota), Watts Bar Reservoir/Tennessee River (Tennessee), and Patrick Bayou (Texas).

A multi-layer bed model is used in the SEDZLJ algorithm, with each bed layer having specific erosion rate parameters (i.e., τ_{cr}, A, and n). For this study, five bed layers are used, with the initial thickness of each layer being 5 cm. Use of 5-cm layers in the bed model is based on the vertical variation in erosion rate data obtained from the Sedflume cores; the shear stress series were repeated in approximately 5-cm increments in a core during the Sedflume tests. Discretizing the bed into five layers allows specifying vertical variation in erosion properties, with the erodibility of cohesive sediment generally decreasing with depth in the bed, primarily due to consolidation processes. Additional discussion about the 5-layer bed model is presented in Section 2.3.4.

The effects of consolidation on erosion properties of deposited sediment are not explicitly incorporated into the bed model. If the initial layer 1 is present, then deposited sediment is added to layer 1 (i.e., surface layer) of the bed model and, thus, that sediment has the same erosion properties as the surface layer. If the initial layer 1 is not present (i.e., that layer has been eroded), then a new surface layer is created by the deposited sediment, which has the same erosion properties as the initial layer 1. This approach produces

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conservative results during a high-flow event because the erosion properties of sediment deposited prior to the event will not have been reduced due to consolidation.

Erosion from cohesive and non-cohesive beds is affected by bed armoring, which is a process that tends to limit the amount of bed scour during a high-flow event. Bed armoring occurs in a bed that contains a range of particle sizes (e.g., clay, silt, sand). During a high-flow event when erosion is occurring, finer particles (i.e., clay and silt) tend to be eroded at a faster rate than coarser particles (i.e., sand). The differences in erosion rates of various particle sizes creates a thin layer at the surface of the bed, referred to as the active layer, that is depleted of finer particles and enriched with coarser particles. This depletion-enrichment process can lead to bed armoring, where the active layer is primarily composed of coarse particles that have limited mobility.

After bed armoring occurs during a high-flow event, various physical mixing processes in the surface layer of the bed (e.g., bioturbation, ship-induced resuspension) can affect the armor layer. The effects of physical mixing processes on bed armoring are not well understood at the present time; these effects are not explicitly incorporated into the bed model and bed armoring algorithm. However, the effects of physical mixing processes are implicitly included into the bed model through use of the Sedflume data, which incorporates these effects into the erosion rate data. Physical mixing in the surface layer is one reason why near-surface sediment is generally more erodible than deeper sediment.

The bed armoring process is simulated using an active layer at the surface of the bed, with the gross erosion rate being affected by the composition of the active layer (Jones and Lick 2001). The active layer is a theoretical construct that approximates the near-bed layer mentioned during the description of gross deposition and erosion rates previously in this section. The active layer is part of a numerical algorithm and it was created as a "holding area," such that the bed model realistically represents the complex processes at the sediment-water interface. Even though the active-layer approach used in the model is a simplification of various complex processes, it is conceptually realistic and has been shown to produce accurate results in previous modeling studies.

In this study, four size classes of sediment were used. Class 1 sediment represents cohesive sediment (i.e., clay and silt, less than 62 μm diameter). Class 2 sediment represents fine sand (i.e., 62 to 250 μm diameter). Class 3 sediment represents medium and coarse sand (i.e., 250 to 2,000 μm diameter). Class 4 sediment represents gravel (i.e., greater than 2,000 μm diameter). The bed model tracks changes in the composition of the active layer associated with erosion and deposition; temporal changes in active layer composition affect the erosion process.

The surface layer in the bed model (i.e., top 5-cm layer) is divided into two zones: 1) active layer; and 2) parent bed. The active layer is at the top of the surface layer and the parent bed is below it. The active layer interacts with the water column; erosion and deposition across the sediment-water interface occurs in the active layer. Use of an active layer to simulate the effects of bed armoring is frequently used in sediment

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transport models (Rahuel et al. 1989). The active layer is composed of two sub-layers (QEA 2008): 1) active-surface layer; and 2) active-buffer layer. The active-surface layer interacts with the water column, while the active-buffer layer controls interactions between the active-surface layer and the parent bed (Figures 2-19 and 2-20).

The thickness of the active-surface layer is assumed to depend on bed shear stress and GSD. The formulation used to calculate active-surface layer thickness (T_{AS}) is (Jones and Lick 2001):

$$T_{AS} = 2\ d_m\ (\tau_{sf} / \tau_{cr}) \qquad (2\text{-}34)$$

Where,
d_m = the mean particle diameter in the active layer.

The active-surface layer thickness is temporally and spatially variable, and it changes as the composition of the bed and bed shear stress change with time. The active-surface layer thickness is determined using Equation 2-34, with the bed model tracking the mass per unit area using:

$$M_{AS} = \rho_{dry}\ T_{AS} \qquad (2\text{-}35)$$

Where,
M_{AS} = the total sediment mass per unit area in the active-surface layer
ρ_{dry} = the dry density of bed sediment.

The thickness, or mass per unit area, of the active-surface layer changes with time as T_{AS} changes as a result of increases or decreases in mean particle diameter or bed shear stress. Let δ_{SB} represent changes in active-surface layer mass, for size class k, caused by temporal changes in M_{AS}. Expansion and contraction of the active-surface thickness (i.e., T_{AS}) causes interactions between the active-surface and active-buffer layers, which result in mass transfer between the two layers. For increasing M_{AS} (i.e., $M_{AS}^{N+1} > M_{AS}^{N}$, where the superscript N represent time-level N in the numerical model):

$$\delta_{SB,k} = f_{AB,k}\ (M_{AS}^{N+1} - M_{AS}^{N}) \qquad (2\text{-}36)$$

Where,
$f_{AB,k}$ = the fraction of size class k sediment in the active-buffer layer.

For decreasing or constant M_{AS} (i.e., $M_{AS}^{N+1} \leq M_{AS}^{N}$):

$$\delta_{SB,k} = f_{AS,k}\ (M_{AS}^{N+1} - M_{AS}^{N}) \qquad (2\text{-}37)$$

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Where
$f_{AS,k}$ = the fraction of size class k sediment in the active-surface layer.

The change in active-surface layer mass is calculated using:

$$M_{AS,k}^{N+1} = M_{AS,k}^{N} + \delta_{SB,k} + \Delta t\,(D_k - E_k - f_{AS,k}\,D_{tot} + f_{AB,k}\,E_{tot}) \qquad (2\text{-}38)$$

Where,
$M_{AS,k}$ = active-surface layer mass per unit area for size class k sediment
E_k = the erosion flux for size class k sediment
D_k = the deposition flux for size class k sediment
Δt = the numerical time-step.

The total deposition and erosion fluxes are given by:

$$D_{tot} = \Sigma\, D_k \qquad (2\text{-}39)$$

$$E_{tot} = \Sigma\, E_k \qquad (2\text{-}40)$$

where the summations are over the four size classes. In Equation 2-40, the values of E_k are calculated using Equation 2-28 for each size class k. Thus, E_{tot} is affected by the composition of the active-surface layer. Note that the deposition and erosion flux terms in the parentheses on the right-hand side of Equation 2-38 do not sum to zero for a specific size class k. This characteristic of the algorithm generates bed armoring effects due to unequal mass transfer of different sediment size classes between the active-surface, active-buffer, and parent-bed layers. However, conservation of mass is assured when Equation 2-38 is summed over all sediment size classes, which results in the sum of the deposition and erosion flux terms being equal to zero.

The terms on the right-hand-side of Equation 2-38 correspond to the following changes in the mass of the active-surface layer: 1) $\delta_{SB,k}$ is an increase in mass of class k sediment if the total active-surface layer mass is increasing (i.e., mass added from active-buffer layer) and it is a decrease in mass of class k sediment if the total active-surface layer mass is decreasing (i.e., mass lost to active-buffer layer); 2) $\Delta t\, D_k$ is an increase in mass of class k sediment due to deposition from the water column to the bed; 3) $\Delta t\, E_k$ is a decrease in mass of class k sediment due to erosion from the bed to the water column; 4) $\Delta t\, f_{AS,k}\, D_{tot}$ is a decrease in mass of class k sediment caused by movement of sediment from the active-surface layer to the active-buffer layer due to deposition; and 5) $\Delta t\, f_{AB,k}\, E_{tot}$ is an increase in mass of class k sediment caused by movement of sediment from the active-buffer layer to the active-surface layer due to erosion (see Figure 2-19).

The change in active-buffer layer mass for size class k ($M_{AB,k}$) is calculated using:

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$$M_{AB,k}^{N+1} = M_{AB,k}^{N} - \delta_{SB,k} + \Delta t\,[(f_{AS,k} - f_{AB,k})D_{tot} - f_{AB,k}\,E_{tot}] \qquad (2\text{-}41)$$

It is assumed that there is no mass transfer between the buffer layer and the parent bed due to erosion processes. The terms on the right-hand-side of Equation 2-41 correspond to the following changes in the mass of the active-buffer layer: 1) $\delta_{SB,k}$ is a decrease in mass of class k sediment if the total active-surface layer mass is increasing (i.e., mass lost to active-surface layer), and it is an increase in mass of class k sediment if the total active-surface layer mass is decreasing (i.e., mass added from active-surface layer); 2) $\Delta t\ f_{AS,k}\ D_{tot}$ is an increase in mass of class k sediment caused by movement of sediment from the active-surface layer to the active-buffer layer due to deposition; 3) $\Delta t\ f_{AB,k}\ D_{tot}$ is a decrease in mass of class k sediment caused by movement of sediment from the active-buffer layer to the parent-bed layer due to deposition; and 4) $\Delta t\ f_{AB,k}\ E_{tot}$ is a decrease in mass of class k sediment caused by movement of sediment from the active-buffer layer to the active-surface layer due to erosion.

When the buffer layer is depleted of sediment (typically during an erosion event), the active-surface layer interacts directly with the parent bed (Figure 2-20). Let $\delta_{SP,k}$ represent changes in active-surface layer mass, for size class k, caused by temporal changes in M_{AS} and expansion/contraction interactions between the active-surface and parent-bed layers. For increasing M_{AS}:

$$\delta_{SP,k} = f_{P,k}\,(M_{AS}^{N+1} - M_{AS}^{N}) \qquad (2\text{-}42)$$

where $f_{P,k}$ is the fraction of size class k sediment in the parent-bed layer. For decreasing or constant M_{AS}:

$$\delta_{SP,k} = f_{AS,k}\,(M_{AS}^{N+1} - M_{AS}^{N}) \qquad (2\text{-}43)$$

The change in active-surface layer mass for size class k is calculated using:

$$M_{AS,k}^{N+1} = M_{AS,k}^{N} + \delta_{SP,k} + \Delta t\,(D_k - E_k - f_{As,k}\,D_{tot} + f_{P,k}\,E_{tot}) \qquad (2\text{-}44)$$

The terms on the right-hand-side of Equation 2-44 correspond to the following changes in the mass of the active-surface layer: 1) $\delta_{SP,k}$ is an increase in mass of class k sediment if the total active-surface layer mass is increasing (i.e., mass added from parent-bed layer) and it is a decrease in mass of class k sediment if the total active-surface layer mass is decreasing (i.e., mass lost to parent-bed layer); 2) $\Delta t\ D_k$ is an increase in mass of class k sediment due to deposition from the water column to the bed; 3) $\Delta t\ E_k$ is an decrease in mass of class k sediment due to erosion from the bed to the water column; 4) $\Delta t\ f_{AS,k}\ D_{tot}$ is a decrease in mass of class k sediment caused by movement of sediment from the active-surface layer to the parent-bed layer due to deposition; and 5) $\Delta t\ f_{P,k}\ E_{tot}$ is an

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increase in mass of class k sediment caused by movement of sediment from the parent-bed layer to the active-surface layer due to erosion.

The change in parent-bed layer mass for size class k ($M_{P,k}$) is determined from:

$$M_{P,k}^{N+1} = M_{P,k}^{N} - \delta_{SP,k} + \Delta t\,(f_{AS,k} D_{tot} - f_{P,k}\, E_{tot}) \qquad (2\text{-}45)$$

The terms on the right-hand-side of Equation 2-45 correspond to the following changes in the mass of the parent-bed layer: 1) $\delta_{SP,k}$ is a decrease in mass of class k sediment if the total active-surface layer mass is increasing (i.e., mass lost to active-surface layer) and it is an increase in mass of class k sediment if the total active-surface layer mass is decreasing (i.e., mass added from active-surface layer); 2) $\Delta t\, f_{AS,k}\, D_{tot}$ is an increase in mass of class k sediment caused by movement of sediment from the active-surface layer to the parent-bed layer due to deposition; and 3) $\Delta t\, f_{P,k}\, E_{tot}$ is a decrease in mass of class k sediment caused by movement of sediment from the parent-bed layer to the active-surface layer due to erosion.

After the buffer layer is depleted, a new active-buffer layer is created when the active-surface layer decreases in thickness as a result of decreasing bed shear stress. For the condition when $M_{AB,k}^{N+1}$ equals zero and M_{AS} is decreasing (i.e., $M_{AS}^{N+1} \leq M_{AS}^{N}$), then the initial mass of the new active-buffer layer, for size class k, is:

$$M_{AB,k}^{N+1} = f_{P,k}\,(M_{AS}^{N} - M_{AS}^{N+1}) \qquad (2\text{-}46)$$

This amount of mass is removed from the parent-bed layer, so that mass is conserved.

The fractions of each sediment size class are updated after the new sediment masses are calculated in each layer:

$$f_{AS,k} = M_{AS,k}^{N+1} / M_{AS}^{N+1} \qquad (2\text{-}47)$$

$$f_{AB,k} = M_{AB,k}^{N+1} / M_{AB}^{N+1} \qquad (2\text{-}48)$$

$$f_{P,k} = M_{P,k}^{N+1} / M_{P}^{N+1} \qquad (2\text{-}49)$$

where M_{AS}^{N+1}, M_{AB}^{N+1},and M_{P}^{N+1} are total sediment mass per unit area in the active-surface, active-buffer, and parent-bed layers, respectively.

The numerical algorithm presented above for the interactions between the active-surface, active-buffer, and parent-bed layers may be difficult to understand from a conceptual viewpoint. The following sequence of figures is intended to clarify the mechanistic interactions between the three layers due to temporal variations in bed shear stress, which

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result in expansion and contraction of the active layer. It is assumed that initially (i.e., time = t_1) two layers exist: 1) active-surface layer (with thickness $T_{AS,1}$ corresponding to a shear stress value of $\tau_{sf,1}$); and 2) parent-bed layer (see Figure 2-21). As the shear stress increases to $\tau_{sf,2}$ (which is greater than $\tau_{sf,1}$) at time = t_2, the active-surface layer thickness increases to $T_{AS,2}$, and sediment is transferred from the parent-bed layer to the active-surface layer (Figure 2-22). The shear stress reaches a maximum value at time = t_2 and decreases to a value of $\tau_{sf,3}$ at time = t_3. As the shear stress decreases during this time interval (i.e., t_2 to t_3), an active-buffer layer is created as the active-surface layer contracts in size, which is the process that generates an active-buffer layer (Figure 2-23). This new active-buffer layer was created from a portion of the active-surface layer that existed at time = t_2; sediment was transferred from the active-surface layer to the active-buffer layer. As the shear stress continues to decrease during the time interval between t_3 and t_4, the active-surface and active-buffer layers decrease and increase in thickness, respectively (Figure 2-24). The shear increases during the time interval between t_4 and t_5, which causes sediment to be transferred from the active-buffer layer (which is contracting) to the active-surface layer (which is expanding; see Figure 2-25). Note that during the time interval between t_2 and t_5, when the shear stress is less than the maximum value of $\tau_{sf,2}$, the sum of the thicknesses of the active-surface and active-buffer layers remains constant at a value of $T_{AS,2}$ (assuming that no deposition or erosion occurs). During the time interval between t_5 and t_6, the active-buffer layer is destroyed, and sediment is transferred from the parent-bed layer to the active-surface layer, as the shear stress exceeds the original maximum value of $\tau_{sf,2}$ and the active-surface layer expands to a thickness greater than $T_{AS,2}$ (Figure 2-26). As the shear stress decreases from the new maximum value of $\tau_{sf,6}$, a new active-buffer layer is created from the active-surface layer as that layer contracts in size (Figure 2-27).

The structure of the bed model described above is based on heuristic concepts that were developed from a general understanding of cohesive bed processes. The overall concepts applied to the model and the general behavior of the model are consistent with known processes. However, uncertainty exists in some details of the model structure (e.g., transfer of sediment between the active-surface, active-buffer, and parent-bed layers as the active layer expands and contracts). Due to the complexity of the model structure, a unique methodology does not exist, and a wide range of alternatives can be constructed from proposed general structure. However, the approach that is described above, and used in the Lower Willamette River modeling study, is consistent with a general understanding of cohesive bed processes, and it does produce reasonable results.

2.3.2.4 Erosion Processes: Non-Cohesive Bed

Non-cohesive sediment bed transport is dominated by gravitational, lift, and drag forces acting on individual particles. Cohesive forces are negligible compared to these other forces and are not evident in non-cohesive bed behavior. Non-cohesive beds generally contain only a small amount of clay and silt particles. Numerous laboratory and field studies have been conducted on the erosion properties of non-cohesive sediments; see van Rijn (1993) for an overview. These investigations have led to the development of various

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formulations for quantification of non-cohesive suspended and bedload transport. Several investigators have evaluated the accuracy of different quantitative approaches using laboratory and field data (Garcia and Parker 1991; Voogt et al. 1991; van den Berg and van Gelder 1993). The results of these investigations have shown that the formulations developed by van Rijn (1984a, b, c) provide one of the best methods for calculating suspended load transport of non-cohesive sediments. The van Rijn equations have been successfully used in sediment transport modeling studies of riverine (Ziegler et al. 2000) and estuarine (van Rijn et al. 1990) systems over a wide range of flow and sediment conditions.

The numerical algorithm discussed below is used to calculate the erosion flux of sediment from a non-cohesive bed to the water column, where it is transported as suspended sediment. Following the van Rijn method, the equations presented below are used to calculate the erosion flux for sediment size class k, which is represented by an effective particle diameter (d_k). The critical bed shear velocity for initiation of bedload transport ($u_{*,crb,k}$) is calculated using the Shields criteria (see Figure 2-28):

$$u_{*,crb,k} = [(s-1)\ g\ d_k\ \theta_{cr,k}]^{0.5} \tag{2-50}$$

where θ_{cr} is the critical mobility parameter, which is approximated by (van Rijn 1993):

$$\begin{aligned} \theta_{cr,k} &= 0.24\ d_{*,k}^{-1} && \text{for } d_{*,k} \leq 4 \\ &= 0.14\ d_{*,k}^{-0.64} && \text{for } 4 < d_{*,k} < 10 \\ &= 0.04\ d_{*,k}^{-0.10} && \text{for } 10 < d_{*,k} < 20 \\ &= 0.013\ d_{*,k}^{0.29} && \text{for } 20 < d_{*,k} < 150 \\ &= 0.055 && \text{for } d_{*,k} > 160 \end{aligned} \tag{2-51}$$

and $d_{*,k}$ is calculated using Equation 2-14. Equation 2-51 is a piece-wise fit to the Shields curve that was developed by van Rijn (1993). Critical shear stresses for initiation of bedload ($\tau_{crb,k}$) and suspended load ($\tau_{crs,k}$) transport are calculated as follows:

$$\tau_{crb,k} = \rho_w\ u_{*,crb,k}^2 \tag{2-52}$$

$$\tau_{crs,k} = \rho_w\ u_{*,crs,k}^2 \tag{2-53}$$

The relationships between particle diameter and the critical bed shear stresses for bedload and suspended load transport are shown in Figure 2-29. For sediment class 1, which represents clay and silt, it is assumed that Equations 2-13 and 2-52 through 2-53 can be extrapolated to particle sizes less than 62 μm (i.e., d* less than 1.47). This assumption is commonly used for simulation of non-cohesive sediment transport with a graded bed (i.e., mixture of sediment particle sizes), and it has a minimal effect on model predictions in non-cohesive bed areas.

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If the bed shear stress exceeds the critical shear stress for suspended load transport, then the equilibrium sediment concentration ($C_{eq,k}$) at a reference height (z = a) above the bed is calculated using:

$$C_{eq,k} = 0.015\ (d_k\ T_k^{1.5}) / (a\ d_{*,k}^{\ 0.3}) \qquad (2\text{-}54)$$

where T_k is the transport stage parameter, given by:

$$T_k = (u_*/u_{*,crs,k})^2 - 1 \qquad \text{for} \qquad u_* > u_{*,crs,k} \qquad (2\text{-}55)$$

The reference height (a) is calculated using:

$$a = MAX\ (0.01\ h,\ k_{nik}) \qquad (2\text{-}56)$$

where h is water depth and k_{nik} is the Nikuradse roughness height:

$$k_{nik} = 33\ D_{90} \qquad (2\text{-}57)$$

The erosion flux for size class k sediment for a non-armoring sediment bed is calculated using:

$$E_{na,k} = -\ W_{s,k}\ (C_{a,k} - Ceq,k) \qquad \text{for} \qquad C_{a,k} < C_{eq,k} \qquad (2\text{-}58)$$

where $C_{a,k}$ is the suspended sediment concentration of size class k at z = a. For the 3D model, $C_{a,k}$ is set equal to the suspended sediment concentration, as predicted by the water-column transport model, in the first grid cell above the bed.

Similar to the cohesive bed discussed in Section 2.3.2.3, bed armoring processes occur in the non-cohesive bed and those processes affect the erosion flux from that bed type. An active layer is assumed to exist at the surface of the non-cohesive bed, with the thickness of that layer calculated using the following relationship:

$$T_{AS,non} = 2\ d_{50}\ (\tau_{sf}\ /\tau_{crb})^N \qquad (2\text{-}59)$$

Where,
T = active layer thickness in the non-cohesive bed
d_{50} = median particle diameter
τ_{crb} = critical shear stress for initiation of bedload transport
N = an exponent that ranges between 0.1 and 1

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A bed model tracks changes in the composition of the non-cohesive active layer associated with erosion and deposition, as well as interactions between the active and parent bed layers. Thus, the erosion flux for size class k sediment from an armoring bed ($E_{non,k}$) is given by:

$$E_{non,k} = f_{non,a,k} S_k E_{na,k} \quad (2\text{-}60)$$

Where,
$f_{non,a,k}$ = the fraction of class k sediment in the active layer of the non-cohesive bed
S_k = the particle-shielding factor (see Equation 2-33).

The particle-shielding factor (Karim and Kennedy 1981; Rahuel et al. 1989) was included in the erosion flux for an armoring bed because this factor accounts for the effects of differential erosion rates.

2.3.3 Sediment Transport Model Inputs: Sediment Properties

Inputs for the sediment transport model are separated into three broad categories: 1) sediment properties (Section 2.3.3); 2) bed properties (Section 2.3.4); and 3) boundary conditions (Section 2.3.5). Sediment properties correspond to the physical properties of sediment particles (i.e., effective particle diameter, settling speed). Bed properties range from bulk bed characteristics (e.g., dry density, GSD) to erosion rates. Determining boundary conditions for the model corresponds to the specification of sediment loads at different inflow locations.

For freshwater tidal rivers such as the Lower Willamette River, suspended sediment particles typically have a range of sizes, with particle diameters ranging from less than 1 μm clays to coarse sands on the order of 1,000 μm (van Rijn 1993). Simulation of the entire particle size spectrum is impractical for several reasons: simulation times and array-storage requirements increase with each particle size class that is added, limitations in GSD data for the sediment bed make it difficult to specify initial conditions for the entire spectrum, and sparse data for the composition of the external sediment load make it problematic for specifying this boundary condition for the entire spectrum. Therefore, particles were separated into four classes: 1) clay and silt with particle diameters less than 62 μm; 2) fine sand (62 to 250 μm); 3) medium and coarse sand (250 to 2,000 μm); and gravel (greater than 2,000 μm). Use of these four size classes provides an adequate approximation of the GSD of bed sediment observed in the Lower Willamette River for achieving the objectives of this study. Based on experience from previous modeling studies (e.g., QEA 2008), the four size classes used in Lower Willamette River simulations provide a realistic range of sediment particle sizes (from clay to gravel) that are present in the graded bed of the river. Inclusion of this wide range of particle sizes in the model is necessary for simulation of bed armoring processes during an erosion event. From a practical point of view, simulating the transport of four sediment size classes makes it possible to conduct long-term, multi-year simulations in a practical amount of time. Finally, the results of the model calibration and validation exercises (discussed

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below) indicate that use of four sediment size classes is sufficient for producing a modeling framework with adequate accuracy and reliability for the application and use of the Lower Willamette River sediment transport model.

For convenience, the four sediment classes have been labeled as noted in Table 2-4. Each sediment size class is represented as an effective particle diameter. The effective particle diameter for classes 1, 2, and 3 were treated as adjustable calibration parameters, see Section 2.3.6. Prior to model calibration, effective particle diameters for classes 2 through 4 were estimated using the following approach (QEA 2008). GSD data are available for the surface layer of sediment cores collected from the Lower Willamette River. For sand and gravel particles, the GSD data were reported as the fractional composition for these seven particle size ranges: 1) 72 to 106 μm; 2) 106 to 250 μm; 3) 250 to 425 μm; 4) 425 to 850 μm; 5) 850 to 2,000 μm; 6) 2,000 to 4,750 μm; and 7) greater than 4,750 μm. The effective diameter of each size range corresponds to the geometric mean of that range. For example, the geometric mean of the 106 to 250 μm size range is 163 μm. The GSD data provide information on the relative amounts of sand in each of the seven size ranges. The effective diameters of classes 2, 3, and 4 (i.e., d2, d3, d4) for a particular core sample were estimated from the GSD data using (QEA 2008):

$$d_2 = (f_{r1}G_{r1} + f_{r2}G_{r2})/ (f_{r1} + f_{r2}) \quad (2\text{-}61)$$

$$d_3 = (f_{r3}G_{r3} + f_{r4}G_{r4} + f_{r5}G_{r5})/ (f_{r3} + f_{r4} + f_{r5}) \quad (2\text{-}62)$$

$$d_4 = (f_{r6}G_{r6} + f_{r7}G_{r7})/ (f_{r6} + f_{r7}) \quad (2\text{-}63)$$

Where,
f_{rk} = fractional content of size range k
G_{rk} = geometric mean diameter of size range k.

Using Equations 2-61 through 2-63 to analyze the GSD data for surface-layer sediment produced median values of effective diameters for classes 2, 3, and 4 as listed in Table 2-4.

Table 2-4. Characteristics of Sediment Particle Size Classes

Sediment Size Class	Particle Size Range (μm)	Data-Based Effective Particle Diameter (μm)	Calibration Effective Particle Diameter (μm)
1: clay and silt	< 62	Not Applicable	Not Applicable
2: fine sand	62 – 250	140	100
3: medium, coarse sand	250 – 2,000	550	700
4: gravel	> 2,000	2,800	2,800

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Notes:
µm = micrometer

2.3.4 Sediment Transport Model Inputs: Bed Properties

The sediment bed in the Lower Willamette River was separated into three distinct types: 1) cohesive (i.e., muddy bed composed of a mixture of clay, silt, sand, and organic matter); 2) non-cohesive (i.e., sandy bed composed of sand and gravel, with small amounts of clay and silt); and 3) hard bottom (i.e., no erosion or deposition). Delineation of the sediment bed into cohesive, non-cohesive and hard bottom areas was accomplished using GSD data from sediment cores collected during the GeoSea and Round 2 field studies during 2000 and 2004, respectively (GeoSea 2001; Integral 2005a, 2005b, 2006). GSD data were available at a total of 1,187 locations in the Study Area (see Figures 2-30 and 2-31). Sediment cores were classified as cohesive using the following criteria: 1) median particle diameter (D_{50}) less than 250 µm; and 2) clay/silt content greater than 15 percent (Ziegler and Nisbet 1994). It was assumed that the sediment bed was hard bottom in the following areas: 1) upstream of RM 12.9 in the Lower Willamette River; 2) Multnomah Channel; and 3) Columbia River. The bed map for the Study Area is shown on Figure 2-32. About 81 percent of the bed area between RM 2 and 11 is cohesive.

The sediment transport model requires specification of the following bed property inputs within the Lower Willamette River: 1) dry (bulk) density; 2) initial sediment bed composition (i.e., relative amounts of sediment size classes 1, 2, 3, and 4); 3) median particle diameter (D_{50}); 4) effective bed roughness (which is proportional to D_{90}, see Equation 2-6); and 5) erosion rate properties in cohesive bed areas. The dry density of the bed was assumed to be spatially variable within the Lower Willamette River, with different values in the cohesive and non-cohesive bed areas. For cohesive bed areas, the dry density has a value of 0.72 g/cm^3, which corresponds to the average value of 596 samples. For non-cohesive bed areas, the dry density has a value of 1.2 g/cm^3, which corresponds to the average value of 162 samples. Dry density is assumed to be horizontally and vertically constant within all areas of a particular bed type.

Spatial distributions of D_{50} and D_{90} values were developed from the GSD data collected at 1,187 locations in the Study Area, see Figure 2-33. The proportional content of the four sediment size classes (i.e., classes 1, 2, 3 and 4) in the bed must be specified at each grid cell at the beginning of a simulation. Spatial distributions of bed composition were specified as initial conditions for the sediment transport model using the GSD data, see Figures 2-34 and 2-35. Changes in bed composition due to erosion and deposition processes are predicted by the model at each grid cell during a simulation. As a reference Table 2-5 presents the average values of D_{50}, D_{90}, and composition of the bed for cohesive and non-cohesive areas.

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Table 2-5. Average Values for Bed Properties Initial Conditions

Bed Type	D_{50} (µm)	D_{90} (µm)	Class 1 Content (%)	Class 2 Content (%)	Class 3 Content (%)	Class 4 Content (%)
Cohesive	50	280	64	26	9	1
Non-Cohesive	510	1,480	13	14	64	9

Notes:
µm = micrometer

A Sedflume study was conducted during 2006 to obtain data on the erosion properties of Lower Willamette River sediments. Cores were collected from 19 locations (Figure 2-36). Details of the field study, including core collection and processing, are described in Sea Engineering (2006). Erosion rates as a function of depth in the bed and applied shear stress were measured over the top 30 cm of each core using Sedflume. Sediment samples were also obtained at 5-cm intervals from each core and analyzed for bulk (wet) density and GSD.

Erosion rate data obtained from Sedflume testing were analyzed to develop an understanding of the erosion properties of Lower Willamette River sediments in cohesive bed areas. The goal of this analysis was to develop a functional relationship between Egross and bed shear stress. The site-specific parameters in Equation 2-29 (i.e., A, n, τ_{cr}) were determined using the erosion rate data collected during the Sedflume field study. Four of the 19 Sedflume cores (i.e., cores SF-2, SF-6, SF-7, SF-18) were determined to consist of non-cohesive (i.e., sandy) sediment and those cores were not included in the analysis described below; Sedflume erosion rate data are only applicable to cohesive bed sediment.

The erosion rate properties of the 15 cores were analyzed using the following procedure. Each core was divided into five layers, with these layers representing the following depth intervals: 0 to 5, 5 to 10, 10 to 15, 15 to 20, and 20 to 25 cm. These depth intervals were chosen because the shear stress series used in the Sedflume tests, where shear stress was increased from low to high values, were cycled over approximately 5-cm thick layers. The erosion rate data within each layer of a particular core were analyzed through application of a log-linear regression analysis between erosion rate and shear stress. The log-linear regression analysis produced values of A and n for each layer in a particular core. The results of this analysis for the Sedflume cores with cohesive sediment are presented in Figures 2-37 through 2-51. The critical shear stress for each 5-cm layer was calculated using:

$$\tau_{cr} = (E_{cr} / A)^{1/n} \qquad (2\text{-}64)$$

Where,
E_{cr} = 0.0001 cm/s.

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The erosion rate parameters (i.e., A, n, τ_{cr}) for each core within the five depth intervals are listed in Tables 2-6 through 2-10. Note that the values of A and n in these tables correspond to units of cm/s for E_{gross} and pascal (Pa) for bed shear stress in Equation 2-29. The correlation coefficient (R^2) values presented in the tables are from the log-linear regression analysis, with perfect correlation corresponding to an R^2 value of one.

Table 2-6. Erosion Rate Parameters for 0 to 5 cm Layer

Sediment Core ID	River Mile Location	Proportionality Constant: A	Exponent: n	Correlation Coefficient (R^2)	Critical Shear Stress (Pa)
SF-1	2.4	0.00113	2.4	0.97	0.36
SF-3	3.7	0.00504	1.6	0.96	0.09
SF-4	4.0	0.00244	2.3	0.99	0.25
SF-5	4.8	0.00137	2.0	0.94	0.27
SF-8	6.1	0.00473	2.7	0.98	0.24
SF-9	6.4	0.00081	2.0	0.80	0.35
SF-10	6.8	0.00110	2.25	0.95	0.33
SF-11	6.9	0.00025	3.1	0.98	0.73
SF-12	7.6	0.00430	1.6	0.92	0.10
SF-13	8.0	0.00218	1.3	0.76	0.10
SF-14	8.3	0.00140	1.3	0.76	0.14
SF-15	8.6	0.00546	2.1	0.96	0.15
SF-16	9.3	0.00065	2.6	0.90	0.49
SF-17	10.0	0.00061	2.9	0.96	0.54
SF-19	10.4	0.00115	2.3	0.95	0.34

Table 2-7. Erosion Rate Parameters for 5 to 10 cm Layer

Sediment Core ID	River Mile Location	Proportionality Constant: A	Exponent: n	Correlation Coefficient (R^2)	Critical Shear Stress (Pa)
SF-1	2.4	0.00106	2.8	0.99	0.43
SF-3	3.7	0.00056	4.6	0.99	0.69
SF-4	4.0	0.00043	3.7	0.97	0.67
SF-5	4.8	0.00014	3.2	0.96	0.89
SF-8	6.1	0.00151	2.1	0.96	0.28
SF-9	6.4	0.00015	3.1	0.99	0.86
SF-10	6.8	0.00036	3.1	0.99	0.66
SF-11	6.9	0.00002	4.4	0.97	1.33
SF-12	7.6	0.00054	2.4	0.99	0.49
SF-13	8.0	0.00115	2.6	0.95	0.38
SF-14	8.3	0.00014	1.9	0.83	0.83
SF-15	8.6	0.00117	2.1	0.96	0.32
SF-16	9.3	0.00306	2.0	0.93	0.18
SF-17	10.0	0.00047	3.0	0.98	0.59
SF-19	10.4	0.00120	2.2	0.60	0.32

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Table 2-8. Erosion Rate Parameters for 10 to 15 cm Layer

Sediment Core ID	River Mile Location	Proportionality Constant: A	Exponent: n	Correlation Coefficient (R^2)	Critical Shear Stress (Pa)
SF-1	2.4	0.00048	3.9	0.98	0.67
SF-3	3.7	0.00608	2.8	0.98	0.23
SF-4	4.0	0.00034	2.8	0.99	0.64
SF-5	4.8	0.00026	2.6	0.99	0.68
SF-8	6.1	N/A	N/A	N/A	N/A
SF-9	6.4	0.00039	2.3	0.93	0.56
SF-10	6.8	0.00008	3.0	0.95	1.08
SF-11	6.9	0.00358	1.7	0.89	0.12
SF-12	7.6	0.00132	1.8	0.99	0.23
SF-13	8.0	0.00030	2.7	0.90	0.66
SF-14	8.3	0.00003	2.8	0.94	1.47
SF-15	8.6	0.00039	3.3	0.97	0.66
SF-16	9.3	0.00163	2.8	0.94	0.37
SF-17	10.0	0.00040	3.0	0.93	0.63
SF-19	10.4	0.00088	2.9	0.84	0.47

Table 2-9. Erosion Rate Parameters for 15 to 20 cm Layer

Sediment Core ID	River Mile Location	Proportionality Constant: A	Exponent: n	Correlation Coefficient (R^2)	Critical Shear Stress (Pa)
SF-1	2.4	0.00097	2.4	0.99	0.39
SF-3	3.7	0.00706	2.8	0.96	0.22
SF-4	4.0	0.00096	2.4	0.95	0.39
SF-5	4.8	0.00082	2.4	0.99	0.42
SF-8	6.1	N/A	N/A	N/A	N/A
SF-9	6.4	0.00027	2.5	0.92	0.66
SF-10	6.8	0.00004	3.1	0.99	1.30
SF-11	6.9	0.00358	1.7	0.89	0.11
SF-12	7.6	0.00090	2.8	0.99	0.45
SF-13	8.0	0.00025	3.1	0.95	0.74
SF-14	8.3	0.00003	2.7	0.88	1.54
SF-15	8.6	0.00002	4.6	0.99	1.41
SF-16	9.3	0.01233	1.1	0.86	0.02
SF-17	10.0	0.00077	2.2	0.77	0.40
SF-19	10.4	0.00409	1.8	0.82	0.13

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Table 2-10. Erosion Rate Parameters for 20 to 25 cm Layer

Sediment Core ID	River Mile Location	Proportionality Constant: A	Exponent: n	Correlation Coefficient (R^2)	Critical Shear Stress (Pa)
SF-1	2.4	0.00049	2.8	0.96	0.56
SF-3	3.7	0.00825	2.7	0.98	0.20
SF-4	4.0	0.00056	2.9	0.95	0.55
SF-5	4.8	0.00026	3.0	0.95	0.72
SF-8	6.1	N/A	N/A	N/A	N/A
SF-9	6.4	0.00004	3.2	0.99	1.33
SF-10	6.8	0.00006	2.7	0.97	1.18
SF-11	6.9	N/A	N/A	N/A	N/A
SF-12	7.6	0.00037	3.5	0.99	0.69
SF-13	8.0	0.00011	3.7	0.84	0.97
SF-14	8.3	0.00003	2.8	0.97	1.42
SF-15	8.6	0.00006	3.1	0.99	1.13
SF-16	9.3	0.01254	1.3	0.99	0.02
SF-17	10.0	0.00003	3.9	0.99	1.36
SF-19	10.4	0.00239	2.6	0.72	0.30

Spatial variation, both horizontal and vertical, in the erodibility of Lower Willamette River sediments in cohesive bed areas was evaluated as follows. The first step in this analysis was to calculate average values of the A and n parameters in Equation 2-29 for each of the five depth intervals. For a log-linear relationship (i.e., Equation 2-29), the average exponent (n_{ave}) value for a depth interval is the arithmetic average of the n values for the cores within the interval. The average proportionality constant (A_{ave}) is determined by calculating the log-average value:

$$\log(A_{ave}) = (1/K) \sum \log(A_k) \qquad (2\text{-}65)$$

where K is equal to the number of cores (i.e., 15). Using this approach, the average erosion parameters for the five layers in the bed model are listed in Table 2-11.

Table 2-11. Vertical Variation in Average Erosion Rate Parameters

Depth Interval	Average Proportionality Constant: A_{ave}	Average Exponent: n_{ave}	Critical Shear Stress (Pa)
Layer 1: 0 – 5 cm	0.00155	2.2	0.28
Layer 2: 5 – 10 cm	0.00048	2.9	0.58
Layer 3: 10 – 15 cm	0.00052	2.7	0.55
Layer 4: 15 – 20 cm	0.00062	2.6	0.49
Layer 5: 20 – 25 cm	0.00032	2.9	0.66

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Vertical variation in the average erosion rate properties for the five depth intervals was quantified using the following procedure. First, calculate the average value of gross erosion rate for depth interval i (${}^{ave}E_{gross,i}$, where i ranges from 1 to 5):

$$ {}^{ave}E_{gross,i} = 1/N \ \Sigma A_{ave,i} \tau^{n,ave,i} \quad (2\text{-}66) $$

where the summation is over the bed shear stress range of 0.05 to 3 Pa in increments of 0.05 Pa, so N is equal to 60. Values of $A_{ave,i}$ and nave,i for depth interval i are given in Table 2-11. Using the values of ${}^{ave}E_{gross,i}$ for the five depth intervals, the average erosion rate ratios for depth interval i ($R_{ave,i}$) was calculated using:

$$ R_{ave,i} = {}^{ave}E_{gross,i} / {}^{ave}E_{gross,1} \quad (2\text{-}67) $$

where i ranges from 1 through 5. Thus, $R_{ave,i}$ represents the ratio of the erodibility of depth interval i to the average erodibility of depth interval 1 (i.e., 0 to 5 cm layer); $R_{ave,1}$ is equal to one. The vertical variation in $R_{ave,i}$ is shown on Figure 2-52. These results show that the average erodibility of Lower Willamette River sediment in cohesive bed areas tends to decrease with increasing depth in the bed, which is a typical characteristic of a cohesive sediment bed and is primarily due to increasing consolidation with increasing depth. Quantification of the changes in bed erodibility with depth in the bed (e.g., erodibility of 20 to 25 cm layer is about four times less than the erodibility of 0 to 5 cm layer) aids in interpreting predictions of the sediment transport model, especially during high-flow events.

A similar approach was used to quantify spatial differences in bed erodibility of surface layer (i.e., 0 to 5 cm layer) within the horizontal plane in the Lower Willamette River. The average gross erosion rate for layer 1 (0 to 5 cm layer) in core k was calculated as follows:

$$ {}^{ave}E_{gross,1,k} = 1/N \ \Sigma A_{1,k} \tau^{n,1,k} \quad (2\text{-}68) $$

where the summation is over the bed shear stress range of 0.05 to 3 Pa in increments of 0.05 Pa, so N is equal to 60. Values of $A_{1,k}$ and $n_{1,k}$ for layer 1 in core k are given in Table 2-6. Using the value of ${}^{ave}E_{gross,1}$ for layer 1, the erosion rate ratio for layer 1 in core k was calculated using:

$$ R_{1,k} = {}^{ave}E_{gross,1,k} / {}^{ave}E_{gross,1} \quad (2\text{-}69) $$

Thus, $R_{1,k}$ represents the ratio of the erodibility of layer 1 in core k to the average erodibility of layer 1 (0 to 5 cm) sediment. The spatial distribution of $R_{1,k}$ for the 15 cores is presented on Figure 2-53. Nine of the 15 cores are below one (i.e., below the average erodibility of layer 1 sediment). Core SF-11 (RM 6.9) has the lowest erodible

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sediment in layer 1 (about 25 percent of the average value), with core SF-8 (RM 6.1) having the highest erodibility in layer (about 280 percent greater than the average value).

Sedflume data from 15 cores are not sufficient to use standard interpolation methods to develop a reliable horizontal distribution of erosion properties. In addition, no spatial patterns in the erosion rate ratio of surface-layer sediment are evident on Figure 2-53. Furthermore, no correlation was found between erosion properties and measured bed properties (i.e., dry density, D_{50}, D_{90}, silt/clay content). Thus, developing a credible spatial distribution of erosion parameters in the horizontal plane is problematic. Therefore, it was assumed that the average erosion rate parameters (i.e., A_{ave} and n_{ave} as listed in Table 2-10) for a given depth interval are spatially constant in the horizontal plane within cohesive bed areas. By assuming that the erosion parameters are spatially constant in the horizontal plane, the erosion parameters only vary in the vertical direction. The potential effects of this approximation on model predictions are evaluated during the sensitivity analysis (see Section 2.3.7).

2.3.5 Sediment Transport Model Inputs: Boundary Conditions

The incoming sediment load at the upstream boundary of the Lower Willamette River was estimated using total suspended sediment (TSS) concentration data collected at the USGS Portland gauging station between 1974 and 2009. A sediment rating curve (i.e., correlation between TSS concentration data and flow rate) was developed using the data obtained at the USGS gauging station (Figure 2-54). The Lower Willamette River sediment rating curve has the following behavior: 1) negligible correlation between TSS concentration and flow rate for discharge less than the average flow rate in the Lower Willamette River (33,200 cfs); and 2) positive correlation between TSS concentration and flow rate for discharge greater than the average flow rate. To correct for bias introduced when performing log-linear regressions analysis on the data, the minimum variance unbiased estimator (MVUE) method of Cohn et al. (1992) was used resulting in:

$$C_{LWR} = 9 \quad \text{for } Q_{LWR} < Q_{LWR,ave} \qquad (2\text{-}70)$$

$$= 1.3\,(Q/10{,}000)^{1.65} \quad \text{for } Q \geq Q_{,LWR,ave}$$

Where,
C_{LWR} = TSS concentration (mg/L)
Q_{LWR} = Lower Willamette River flow rate (cfs)
$Q_{LWR,ave}$ = average Lower Willamette River flow rate (33,200 cfs).

For the low-flow regime (i.e., less than average flow rate), C_{LWR} was assumed to be equal to the average value of the TSS concentration data (9 mg/L). The correlation coefficient for the log-linear correlation between TSS concentration and flow rate in the high-flow regime is 0.62.

The composition of the incoming sediment load to the Lower Willamette River was estimated using fine sediment content data (i.e., clay/silt content of suspended sediment

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load) collected at the USGS Portland gauging station. The relationship between clay/silt content (i.e., class 1 sediment content) and flow rate is shown on Figure 2-55. This relationship indicates the following: 1) negligible correlation between class 1 content and flow rate when flow rate is less than twice the average value; and 2) decreasing class 1 content with increasing flow rate when flow rate is greater than twice the average value. An analysis of these data yielded this functional relationship between class 1 content and flow rate:

$$f_1 = 0.92 \quad \text{for } Q_{LWR} < 2\, Q_{LWR,ave} \qquad (2\text{-}71)$$

$$= 1.01 - 0.014\,(Q_{LWR}/10{,}000) \quad \text{for } Q_{LWR} \geq 2\, Q_{LWR,ave}$$

where f_1 is class 1 content in suspended sediment load. The class 2 content in the suspended sediment load (i.e., fine sand content) is given by:

$$f_2 = 1 - f_1 \qquad (2\text{-}72)$$

It was assumed that the class 3 and 4 contents (i.e., medium/coarse sand and gravel) in the incoming sediment load of the Lower Willamette River were zero.

The incoming sediment load at the upstream boundary in the Columbia River was estimated using TSS concentration data collected at the USGS gauging station at Vancouver between 1963 and 1969. The correlation between TSS concentration and flow rate in the Columbia River is shown on Figure 2-56. Based on these data, the sediment rating curve for the Columbia River is:

$$C_{CR} = 0.26\,(Q_{CR}/10{,}000)^{1.53} \qquad (2\text{-}73)$$

Where,
C_{CR} = TSS concentration (mg/L)
Q_{CR} = the Columbia River flow rate (cfs).

The correlation coefficient for the log-linear correlation between TSS concentration and flow rate is 0.13.

The Lower Willamette River sediment rating curve (Equation 2-70) was used to estimate the incoming sediment load to the Lower Willamette River for the 36-year period from 1973 through 2008. Variations in the annual sediment load during this 36-year period are shown on Figure 2-57, with the long-term average being 1,200,000 metric tons/year (MT/yr). For the 7-year period from 2002 through 2008, the average load was 900,000 MT/yr. Seasonal variations in the annual sediment are presented on Figure 2-58, where 73 percent of the annual load occurs during the winter months (December, January, and February).

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2.3.6 Sediment Transport Model Calibration Approach and Results

The primary calibration target for the sediment transport model was bed elevation change in the Study Area (RM 1.9 to 11.8) over a multi-year period. The large amount of bed elevation data available made it possible to evaluate the performance of the sediment transport model over a wide range of spatial scales, ranging from the entire Study Area (about 1,920 acres excluding the areas where capping or dredging occurred between surveys) to single grid cells (about 1 acre). The high density of bed elevation data in the Lower Willamette River is unique for a sediment transport model. Typically, less than 10 data points for NSR (based on analysis of radioisotope core data) are available for calibration of a sediment transport model. A relatively high number of NSR data points (about 60 values) were available for evaluating the performance of the Lower Duwamish Waterway sediment transport model (QEA 2008). For the Lower Willamette River sediment transport model, approximately 1,700 values of bed elevation change were used during the model calibration process. Each Lower Willamette River data point represents bed elevation change within a single grid cell, with the average area of a grid cell being 1.1 acres (range of 0.6 to 1.9 acres) within the Site.

Bathymetric surveys were conducted within the Study Area at five different times between 2002 and 2009: 1) January 2002; 2) July/September 2002; 3) May 2003; 4) February 2004; and 5) January 2009. The bathymetry data were analyzed by David Evans and Associates (DEA) to produce bed elevation change data for the four time periods between surveys. Multibeam bathymetry surveys have a typical measurement error range of 0.5 feet resulting in an uncertainty range of 1 foot for bed elevation changes between two surveys. Thus, the uncertainty in bed elevation change decreases as the time period between two surveys increases. Therefore, after a preliminary screening of the data, it was considered more representative to consolidate the first two time periods and analyze the bed elevation changes for the following time periods: 1) January 2002 to May 2003 (16 months); 2) May 2003 to February 2004 (10 months); and 3) February 2004 to January 2009 (58 months). An evaluation of the bed elevation change data during these three time periods was conducted to determine what data would be most useful for calibrating the sediment transport model.

The average incoming sediment load to the Lower Willamette River for the 7-year period (January 2002 to January 2009) was 944,000 MT/yr. A summary of the incoming sediment load for the three time periods between 2002 and 2009 when bed elevation change are available is given in Table 2-12. The temporal distribution of the total upstream load between the three time periods is presented on Figure 2-59, where 72 percent of the load occurred during February 2004 to January 2009.

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Table 2-12. Incoming Sediment Load to Lower Willamette River Between 2002 and 2009

Time Period	Length of Time Period (months)	Annual Sediment Load (MT/yr)	Total Sediment Load During Period (MT)
January 2002 to May 2003	16	915,000	1,220,000
May 2003 to February 2004	10	809,000	674,000
February 2004 to January 2009	58	972,000	4,698,000
January 2002 to January 2009	84	937,000	6,592,000

Notes:
MT = metric tons
MT/yr = metric tons per year

The bed elevation change data were analyzed and used to construct sediment mass balances for the 9.9-mile reach of the Lower Willamette River extending from RM 1.9 to 11.8 during the 7-year period between January 2002 and January 2009 (see Figures 2-60 through 2-63). The total mass of sediment eroded or deposited within the 9.9-mile reach of the Lower Willamette River was calculated using the bed elevation change data for a particular time period. The average NSR for the entire 9.9-mile reach was also estimated from the bed elevation change data. This information, combined with the upstream sediment load, was used to construct a sediment mass balance for a specific time period and calculate the trapping efficiency of the 9.9-mile reach, where trapping efficiency is the portion of the upstream sediment load deposited in the reach. A summary of the mass balance results is given in Table 2-13. The temporal distribution of net deposition between the three time periods is presented on Figure 2-64, where 92 percent of the total net deposition occurred during February 2004 to January 2009. Variation in the average NSR during the different time periods between January 2002 and January 2009 is presented on Figure 2-65.

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Table 2-13. Sediment Mass Balances for RM 1.9 to 11.8 Region for 2002 to 2009 Period

Time Period	Net Deposition Rate (MT/yr)	Average Net Sedimentation Rate (cm/yr)	Trapping Efficiency (%)
January 2002 to May 2003	-1,400 (net erosion)	0.0	0
May 2003 to February 2004	154,000	2.1	18
February 2004 to January 2009	262,000	3.5	26
January 2002 to January 2009	197,000	2.6	20

Notes:
cm/yr = centimeters per year
MT/yr = metric tons per year

The results of this analysis of the bed elevation change data have the following implications for calibration of the sediment transport model. Net deposition processes in the 9.9-mile reach (RM 1.9 to 11.8) during the 16-month period from January 2002 to May 2003 are significantly different than during the period from May 2003 to January 2009, even though the incoming sediment load is similar. Thus, the 16-month period (January 2002 to May 2003) appears to be anomalous and using bed elevation change data collected during that period for calibration would have produced a sediment transport model that would predict unrealistically low NSRs. Therefore, the 68-month period from May 2003 to January 2009 was selected as the model calibration period because it will produce a robust model that is representative of long-term sediment transport processes in the Study Area (RM 1.9 to 11.8).

The sediment transport model was calibrated using bed elevation change data collected during the 68-month period from May 2003 to January 2009. The hydrograph in the Lower Willamette River for this time period is shown on Figure 2-66. Several high-flow events (i.e., greater than 100,000 cfs) occurred during the calibration period, with the maximum flow rate happening during a 2-year flood in January 2006. Three input parameters were adjusted during the calibration process: 1) effective diameter of class 2 (fine sand) sediment; 2) effective diameter of class 3 (medium/coarse sand) sediment; and 3) exponent (N) in active layer thickness formulation for non-cohesive bed (Equation 2-59). The data-based and calibrated effective diameters for all sediment classes are listed in Table 2-14. The exponent (N) in the active layer thickness equation for the non-cohesive bed was set at a value of 0.5.

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Table 2-14. Characteristics of Sediment Particle Size Classes

Sediment Size Class	Particle Size Range (μm)	Data-Based Effective Particle Diameter (μm)	Calibration Effective Particle Diameter (μm)
1: clay and silt	< 62	Not Applicable	Not Applicable
2: fine sand	62 – 250	140	100
3: medium, coarse sand	250 – 2,000	550	700
4: gravel	> 2,000	2,800	2,800

Notes:
μm = micrometer

Model performance was evaluated over a range of spatial scales within the Site (RM 1.9 to 11.8). The calibration results will be examined starting with the largest spatial scale (i.e., entire Study Area, about 1,920 acres) and then proceed to smaller spatial scales, with the small scale being a single grid cell (about 1 acre). The sediment mass balance predicted by the model within the Study Area (RM 1.9 to 11.8) for the 68-month calibration period is presented on Figure 2-67. The model predicted a net deposition rate of 203,000 MT/yr for the entire Site, which is within 6 percent of the data-based estimate (192,000 MT/yr). If regions where capping and dredging activities occurred during the calibration period are excluded from the comparison, then the predicted and measured net deposition rate is reduced by 14,000 MT/yr and 8,000 MT/yr, respectively. The data-based and predicted trapping efficiencies for the Site during the calibration period are 20 percent and 21 percent, respectively. Comparison of measured (data-based) and predicted regions of net erosion and deposition within the Site during the 68-month period are shown on Figure 2-68. These results show that for the largest spatial scale (entire Study Area), the model adequately predicts the net deposition mass and trapping efficiency with a slight tendency to over-predict sedimentation. In addition, the overall spatial distribution of erosion and deposition areas is well represented by the model.

Spatial distributions of laterally averaged (i.e., cross-channel average) bed elevation change predicted by the model during the 68-month calibration period were compared to measured values over three spatial scales: 1) 1-mile average (about 200 acres); 2) 0.5-mile average (about 100 acres); and 3) 1/8-mile average (about 22 acres). The 1/8-mile laterally averaged bed elevation changes correspond to one row of grid cells across the river channel. The predicted and measured longitudinal (along channel) distributions of laterally-averaged values for the 1-mile, 0.5-mile and 1/8-mile averages are shown on Figures 2-69, 2-70 and 2-71, respectively. The model-data comparisons on these figures demonstrate that the model adequately simulates longitudinal variations in laterally-averaged bed elevation change from 1-mile to 1/8-mile spatial scales.

A spatial scale analysis (QEA 2008) was conducted to determine the relationship between model predictive capability and spatial scale within the Study Area (RM 1.9 to 11.8). Absolute differences between predicted and measured bed elevation changes were calculated for different zones located in the RM 1.9 to 11.8 region, with zonal areas

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ranging from about 1 acre (i.e., a single grid cell) to about 1,920 acres (entire RM 1.9-11.8 region). The zonal analysis separated the Site into zones based on rows of grid cells across the Lower Willamette River channel; on average, there are 25 grid cells in the cross-channel direction. An idealized channel consisting of 11 rows in the longitudinal direction, and 5 grid cells in the cross-channel direction is used to illustrate this approach. The smallest zones in this analysis are 1-row zones, which results in 11 zones for the idealized channel (Figure 2-72). The next-largest zones are composed of 2-row zones (Figure 2-73). For the 2-row zones, each zone is shifted by one row with respect to location, so that adjacent zones overlap by one row. This process results in ten 2-row zones. Similarly, there are nine 3-row zones, eight 4-row zones, and, finally, two 10-row zones (Figure 2-74).

The primary results of the spatial-scale analysis are shown in Figure 2-75. This figure presents the absolute difference for zonal spatial-scales ranging from about 1 to 1,920 acres. The solid dots in Figure 2-75 represent the average absolute difference, with the 95 percent confidence interval about the average shown as error bars. The following general conclusions were derived from the spatial-scale analysis: 1) the average absolute difference is less than +/- 0.1 centimeters per year (cm/yr) for all spatial scales, indicating that the model is not biased and has approximately the same predictive capability, on average, over the entire range of spatial scales; and 2) for all spatial scales the confidence interval of the model prediction is below $\pm$0.5 cm/yr, which indicates that the model does not tend to significantly over-predict sedimentation rate.

The smallest spatial scale at which the predictive capability of the model was evaluated is a single grid cell. The first step in this evaluation was determining qualitative agreement between erosion and deposition areas (e.g., if the model predicts net deposition in a specific grid cell, is the prediction consistent with the data-based bed elevation change?). The spatial distribution of qualitative agreement between areas of net erosion and deposition during the 68-month calibration period is shown on Figure 2-76. Overall, model predictions of net erosion and deposition on a grid-cell basis agreed with the measured bed elevation change for 75 percent of the grid cells within the Study Area (RM 1.9 to 11.8), which contains a total of 1,909 grid cells (Figure 2-77). Results of a quantitative analysis of model predictions at the grid-cell spatial scale within areas of net erosion and deposition are shown on Figure 2-78 and summarized in Table 2-15. Within the Site, the model predicted net deposition to occur over 88 percent of the total area (1,690 acres) and net erosion over the remaining 12 percent (230 acres) during the time period between May 2003 and January 2009. Thus, these results indicate that significant variability exists in the predictive capability of the sediment transport model at the grid-cell spatial scale.

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Table 2-15. Sediment Transport Model Performance at Grid-Cell Spatial Scale

Difference Between Predicted and Measured Bed Elevation Change (cm/yr)	Relative Portion of Grid Cells With Predicted Net Erosion (%)	Relative Portion of Grid Cells With Predicted Net Deposition (%)
Less than ±2.5	31	58
±2.5 to ±5	27	26
±5 to ±10	30	12
Greater than ±10	12	4

Notes:
cm/yr = centimeters per year

In summary, the predictive capability of the sediment transport model was evaluated over a wide range of spatial scales, from a single grid cell (about 1 acre) to the entire Study Area (about 1,900 acres), during the calibration process. Extensive analysis of model results demonstrated that:

- Within the Study Area (RM 1.9 to 11.8), the model is able to adequately simulate: 1) large-scale deposition and erosion processes; and 2) longitudinal variations in laterally averaged bed elevation change.
- At grid-cell spatial scales (about 1 acre), model predictions have approximately zero bias on average. However, significant variability exists in model predictive capability at this spatial scale.

Therefore, it is concluded that the Lower Willamette River sediment transport model was successfully calibrated.

As described above, the sediment transport model was calibrated using bed elevation change data in the Study Area. The calibration process, however, did not consider the behavior of sediments that are too fine to settle onto the sediment bed (i.e., wash load). Although wash load by definition does not impact erosion and deposition processes, it has significance in the fate and transport of contaminants as it affects the partitioning of contaminants in the water column. Therefore, existing TSS concentration data collected during the calibration period (Integral et al. 2011) were used to estimate the wash load concentration. During low-flow conditions, it was determined that the wash load concentration is about 5 mg/L. To represent the wash load in the model, an additional sediment class with zero settling speed and a constant concentration of 5 mg/L was added. Only predicted values of TSS concentration are affected by this modification to the model.

2.3.7 Evaluation of Model Reliability

The calibrated sediment transport model is a reliable tool for erosion, deposition, and transport processes over multi-year periods in the Lower Willamette River. However, uncertainty exists in model predictions because of uncertainty in model inputs or

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parameters. The effects of input uncertainty on model predictions were evaluated through a sensitivity analysis.

Based on a similar uncertainty analysis conducted for a sediment transport model of the Lower Duwamish Waterway, which is an estuary near Seattle, Washington (QEA 2008), the effects of five inputs on model uncertainty were chosen for this analysis: 1) upstream sediment load in Lower Willamette River; 2) upstream sediment load in Columbia River: 3) composition of upstream sediment load in Lower Willamette River; 4) erosion rate parameters for cohesive sediment; and 5) effective bed roughness (D_{90}). Lower- and upper-bound limits of these there inputs were specified as follows:

- *Upstream sediment load in Lower Willamette River:* ± a factor-of-two with respect to base-case simulation
- *Upstream sediment load in Columbia River:* ± a factor-of-two with respect to base-case simulation
- *Composition of upstream sediment load in Lower Willamette River:* ± 5 percent class 1 content with respect to base-case simulation
- *Erosion rate parameters for cohesive sediment:* lower-bound corresponds to least erodible core and upper-bound corresponds to most erodible core
- *Effective bed roughness:* mean ± 2 standard errors

Table 2-16 presents additional information regarding the parameters used for the sensitivity analysis.

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Table 2-16. Summary of Parameters Varied in Sensitivity Analysis

Parameters	Base Case	Lower Bound	Upper Bound
Average upstream sediment load in Lower Willamette River (MT/yr)	951,000	475,000	1,901,000
Average upstream sediment load in Columbia River (MT/yr)	3,769,000	1,884,000	7,537,000
Composition of upstream sediment load in Lower Willamette River f_1: fraction of class 1 Q: Discharge Q_m: Mean discharge = 33,200 cfs	if $Q < 2Q_m$, $f_1 = 0.92$ else, $f_1 = 1.01 - 0.014 \frac{Q}{10000}$	if $Q < 2Q_m$, $f_1 = 0.87$ else, $f_1 = 0.96 - 0.014 \frac{Q}{10000}$	if $Q < 2Q_m$, $f_1 = 0.97$ else, $f_1 = 1.06 - 0.014 \frac{Q}{10000}$
Erosion rate parameters for cohesive sediment	Average Sedflume core See Table 2-11	Least erodible Sedflume core (SF-11) See Tables 2-6 to 2-10	Most erodible Sedlume core (SF-8) See Tables 2-6 to 2-10
Effective bed roughness: D_{90} (μm)	Spatial variable D_{90}	Cohesive bed = 286 μ, Non cohesive bed = 1196 μ	Cohesive bed = 327 μ, Non cohesive bed = 1355 μ

To evaluate the effects of possible interactions between the three inputs, a factorial analysis was conducted, which resulted in 32 simulations to account for all of the possible combinations of the bounding limits of the five inputs. The parameter sets used in the 32 uncertainty simulations are provided in Table 2-17, where "lower" refers to lower-bound value and "upper" refers to upper-bound value.

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Table 2-17. Bounding Limits for Sensitivity Simulations

Simulation Number	Lower Willamette River Sediment Load Bound	Columbia River Sediment Load Bound	Lower Willamette River Sediment Load Composition Bound	Erosion Rate Parameters Bound	Effective Bed Roughness Bound
1	Lower	Lower	Lower	Lower	Lower
2	Lower	Lower	Lower	Lower	Upper
3	Lower	Lower	Lower	Upper	Lower
4	Lower	Lower	Lower	Upper	Upper
5	Lower	Lower	Upper	Lower	Lower
6	Lower	Lower	Upper	Lower	Upper
7	Lower	Lower	Upper	Upper	Lower
8	Lower	Lower	Upper	Upper	Upper
9	Lower	Upper	Lower	Lower	Lower
10	Lower	Upper	Lower	Lower	Upper
11	Lower	Upper	Lower	Upper	Lower
12	Lower	Upper	Lower	Upper	Upper
13	Lower	Upper	Upper	Lower	Lower
14	Lower	Upper	Upper	Lower	Upper
15	Lower	Upper	Upper	Upper	Lower
16	Lower	Upper	Upper	Upper	Upper
17	Upper	Lower	Lower	Lower	Lower
18	Upper	Lower	Lower	Lower	Upper
19	Upper	Lower	Lower	Upper	Lower
20	Upper	Lower	Lower	Upper	Upper
21	Upper	Lower	Upper	Lower	Lower
22	Upper	Lower	Upper	Lower	Upper
23	Upper	Lower	Upper	Upper	Lower
24	Upper	Lower	Upper	Upper	Upper
25	Upper	Upper	Lower	Lower	Lower
26	Upper	Upper	Lower	Lower	Upper
27	Upper	Upper	Lower	Upper	Lower
28	Upper	Upper	Lower	Upper	Upper
29	Upper	Upper	Upper	Lower	Lower
30	Upper	Upper	Upper	Lower	Upper
31	Upper	Upper	Upper	Upper	Lower
32	Upper	Upper	Upper	Upper	Upper

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The sensitivity simulation results were analyzed, with simulations 11 and 26 producing the ultimate lower- and upper-bound results, respectively. Further analysis of the sensitivity results showed that simulations 7 and 12 yielded results which correspond to realistic lower- and upper-bound predictions (i.e., within a factor of two of the base case simulation). The realistic lower- and upper-bound simulations (i.e., parameters sets for simulations 7 and 12) were used as input for the contaminant fate and transport model to evaluate the impact of uncertainty in the sediment transport model inputs on the contaminant fate and transport model (see Appendix Ha for more discussion on the contaminant fate model sensitivity analysis). Base case simulation results are compared to lower- and upper-bound results for the realistic and ultimate model parameter sets on Figure 2-79.

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3.0 DIAGNOSTIC AND PROGNOSTIC MODELING ANALYSES

3.1 SEDIMENT BED STABILITY DURING HIGH-FLOW EVENTS

The effects of high-flow events on bed stability in the Lower Willamette River were evaluated by using the sediment transport model to simulate the February 1996 flood. The peak flow rate during the 1996 flood was 420,000 cfs, which likely represents a high-flow event with a return period of at least 100 years. Therefore, the bed stability analysis was conducted using flow conditions that are representative of an extreme high-flow event.

The predicted sediment mass balance for the Study Area (RM 1.9 to 11.8) during the 1996 flood is shown on Figure 3-2. The incoming sediment load was 1,260,000 MT, which was estimated using Equation 2-70. This incoming load, which occurred during a 14-day period, is about 33 percent greater than the average annual incoming load during the 68-month calibration period (i.e., 950,000 MT/yr). Overall, net erosion occurred within the Study Area, with 182,000 MT of sediment being predicted to be eroded and transported out of the Study Area. This amount of sediment is approximately equal to the amount of net deposition that occurred on an annual basis during the calibration period (see Figure 2-67).

The spatial distribution of bed elevation change that was predicted during the 1996 flood is shown on Figure 3-3. Overall, net erosion occurred in 54 percent of the bed area within the RM 1.9 to 11.8 region. Predicted maximum scour depths during 1996 flood are presented on Figure 3-4. The relative areal distribution of various ranges of scour depths is tabulated in Table 3-1. The maximum scour depth was predicted to be 62 cm, which occurred near RM 5.3. This information was used in evaluations of the potential for rare high-flow events to expose elevated contaminant concentrations buried at depth in the bed, as discussed in Section 5.7 of the main text.

Table 3-1. Relative Areal Distribution of Maximum Scour Depths During 1996 Flood

Maximum Scour Depth (cm)	Relative Portion of Area Within River Mile 1.9 to 11.8 Region (%)
0 to 10	43
10 to 20	13
20 to 30	16
Greater than 30	1
Net Depositional	27

Notes:
cm = centimeter

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A diagnostic analysis of the 1996 flood simulation was conducted to develop insights about model performance at specific locations within the Study Area. A total of 15 locations were selected for the diagnostic analysis, with 10 locations in cohesive bed areas and 5 locations in non-cohesive bed areas (Figure 3-5). The locations were selected such that a range of sediment transport regimes were represented (i.e., different rates of net sedimentation or net erosion), see Table 3-2. The NSRs in Table 3-2 correspond to predicted values for the 68-month calibration simulation; negative values in the table represent net erosion.

Table 3-2. Locations of Grid Cells Used in Diagnostic Analysis of 1996 Flood

Location Label	River Mile Location	Type of Bed	Net Sedimentation Rate (cm/yr)
C-1	3.22	Cohesive	0.0
C-2	3.28	Cohesive	-0.19
C-3	3.64	Cohesive	0.08
C-4	4.30	Cohesive	1.3
C-5	4.40	Cohesive	5.0
C-6	6.81	Cohesive	-0.21
C-7	7.19	Cohesive	0.02
C-8	7.42	Cohesive	0.2
C-9	7.89	Cohesive	24
C-10	10.82	Cohesive	3.8
NC-1	5.29	Non-cohesive	0.76
NC-2	5.66	Non-cohesive	-0.7
NC-3	8.93	Non-cohesive	2.1
NC-4	9.22	Non-cohesive	1.5
NC-5	10.31	Non-cohesive	13

Notes:
cm/yr = centimeters per year

The diagnostic analysis of the 1996 flood simulation examined temporal variations in the following predictions at specific grid cell locations: depth-averaged current velocity; bed shear stress; TSS concentrations (total, classes 1, 2, 3, 4); bed elevation change; erosion flux; deposition flux; and surface-layer bed content of classes 1, 2, 3, and 4. The results of the diagnostic analysis at the 15 grid cell locations are presented on Figures 3-6 through 3-35.

Eight of the ten cohesive bed locations were predicted to be net erosional during the 1996 flood, with net erosion depths ranging between about 10 and 25 cm and peak bed shear stresses greater than 1.5 Pa. The two cohesive bed locations that were net depositional during the 1996 flood (i.e., locations C-5 and C-9) are the two locations where the long-term NSR was predicted to be greater than 4 cm/yr. Peak bed shear stresses were less than about 1 Pa at the cohesive bed locations that were net depositional.

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At the non-cohesive bed locations, three locations were predicted to be net erosional during the 1996 flood, with maximum net erosion depths of about 5 cm and peak bed shear stresses between 4 and 6 Pa. The two non-cohesive bed locations that were net depositional during the 1996 flood (i.e., locations NC-3 and NC-5) are locations where the long-term NSR was greater than 2 cm/yr. Peak bed shear stresses were less than about 1 Pa at the non-cohesive bed locations that were net depositional.

3.2 LONG-TERM SEDIMENT TRANSPORT PROCESSES

Sediment transport in the Lower Willamette River was simulated over a 45-year period. This simulation was conducted to: 1) evaluate the behavior of the sediment transport model over a multi-year period; and 2) provide coupling output for the contaminant fate and transport model such that the effects of remedial alternatives could be evaluated over a 45-year period (see Appendix Ha). The 45-year sediment transport simulation was constructed as follows: 1) simulate 30-year period (1979 through 2008) with the hydrodynamic model; and 2) create hydrodynamic model inputs for the sediment transport model by repeating the first 15 years (i.e., 1979 through 1993) and using those inputs for years 31 through 45 of the 45-year sediment transport simulation. This approach produces a reasonable approximation of long-term hydrodynamic conditions in the Study Area. Temporal variations in the annual average flow rate in the Lower Willamette River for 1979 through 2008 are displayed on Figure 3-36, with the lowest and highest values occurring during 1992 and 1996 respectively. The average annual incoming sediment load to the Lower Willamette River during this 30-year period was about 1,200,000 MT/yr (see Figure 2-57).

The 45-year simulation was conducted using "base case" model inputs (i.e., calibration parameters, upstream sediment load based on Equation 2-70). The only input that needed to be modified for the 45-year simulation was the downstream boundary in the hydrodynamic model due to lack of WSE data at the NOAA gauge located at St. Helens before 2002. Thus, water surface elevations predicted by NOAA using tidal harmonics for the period between 1979 and 2001 were used to specify the downstream boundary condition. Predicted WSE will tend to be lower than actual values because changes in mean WSE due to changes in upstream river discharge are not incorporated into the NOAA tidal harmonics model. Lower mean WSE at the downstream boundary will produce an over-prediction of current velocities by the hydrodynamic model. The over-prediction of current velocities will tend to decrease the deposition rates predicted by the sediment transport model and, thus, the contaminant fate and transport model will generate more conservative predictions (i.e., slower rate of natural recovery will be predicted).

Sensitivity of the long-term simulations to uncertainty in model input parameters was evaluated by conducting 30-year simulations using the realistic lower- and upper-bound parameter sets discussed in Section 2.3.7 (i.e., sensitivity simulations 7 and 12). Although the full 45-year period was simulated to provide the necessary inputs for the contaminant fate and transport model, the two sensitivity simulations were conducted for only the first 30 years of the 45-year period. The predicted sediment mass balance for the

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base-case 30-year (1979 to 2008) simulation is shown on Figure 3-37. The Study Area (RM 1.9 to 11.8) is net depositional, with a trapping efficiency of 19 percent. Sediment mass balances for the lower- and upper-bound 30-year simulations are presented on Figures 3-38 and 3-39, respectively. The trapping efficiencies for the bounding simulations are approximately equal to the trapping efficiency for the base-case simulation. This result indicates that variations in the five model parameters/inputs used in the sensitivity analysis do not affect the large-scale behavior of the model. The bounding simulations also demonstrate that the net deposition rate in the Study Area is approximately linearly correlated to the incoming sediment load in the Lower Willamette River (i.e., net deposition rate increases by 100 percent when the incoming sediment load is increased by 100 percent).

The relative portions of the Study Area with net erosion and deposition during the 30-year base-case simulation are shown on Figure 3-40. Similar graphical displays for the lower- and upper-bound simulations are presented on Figure 3-41 and 3-42, respectively. Numerical comparisons of the base-case, lower- and upper-bound simulations are provided in Table 3-3. Longitudinal (along channel) variations in laterally-averaged bed elevation change for the base-case, lower- and upper-bound simulations are presented on Figure 3-43.

Table 3-3. Relative Portions of Study Area with Net Erosion/Deposition, 30-Year Simulation

Range of Net Erosion and Deposition	Portion of the Study Area: Base-Case Simulation (%)	Portion of the Study Area: Lower-Bound Simulation (%)	Portion of the Study Area: Upper-Bound Simulation (%)
Erosion: < -5 cm/yr	1	1	0
Erosion: 0 to -5 cm/yr	13	14	6
Deposition: 0 to 5 cm/yr	56	74	49
Deposition: > 5 cm/yr	30	11	45

Notes:
cm/yr = centimeters per year

Model predictions for the 30-year simulation were evaluated at the same 15 locations used in the diagnostic analysis of the 1996 flood simulation (see Table 3-2 and Figure 3-5 for locations). The analysis of the 30-year simulation examined temporal variations in the following model predictions at specific grid cell locations: 1) bed elevation change; and 2) surface-layer bed content of classes 1, 2, 3, and 4. Results of the 30-year diagnostic analysis at the 15 grid cell locations are presented on Figures 3-44 through 3-58.

Eight of the ten cohesive bed locations were predicted to be net depositional during the 30-year period, with NSRs typically ranging between about 0.1 and 33 cm/yr. The two cohesive bed locations that were net erosional during the 30-year period (i.e., locations C-1 and C-6) had average net erosion rates ranging between about -0.1 and -1.3 cm/yr. At

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the five non-cohesive bed locations, three locations were predicted to be net depositional during the 30-year period, with NSRs ranging between about 1.5 and 15 cm/yr. The other two locations, NC-1 and NC-2, presented average net erosion rates of -1.2 and -3.4 cm/yr, respectively. The effects of the 1996 flood on bed elevation change are clearly evident at all 15 locations.

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To: Gustavson, Karl[Gustavson.Karl@epa.gov]
Cc: Mullin, Jeanette[MullinJM@cdmsmith.com]; Foster, Malena L.[fosterml@cdmsmith.com]
From: King, Todd W.
Sent: Fri 6/26/2015 12:52:06 PM
Subject: Fwd: prop tech
Proposed Technology Assignment Rules_2015-06-24.docx
ATT00001.htm

Todd King
kingtw@cdmsmith.com
c:(313)670-6020

Begin forwarded message:

From: "King, Todd W." <KingTW@cdmsmith.com>
Date: June 25, 2015 at 9:16:42 PM EDT
To: "King, Todd W." <KingTW@cdmsmith.com>
Subject: prop tech

To: Legare, Amy[Legare.Amy@epa.gov]; Lambert, Matthew[Lambert.Matthew@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]
From: Fonseca, Silvina
Sent: Wed 4/9/2014 1:09:32 PM
Subject: FW: Principle Threat Material Memo
PTW_Tech Memo_04-03-14_Draft_REV 1.pdf

For today at 10 am.

Silvina Fonseca, Environmental Engineer
Office of Superfund Remediation and Technology Innovation

Phone #: 703-603-8799
Fax #: 703-603-9104

From: Sheldrake, Sean
Sent: Friday, April 04, 2014 4:40 PM
To: Alex Liverman (liverman.alex@deq.state.or.us); allenmc@cdm.com; audiehuber@ctuir.com; bayuk.dana@deq.state.or.us; schwarz.bob@deq.state.or.us; brandy.humphreys@grandronde.org; callie@ridolfi.com; Conley, Alanna; Cora, Lori; cunninghame@gorge.net; Dan Hafley (HAFLEY.Dan@deq.state.or.us); erin.madden@gmail.com; Fuentes, Rene; Gail Fricano (gfricano@indecon.com); Genevieve Angle (Genevieve.Angle@noaa.gov); Humphrey, Chip; jd@williamsjohnsonlaw.com; Jen Kassakian (jkassakian@indecon.com); Jeremy_Buck@fws.gov; johnson.keith@deq.state.or.us; jweis@hk-law.com; Kristin Callahan; Koch, Kristine; Lance Peterson (PetersonLE@cdmsmith.com); matt@williamsjohnsonlaw.com; mcclincy.matt@deq.state.or.us; tosm@yakamafish-nsn.gov; Michael.karnosh@grandronde.org; Muza, Richard; nancy.munn@noaa.gov; peterson.Jennifer@deq.state.or.us; poulsen.mike@deq.state.or.us; Rachel DelVecchio (rdelvecchio@indecon.com); Robert.Neely@noaa.gov; rose@yakamafish-nsn.gov; Susan Penoyar (PenoyarSJ@cdmsmith.com); ted_buerger@fws.gov; tomd@ctsi.nsn.us; Tom Gainer (gainer.tom@deq.state.or.us)
Cc: Ells, Steve; Fonseca, Silvina
Subject: Principle Threat Material Memo

Hello everyone,

As discussed on our last TCT teleconference, please see the attached PTM memo for usage in the Tuesday April 15 meeting with LWG. Kristine and I would ask for your input on the memo on a short timeframe—by next Wednesday such that we can prepare for final logistics for the

meeting.

An associated component that we'll develop soon is the element of practicability/accessibility issues that we'll be putting together as a companion framework to guide how FS costing will proceed in the short term and the steps required for how design might proceed in the future.

Thanks and have a good weekend.

S

Sean Sheldrake, Unit Diving Officer, RPM

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http://yosemite.epa.gov/r10/cleanup.nsf/sites/ptldharbor

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From: King, Todd W.
Sent: Mon 3/31/2014 7:45:05 PM
Subject: Draft Slides for Tomorrow. Please call if questions.
EPA_LWG_TechAssign_20140401v2.pdf

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Cc: Rood, Stephen[RoodSG@cdmsmith.com]
From: King, Todd W.
Sent: Tue 3/25/2014 2:43:54 PM
Subject: Another LWG Data Request

Chip-

A couple more requests of LWG…

Thanks,

TK

In order for EPA to further evaluate the draft FS for the Portland Harbor Superfund site, EPA is requesting the following additional information to be submitted electronically to EPA:

1) The Sept 2002 and Feb/Mar 2004 bathymetry data – these data sets were missing or corrupted from the previous CDs/DVDs provided to EPA earlier. File format should be raster or grid file in ArcGIS format with 1 meter max pixel size/grid spacing.

2) The "Site Dredging and Capping Activities" map Figure 2.4-4 from the Draft FS. File format should be an ArcGIS shape file or polygon file in a geodatabase.

Your expedited response to these requests would be most appreciated.

To: Humphrey, Chip[Humphrey.Chip@epa.gov]; Koch, Kristine[Koch.Kristine@epa.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]
Cc: Penoyar, Susan[PenoyarSJ@cdmsmith.com]; Blischke, Eric[blischkee@cdmsmith.com]; Mullin, Jeanette[MullinJM@cdmsmith.com]; Peterson, Lance[PetersonLE@cdmsmith.com]; Rood, Stephen[RoodSG@cdmsmith.com]
From: King, Todd W.
Sent: Tue 3/25/2014 2:31:24 PM
Subject: Revised Slides for LWG SDU Conversation this Thursday
EPA_LWG_Meeting_20140327v1.pdf

Please review and forward to LWG if no further changes.

Thanks,

Todd

To: Humphrey, Chip[Humphrey.Chip@epa.gov]; Koch, Kristine[Koch.Kristine@epa.gov]; Sheldrake, Sean[sheldrake.sean@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]
Cc: Peterson, Lance[PetersonLE@cdmsmith.com]; Mullin, Jeanette[MullinJM@cdmsmith.com]; King, Todd W.[KingTW@cdmsmith.com]; Blischke, Eric[blischkee@cdmsmith.com]
From: Penoyar, Susan
Sent: Fri 3/21/2014 9:03:45 PM
Subject: Principal Threat Waste identification
PTW_Tech Memo_03-21-14_Final.pdf

Hi everyone!

Attached is a technical memo presenting an approach for identifying PTW at the Portland Harbor site for your review. We focused on presenting approaches that are consistent with EPA guidance. We identified three lines of evidence to identify PTW:

1. Observance of NAPL (mobility and toxicity)
2. Sediment contaminant concentrations that would exceed the contaminant's corresponding theoretical solubility limits in pore water (mobility)
3. Sediment contaminant concentrations that exceed a high concentration threshold equal to a sediment PRG multiplied by 1,000 (toxicity)

We are available to discuss the PTW identification approach at your convenience.

Have a great weekend!

Susan J. Penoyar, PE, LEG, BCEE | Vice President | CDM Smith

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Cc: Rood, Stephen[RoodSG@cdmsmith.com]
From: King, Todd W.
Sent: Fri 3/21/2014 2:19:32 PM
Subject: Draft Slides for LWG SDU Meeting
EPA_LWG_Meeting_20140327v0.pdf

All-

For review for next week.

TK

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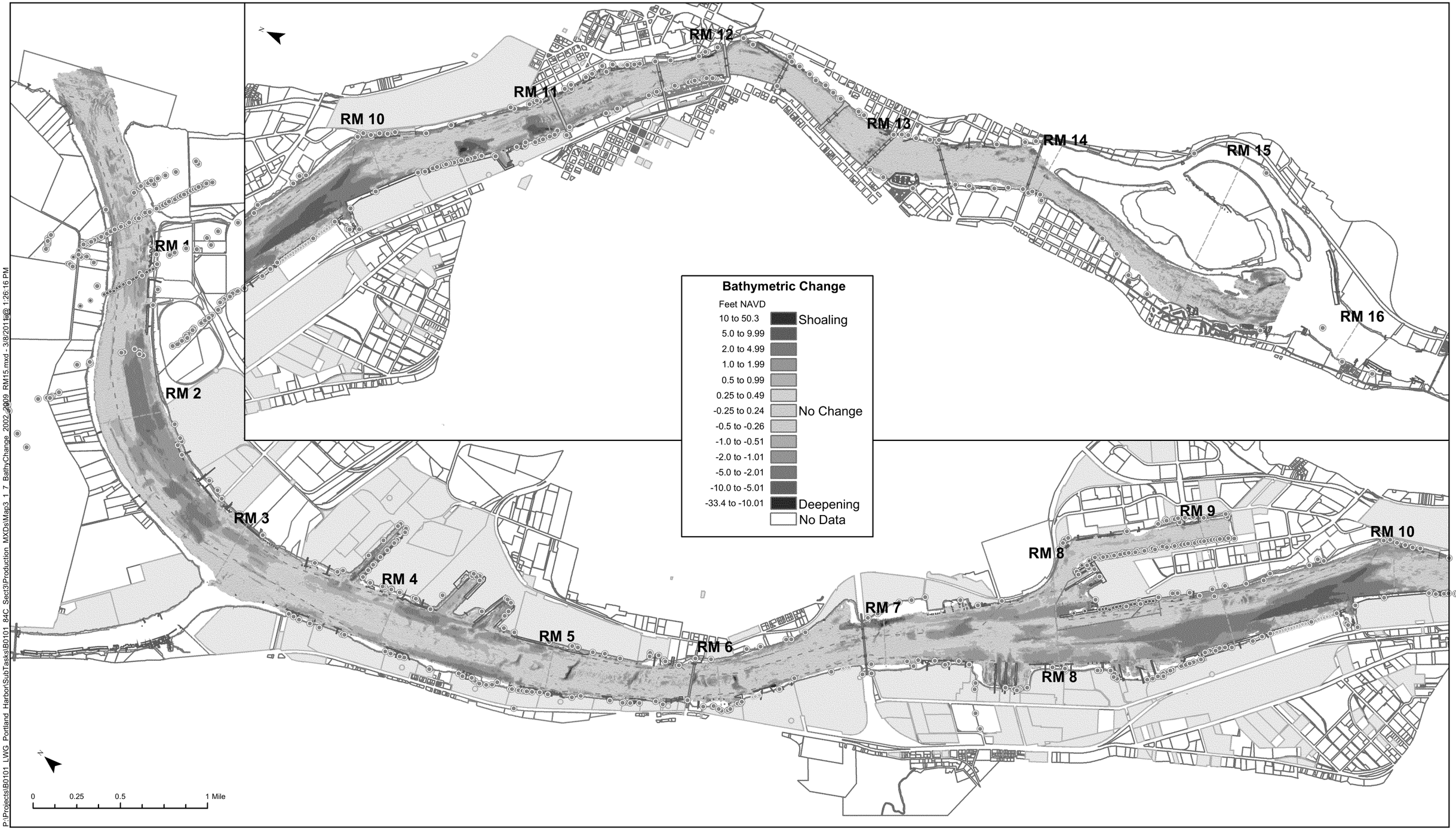
p/f: (313) 230-5648

c: (313) 670-6020



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integral consulting inc.

LWG Lower Willamette Group

FEATURE SOURCES:
Transportation, Property, or Boundaries: Metro RLIS.
Channel & River Miles: US Army Corps of Engineers.
Bathymetric Information: David Evans and Associates, Inc.

Map Features

- River Miles
- Bridges
- Docks and Structures
- Navigation Channel

Outfalls

- Outfall
- Dock Drain
- Roof Drain

- Upland ECSI Sites (2008)
- Waterfront Taxlots
- River Edge +13 ft NAVD

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Map 3.1-7
Portland Harbor RI/FS
Remedial Investigation Report
Bathymetric Change
July 2002 to January 2009

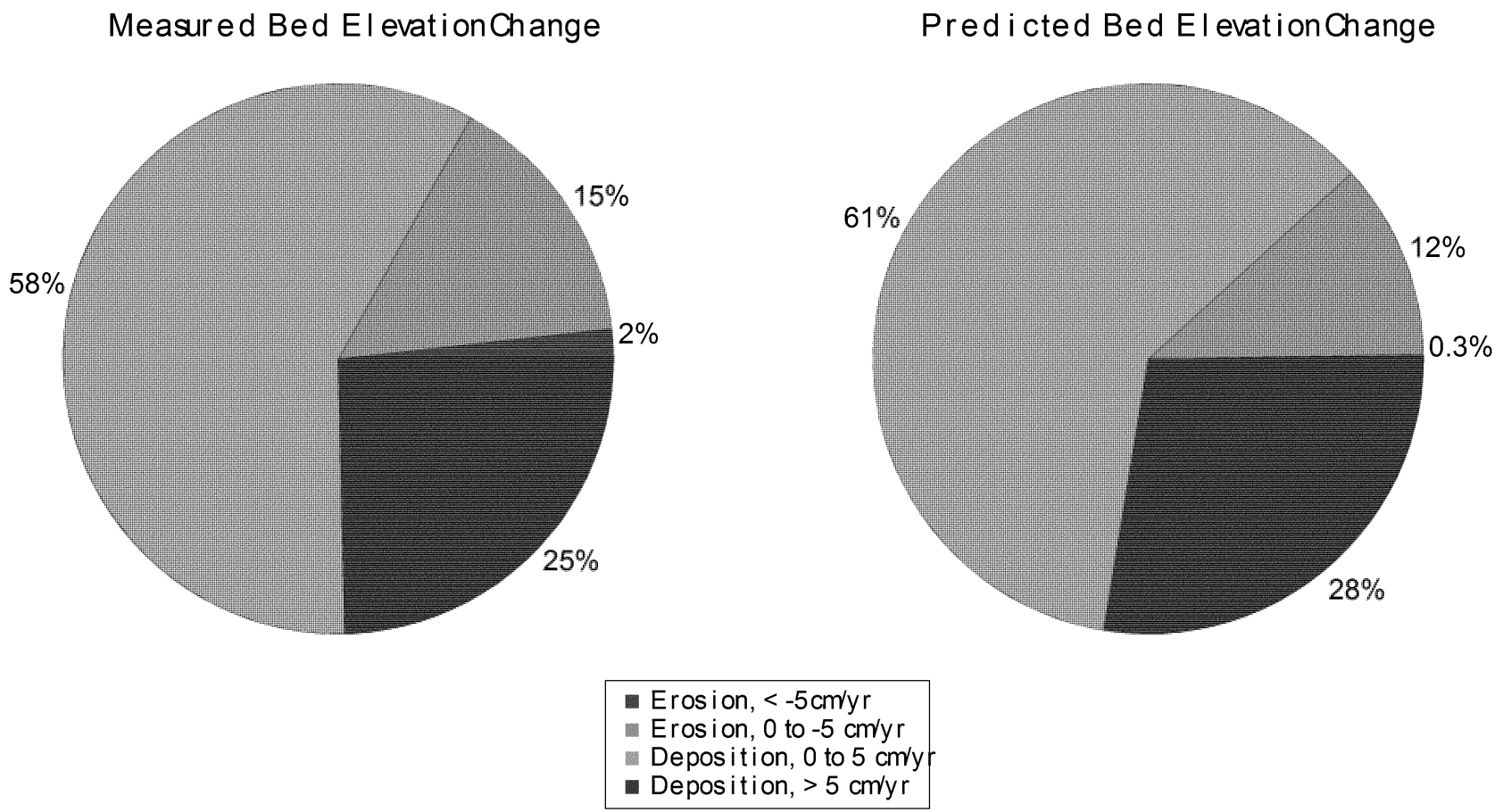

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Figure 2-68

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Draft Feasibility Study

Relative Areal Distribution of Erosion and Deposition during May 2003 - January 2009, RM 1.9 - 11.8

Bathymetry data projected to model grid. Exclusive of capping and dredging.

EG/BTR - \\MONTVALEBU\Jobs26a\Jobs\LWG\Documents\Report\Figures\Figures_120228\piechart_year2model_byarea_090730_figure_2_68_120228.pro Tue Mar 13 16:46:10 2012

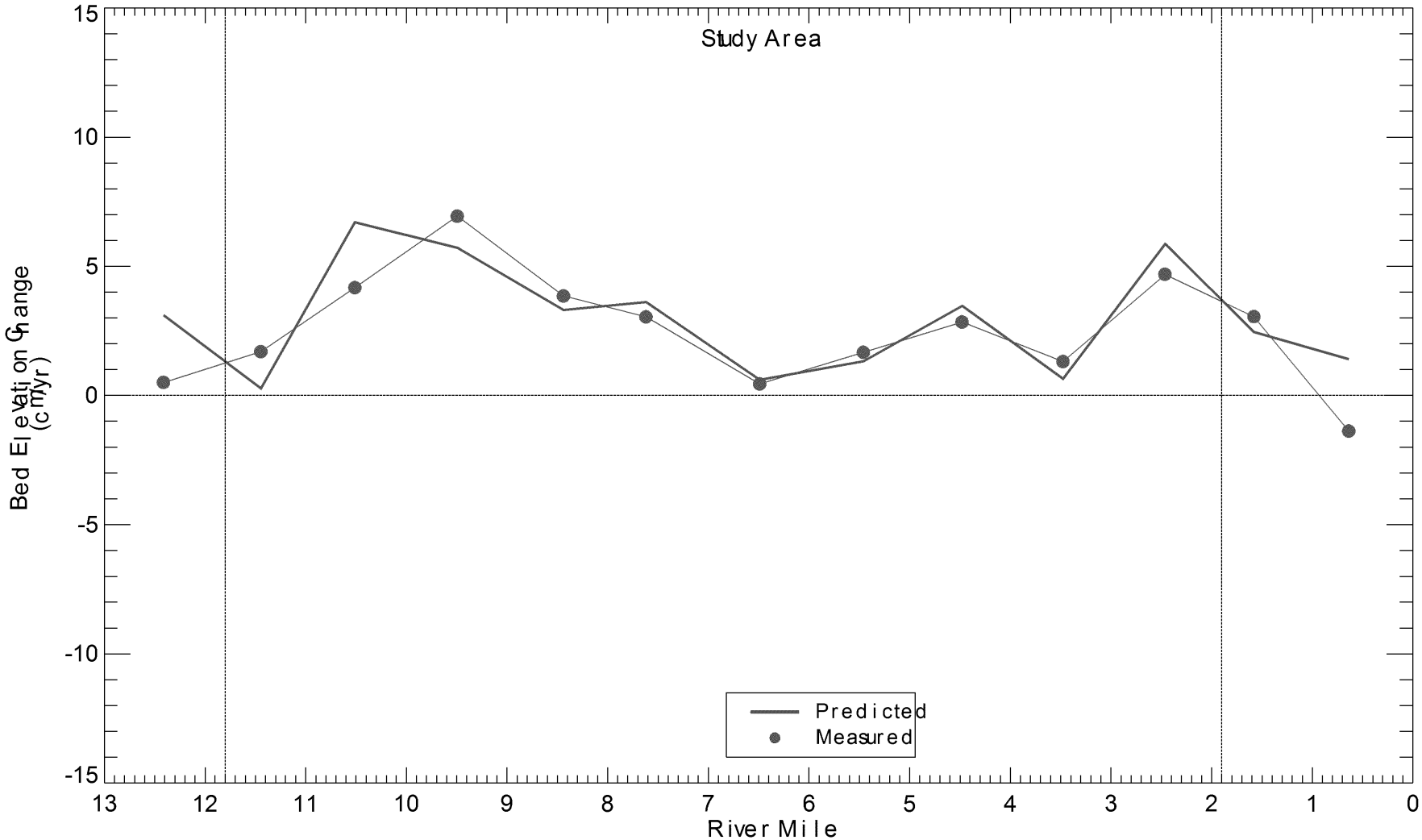

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Figure 2-69

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Draft Feasibility Study

Comparison of Predicted and Measured Bed Elevation Change at 1.0 Mile Scale during May 2003 - January 2009

Data from multi-beam bathymetry surveys performed in May 2003 and January 2009.
Model results from 5/15/2003 - 1/15/2009.

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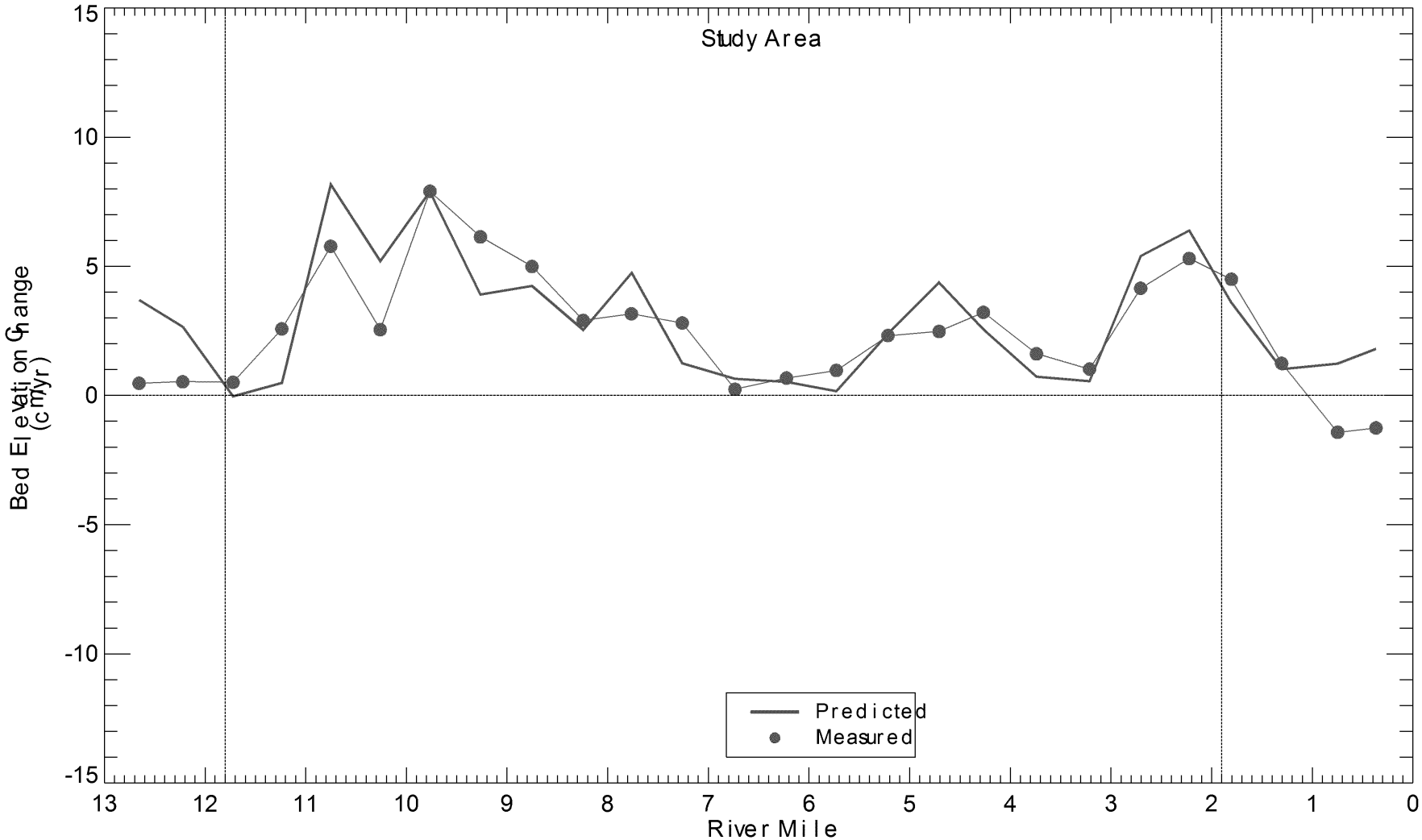

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Comparison of Predicted and Measured Bed Elevation Change at 0.5 Mile Scale during May 2003 - January 2009

Data from multi-beam bathymetry surveys performed in May 2003 and January 2009.
Model results from 5/15/2003 - 1/15/2009.

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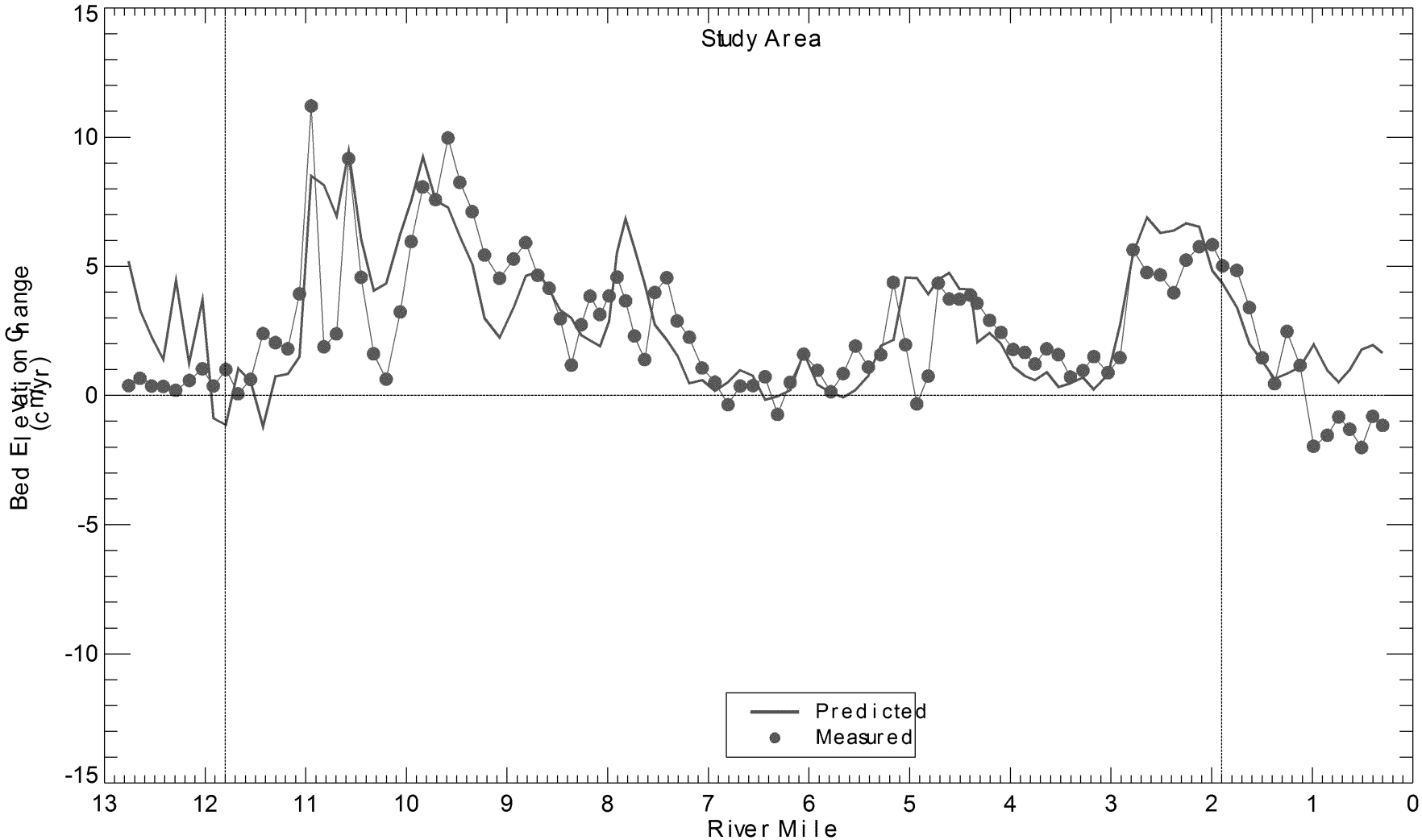

Figure 2-71

Portland Harbor RI/FS

Draft Feasibility Study

Comparison of Predicted and Measured Bed Elevation Change at 1/8 Mile Scale during May 2003 - January 2009

Data from multi-beam bathymetry surveys performed in May 2003 and January 2009.
Model results from 5/15/2003 - 1/15/2009.

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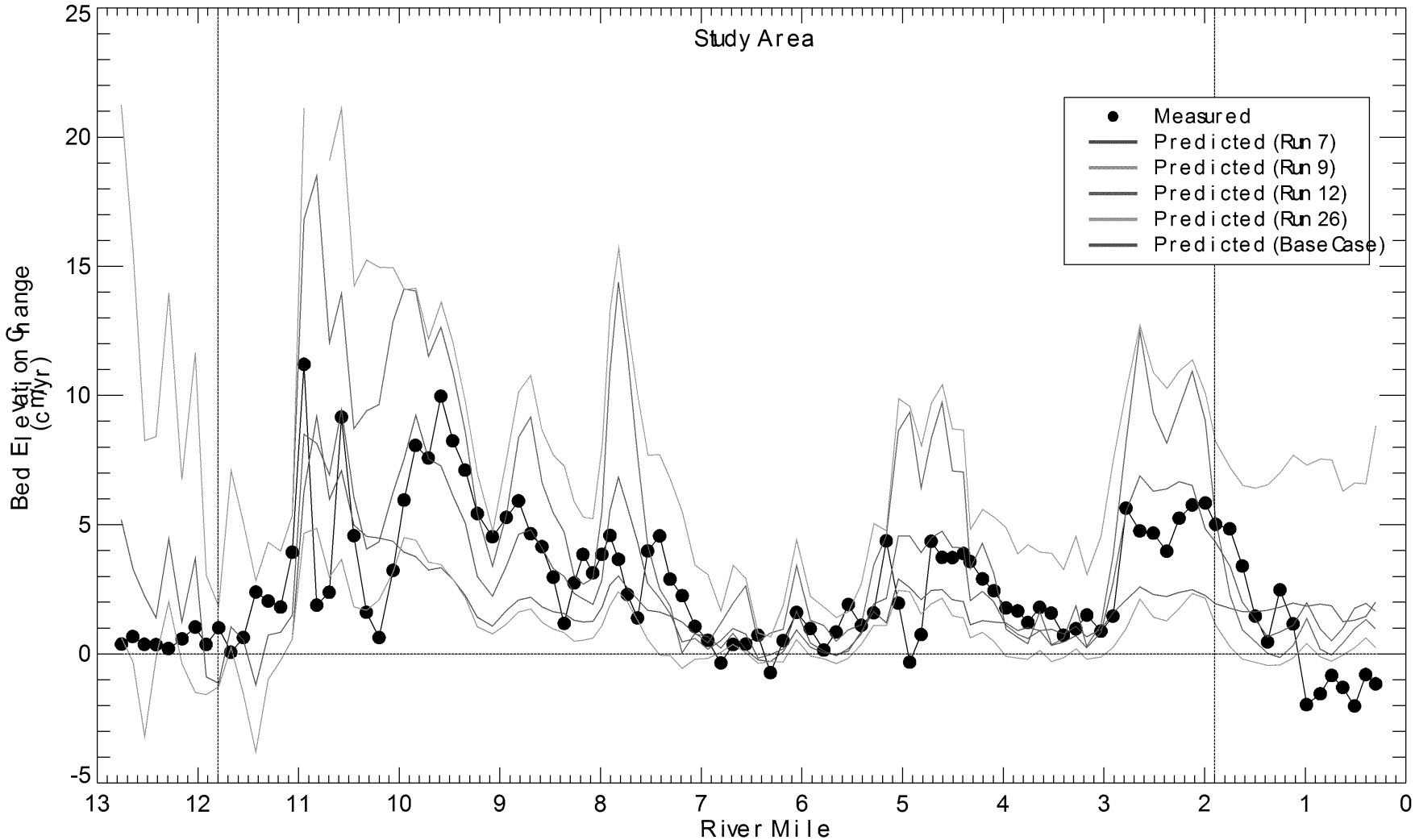

Figure 2-79

Portland Harbor RI/FS

Draft Feasibility Study

Sensitivity Analysis - Overall and Realistic Upper and Lower Bound Predicted Bed Elevation Chan

Data from multi-beam bathymetry surveys performed in May 2003 and January 2009.
Model results from 5/15/2003 - 1/15/2009.

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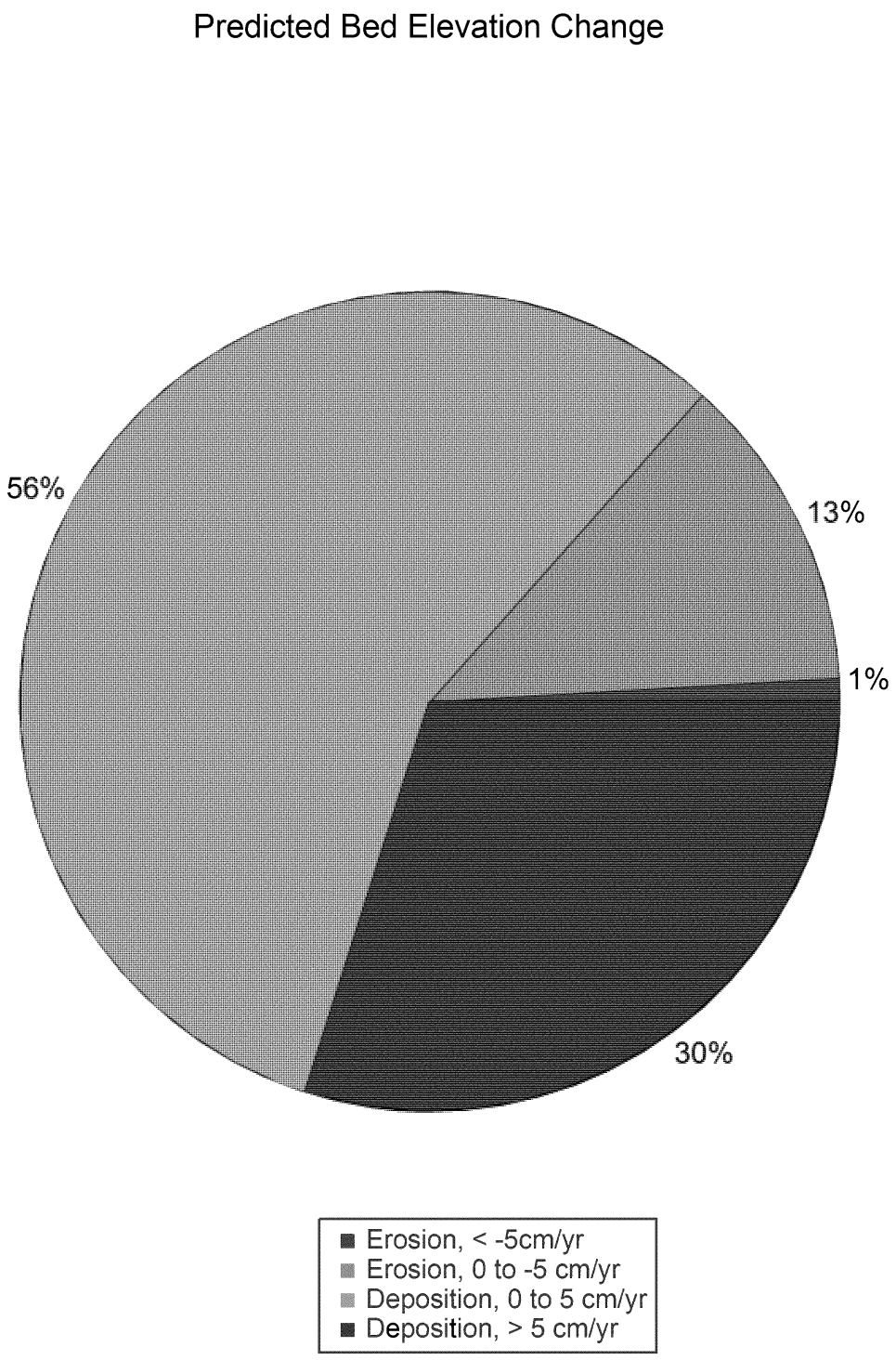

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Figure 3-40
Portland Harbor RI/FS
Draft Feasibility Study
Base Case Predicted Bed Elevation Change for 1979-2009
in the Lower Willamette Study Area, RM 1.9 - 11.8

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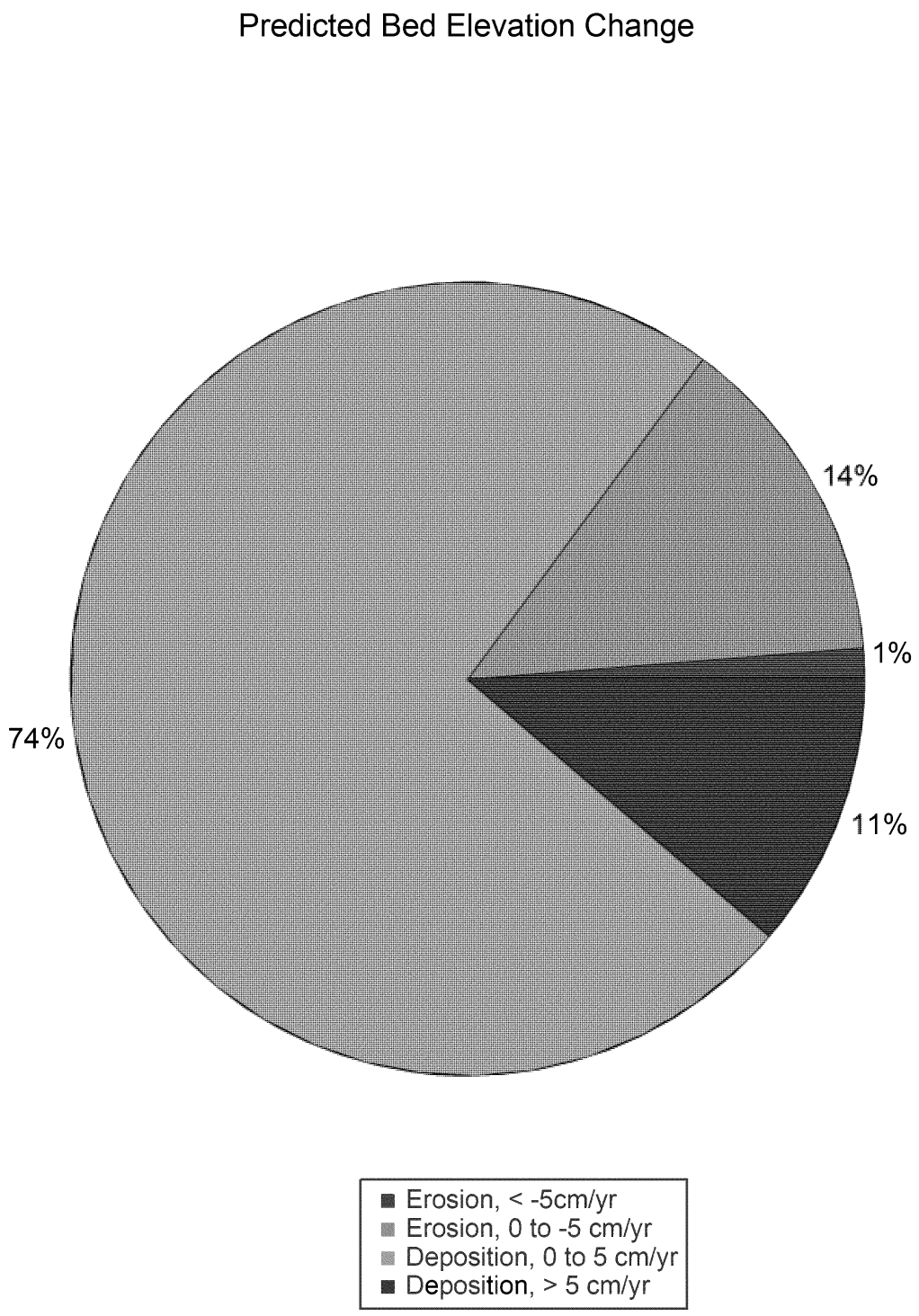

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Draft Feasibility Study
Lower Bound Predicted Bed Elevation Change for 1979-2009
in the Lower Willamette Study Area, RM 1.9 - 11.8

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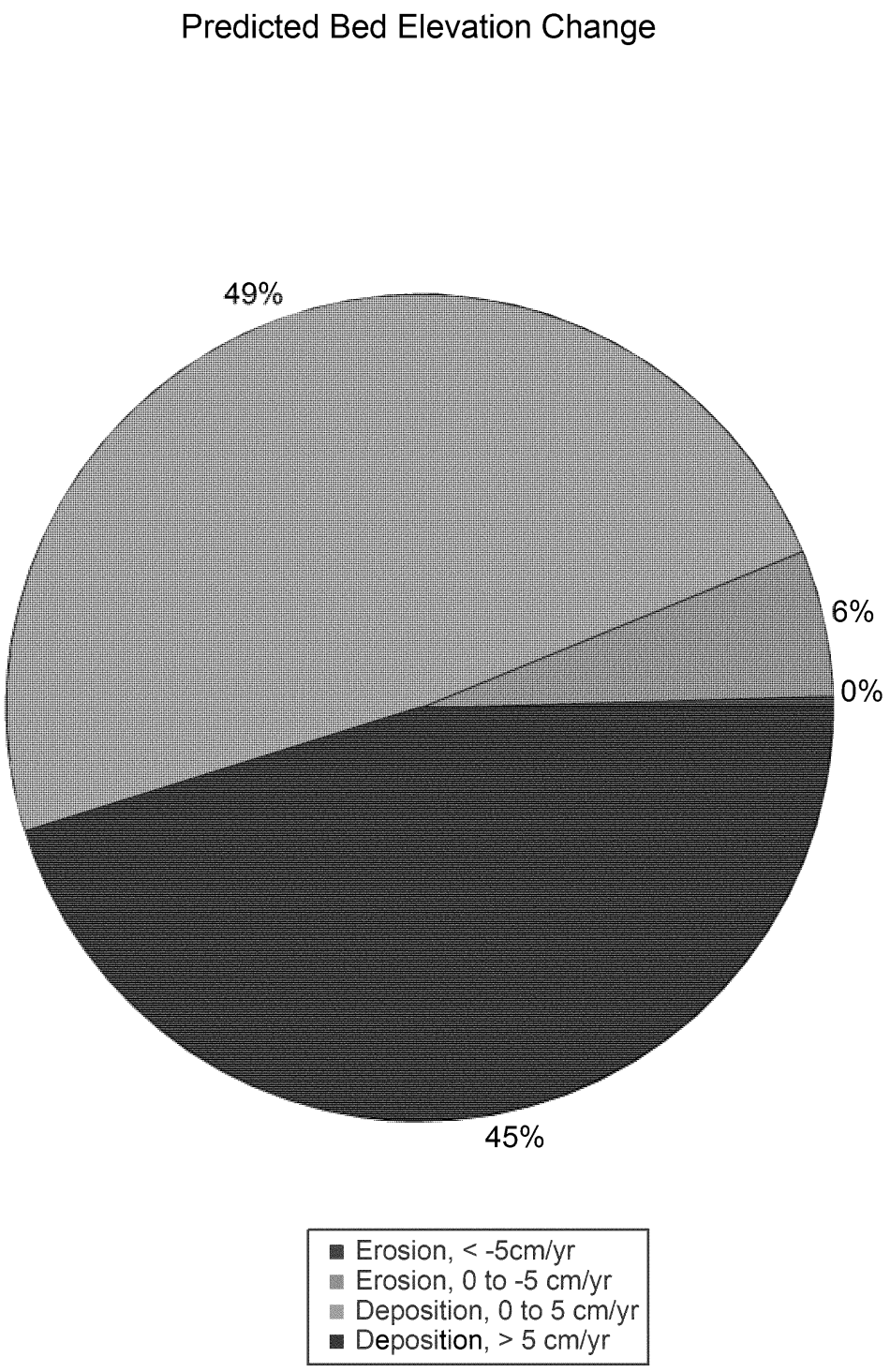

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Upper Bound Predicted Bed Elevation Change for 1979-2009
in the Lower Willamette Study Area, RM 1.9 - 11.8

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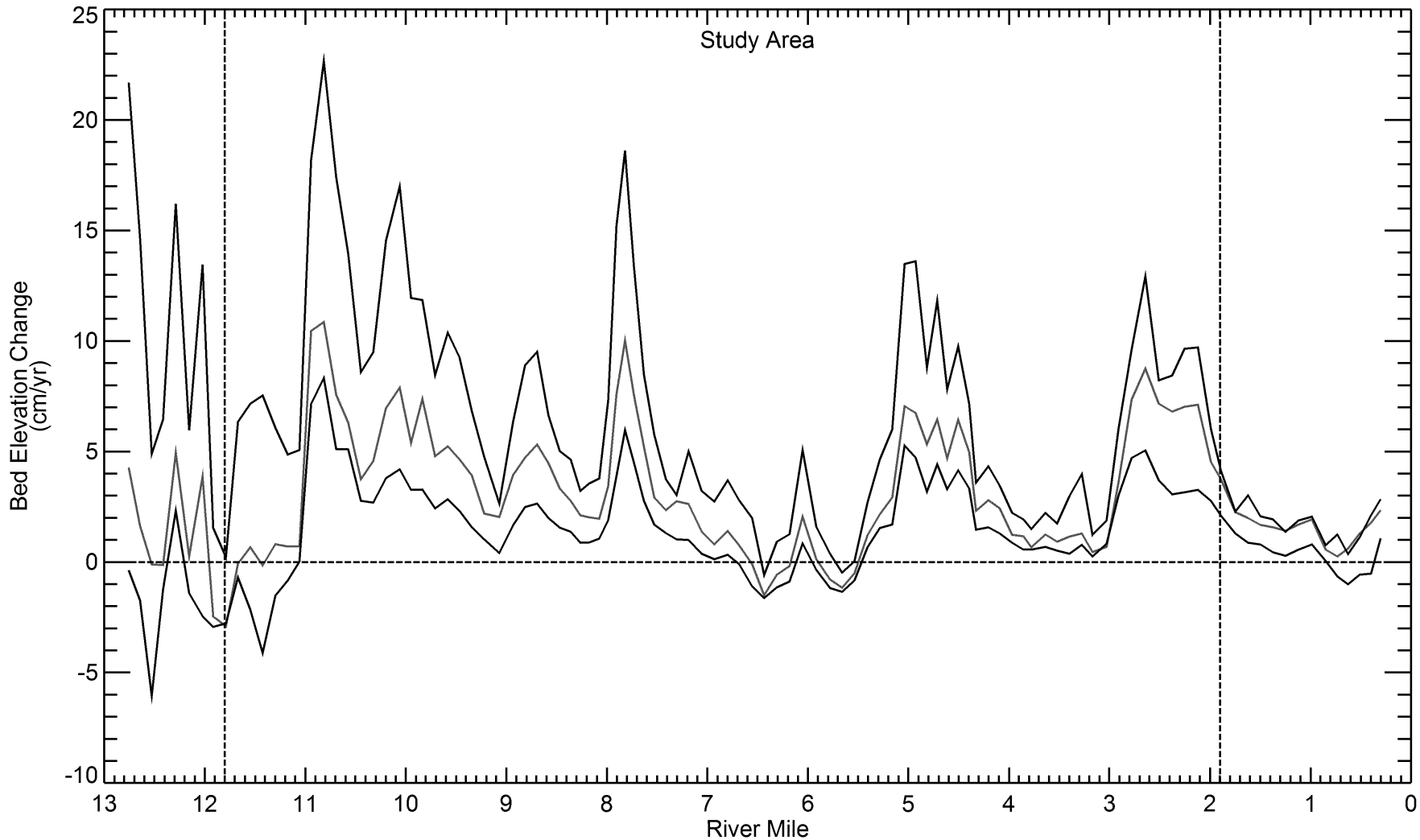

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Figure 3-43
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Draft Feasibility Study
Predicted Bed Elevation Change at 24 Acre Scale for 1/1/1979 - 1/31/2009

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New Information and Changes

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02_Figures	new item (folder)	Mullin, Jeanette
03_Tables	new item (folder)	Mullin, Jeanette
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FS Outline - List of Tables.xlsx	new item (file)	Mullin, Jeanette
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05_BERA Table 1-3 BERA Significant Chemicals.docx	new item (file)	Mullin, Jeanette

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From: Blischke, Eric
Sent: Wed 2/12/2014 7:46:06 PM
Subject: RE: draft, privileged, confidential: cells
Diagnostic_Cell_Locations.pdf

Here is a figure and table showing the locations.

Eric

From: Gustavson, Karl [mailto:Gustavson.Karl@epa.gov]
Sent: Wednesday, February 12, 2014 11:19 AM
To: King, Todd W.
Cc: Blischke, Eric
Subject: draft, privileged, confidential: cells

Todd, I spoke with Earl a bit more this morning about LWGs model. Do you know the location of the cells used in their "diagnostic analysis" (15 cells, shown in the figure label on the attachment)?

I have asked whether Earl can pull information similar to this from his runs of LWGs model. I would like to combine this elevation data in each "cookie" cell with the bathymetry data. The delta bathymetry data is the LWGs calibration data, so it is a way to check whether the model works well in the areas we care about.

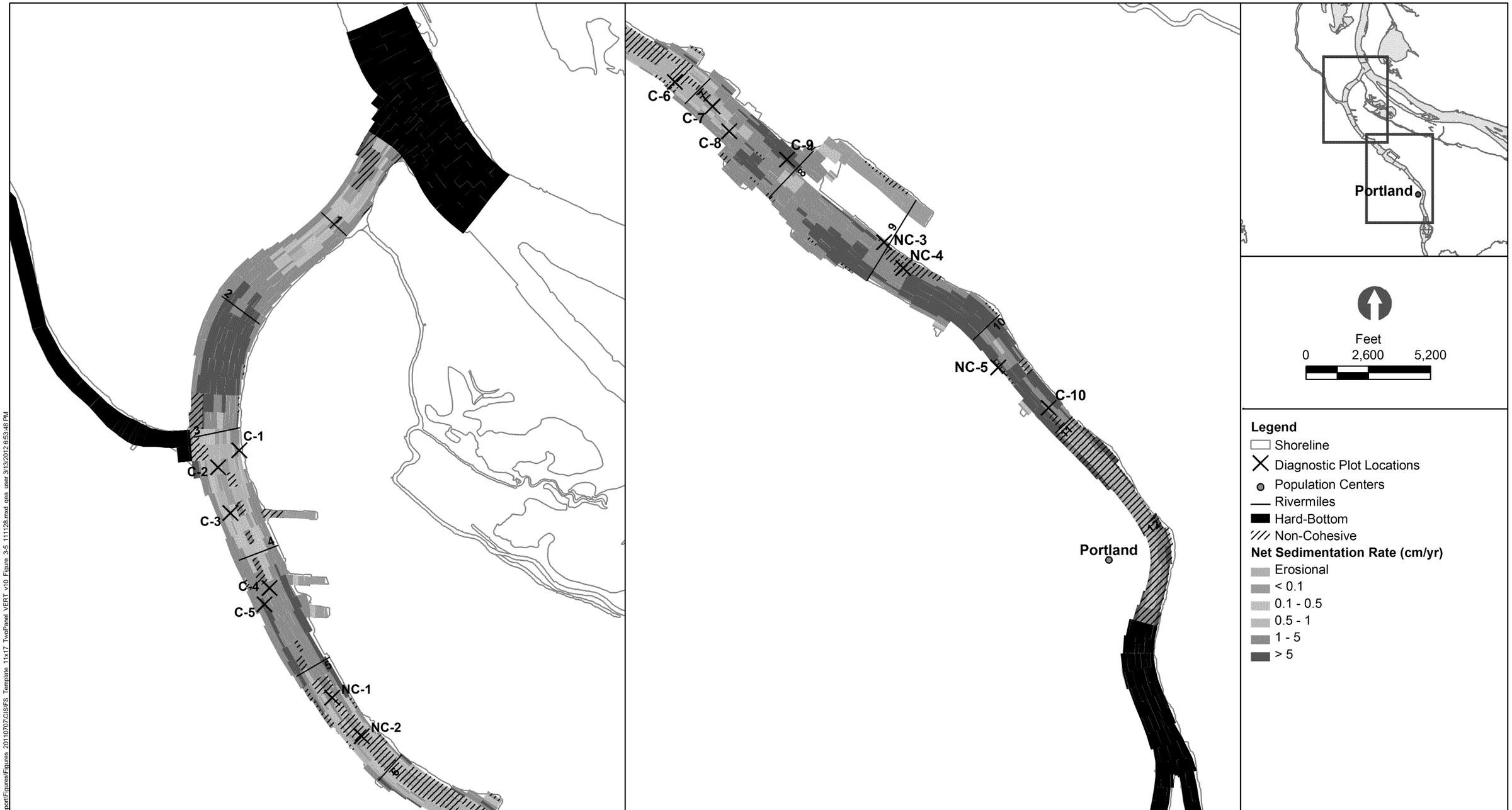

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Figure 3-5
Portland Harbor RI/FS
Draft Feasibility Study
Locations of Grid Cells Used in Diagnostic Analysis
River Mile 1.9 to 11.8

\\Montvalebu\Jobs26a\Jobs\LWG\Documents\Report\Figures\Figures 20110707\GIS\FS Template 11x17 TwoPanel VERT v10 Figure 3-5 111128.mxd qea user 3/13/2012 6:53:48 PM

A diagnostic analysis of the 1996 flood simulation was conducted to develop insights about model performance at specific locations within the Study Area. A total of 15 locations were selected for the diagnostic analysis, with 10 locations in cohesive bed areas and 5 locations in non-cohesive bed areas (Figure 3-5). The locations were selected such that a range of sediment transport regimes were represented (i.e., different rates of net sedimentation or net erosion), see Table 3-2. The NSRs in Table 3-2 correspond to predicted values for the 68-month calibration simulation; negative values in the table represent net erosion.

Table 3-2. Locations of Grid Cells Used in Diagnostic Analysis of 1996 Flood

Location Label	River Mile Location	Type of Bed	Net Sedimentation Rate (cm/yr)
C-1	3.22	Cohesive	0.0
C-2	3.28	Cohesive	-0.19
C-3	3.64	Cohesive	0.08
C-4	4.30	Cohesive	1.3
C-5	4.40	Cohesive	5.0
C-6	6.81	Cohesive	-0.21
C-7	7.19	Cohesive	0.02
C-8	7.42	Cohesive	0.2
C-9	7.89	Cohesive	24
C-10	10.82	Cohesive	3.8
NC-1	5.29	Non-cohesive	0.76
NC-2	5.66	Non-cohesive	-0.7
NC-3	8.93	Non-cohesive	2.1
NC-4	9.22	Non-cohesive	1.5
NC-5	10.31	Non-cohesive	13

Notes:
cm/yr = centimeters per year

The diagnostic analysis of the 1996 flood simulation examined temporal variations in the following predictions at specific grid cell locations: depth-averaged current velocity; bed shear stress; TSS concentrations (total, classes 1, 2, 3, 4); bed elevation change; erosion flux; deposition flux; and surface-layer bed content of classes 1, 2, 3, and 4. The results of the diagnostic analysis at the 15 grid cell locations are presented on Figures 3-6 through 3-35.

Eight of the ten cohesive bed locations were predicted to be net erosional during the 1996 flood, with net erosion depths ranging between about 10 and 25 cm and peak bed shear stresses greater than 1.5 Pa. The two cohesive bed locations that were net depositional during the 1996 flood (i.e., locations C-5 and C-9) are the two locations where the long-term NSR was predicted to be greater than 4 cm/yr. Peak bed shear stresses were less than about 1 Pa at the cohesive bed locations that were net depositional.

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Stephen J. Ells

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Science Policy Branch

Office of Superfund Remediation and

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US EPA 5204P

1200 Pennsylvania Ave. N. W.

Washington DC 20460

"*Get your facts first, and then you can distort them as much as you please*." - Mark Twain

www.epa.gov/superfund/health/conmedia/sediment/index.htm

SEDIMENT RECONTAMINATION ANALYSIS APPROACH

TERMINAL 4 REMOVAL ACTION

Port of Portland

Portland, Oregon

8 September 2009

NEWFIELDS

2500 55th Street, Suite 200
Boulder, CO 80301

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1.0 INTRODUCTION

In 2003, the Port of Portland ("the Port") entered into an Administrative Order of Consent (AOC) with the USEPA to conduct a Non-Time Critical Removal Action (NTCRA) at Terminal 4 to address contaminated sediment.

Under the AOC, the Port conducted an Engineering Evaluation and Cost Analysis (EE/CA) for the Removal Action. The Removal Action objectives (RAOs), as stated in the EE/CA Workplan (BBL, 2004) include:

- reducing the ecological and human health risks associated with sediment contamination within the Removal Action Area to acceptable levels; and
- limiting the likelihood of recontamination of sediments within the Removal Action Area.

The second RAO established in the EE/CA Workplan is "to limit the likelihood of recontamination of sediments within the Removal Action Area". Specifically, the Recontamination Analysis will be the first step in assessing the progress of meeting this objective.

This document describes the proposed approach to assess the potential for recontamination of sediment in the Removal Action Area after actions have been implemented. The recontamination analysis is planned to be reported as part of the 60% design submittal, currently scheduled for submittal in May 2010.

1.1 Site Description and Project History

The Port owns the Terminal 4 uplands between River Miles (RMs) 4.1 and 4.5 on the Lower Willamette River. The Port acquired Terminal 4 from the City of Portland (City) Commission of Public Docks in 1971. The Port also currently owns a portion of the submersible and submerged lands in Slip 1 and Slip 3 located within the RAA (defined below). The remainder of the submersible or submerged land is owned by the State of Oregon and managed by the Oregon Department of State Lands (DSL).

The Terminal 4 facility itself is within or adjacent to the Portland Harbor Superfund Site. The RAA is defined in the AOC as "that portion of the site adjacent to and within the Port of Portland's Terminal 4 at 11040 North Lombard, Portland, Multnomah County, Oregon, extending west from the ordinary high water line on the northeast bank of the Lower Willamette River to the edge of the navigation channel, and extending south from the downstream end of Berth 414 to the downstream end of Berth 401, including Slip 1, Slip 3, and Wheeler Bay."

Per the AOC, the Port submitted an Engineering Evaluation/Cost Analysis (EE/CA) in 2005 (BBL, 2005a). The EE/CA had a placeholder for Appendix N, the recontamination analysis. The Draft Appendix N/Recontamination Analysis (BBL/Arcadis, 2006) was submitted to EPA in November 2006. The Draft Recontamination Analysis provided the initial analysis approach to support the design. The document also identified stormwater data gaps that would need to be filled to support the final analysis. In December 2006, EPA submitted comments to the Port regarding the Draft Recontamination Analysis. The Port made several recommendations to EPA in a letter sent January 24, 2007. Among those recommendations were:

1) Complete the field work to collect additional data identified in section 6 of the Draft Recontamination Analysis in concert with the EPA/DEQ/LWG stormwater technical group that was designing the RI stormwater sampling program;

2) Update the mass loading evaluation with the new data, incorporating the decisions regarding technical process and procedures made in the LWG technical group into the methodology;

3) Submit a revised Recontamination Analysis Report.

The field work for additional data (discussed above in item #1) was conducted in 2007 and 2008. The data collected from 2007 through 2008 was submitted to EPA and DEQ in two ways: (1) all of the data collected by the Port related to the Terminal 4 recontamination analysis, including the City outfalls, was provided to LWG and LWG reported it to EPA and DEQ in the Round 3A and 3B Upland Stormwater Sampling Data Report (LWG, 2008); and (2) The data specific to Terminal 4 USC was submitted to DEQ (with a copy to EPA) in the Final Stormwater Data Summary Report Terminal 4 Slip 1 and Slip 3 Upland Facilities (ACA/Newfields March 2009).

In addition, the Removal Action project was split into two phases in 2007. The Port implemented Phase I of the Removal Action during the 2008 in-water work window. Phase II includes completion of the recontamination analysis. This report describes the recontamination analysis approach.

1.2 Description of the Removal Action

The location and main features of Terminal 4 are shown in Figure 1-1.

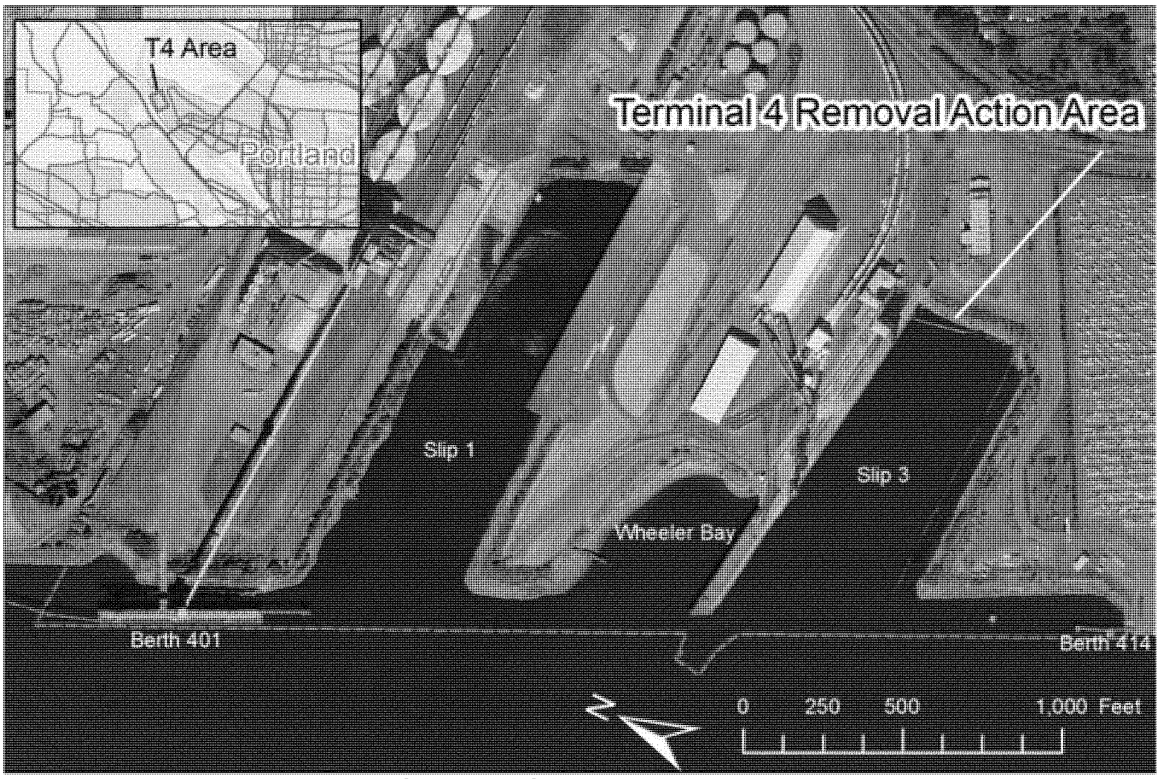

Figure 1-1: Location and main features of the Terminal 4 Removal Action Area.

The selected removal action was outlined in an Action Memorandum in 2006 (EPA, 2006). As described above, the action is being implemented in phases, in order to align the Terminal 4 Removal Action design and construction with the Portland Harbor-wide Remedial Investigation and Feasibility Study (RI/FS) and Record of Decision (ROD). The schedule realignment was proposed in a letter to EPA in August, 2007. The Port also prepared an Abatement Measures Proposal (October 2007), detailing the specific tasks that could be performed in an initial phase to address "imminent health and ecological risks" at Terminal 4 (Anchor, 2007). EPA approved the schedule realignment in November, 2007 on the condition that the abatement measures were carried out. Therefore, a Phase I plan was designed and implemented in 2008. Phase I included dredging of three areas showing the highest contaminant concentrations in Terminal 4; adjacent Berth 411, adjacent Pier 5 and north of Berth 414 (former Berth 413). Dredging was also completed adjacent to Berth 410 in Slip 3 in support of water-dependent maritime use. Dredged material was disposed of off-site. A cap was placed at the head of Slip 3 and the shoreline at Wheeler Bay was stabilized and capped to prevent migration of contaminants to the river (Anchor QEA, Ash Creek Associates and Hickey Marine Enterprises, 2009).

The remaining areas of Terminal 4 will be addressed by the Phase II Removal Action, which will proceed based on coordination with the harbor-wide RI/FS and ROD schedule. Phase II of the plan anticipates additional dredging and capping within Slip 3,

additional dredging and capping north of Berth 414 (former Berth 413), additional capping in Wheeler Bay, and capping adjacent to Berth 401 (see Figure 1-2). Phase II also includes the construction of a confined disposal facility (CDF) in Slip 1 and monitored natural recovery (MNR) of the remaining areas. The status of the Phase II Design as of May 2009 is outlined in the draft Design Status Report (Anchor QEA and NewFields, 2009).

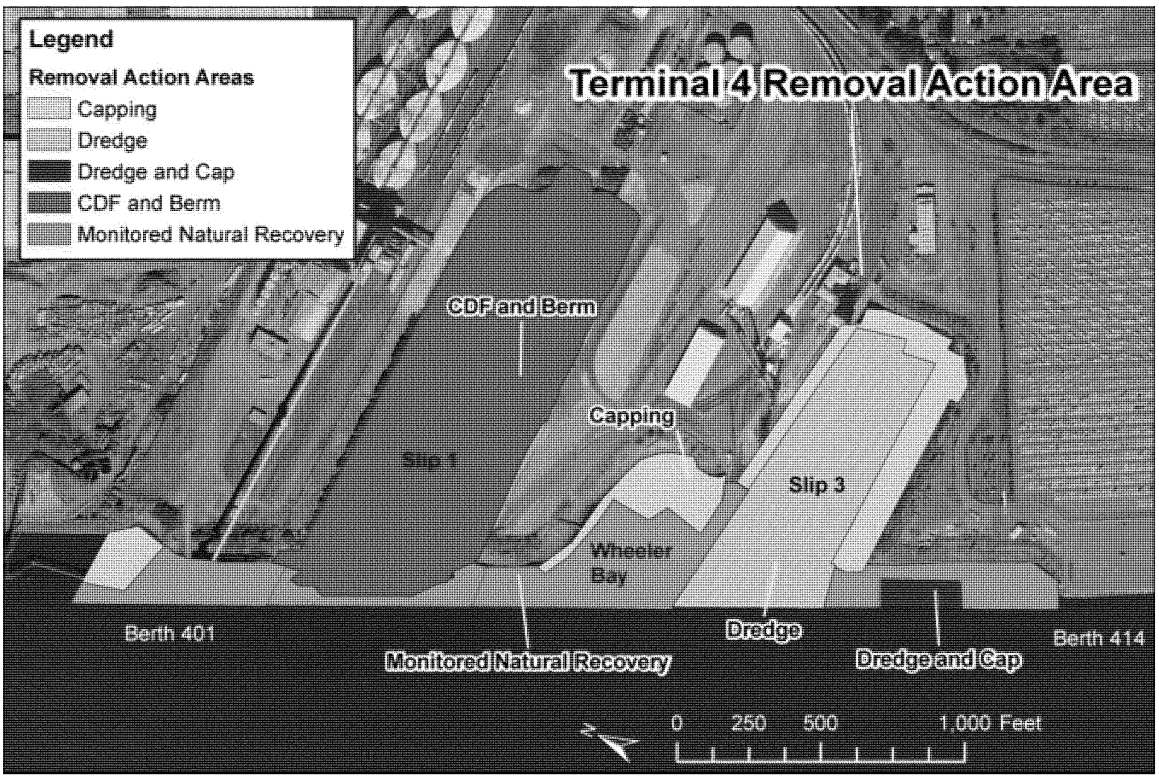

Figure 1-2: Phase II Removal Action Areas (adapted from Anchor QEA and NewFields, 2009).

1.3 Purpose of Recontamination Analysis and Approach

The purpose of this document is to outline the methodology that will be used to assess recontamination potential of sediment in the Terminal 4 Removal Action Area after the removal actions have been implemented. Data gaps that need to be addressed prior to completing the analysis are also reviewed. Comments pertaining to the Draft Recontamination Analysis conducted by BBL/Arcadis in 2006 have been considered and incorporated into the new Recontamination Analysis approach. This document presents the data, methods, and equations to be used in calculations. In addition, an example calculation of recontamination potential is presented for one chemical of interest (COI) and one portion of the Removal Action Area. This calculation is not meant to be a final analysis; rather it is presented to demonstrate the methodology. A final analysis of

recontamination potential for all COIs and the entire Removal Action Area will be presented in the Recontamination Analysis.

1.4 Defining Recontamination

Recontamination is significant if concentrations on the remediated surfaces (e.g., dredged area, caps, and MNR areas) exceed the cleanup goals that are identified in the Harborwide RI/FS process. The final cleanup goals for sediments will be established as a result of the Harborwide Record of Decision (ROD). In the interim, preliminary remediation goals (PRGs) and "hilltopping" values provide the target concentrations for analysis of the recontamination. Hilltopping values are established for bioaccumulative COIs and represent the concentrations that are to be addressed with active remedies in order to reduce average concentrations for a river segment to acceptable levels based on risk to humans and ecological receptors.

In the context of the Recontamination Analysis, the following decision criteria will be addressed:

- If concentrations in surface sediment are predicted to decrease from the initial post-construction value, then recontamination will not occur.
- If concentrations are predicted to increase, then the effectiveness of the source control action(s) will be assessed against cleanup goals to determine if additional action could be necessary.

1.5 Report Structure

Section 2 of this report reviews the site conceptual model, including the removal action, the COIs, and identification of potential sources of recontamination. Section 3 describes the overall methodology for recontamination assessment, including the mathematical model SEDCAM (Jacobs et al., 1988), the model inputs, the primary data sources to be used in the analysis, equations, uncertainties, and data gaps. Finally, Section 4 includes an example application of the described methodology for one COI and one subarea of the Terminal 4 Removal Action Area.

2.0 CONCEPTUAL SITE MODEL

The conceptual site model is described in the following sections. The main pertinent features are the areas of concern (Removal Action Areas), COIs, the potential sources of sediment, and the potential sources of COIs to the sediment.

2.1 Removal Action Area

The Removal Action chosen for Terminal 4 consists of a combination of MNR, capping and dredging, with dredged material being disposed of in a CDF to be built on site (Anchor QEA and NewFields, 2009). Multiple areas of planned MNR, capping and dredging occur in the Removal Action Area. In order to evaluate recontamination, areas affected by different removal actions will be evaluated separately. For example, the post-Removal Action concentration of a particular COI in surface sediment will be different in a capped area than in an area that was dredged. Post-Removal Action concentrations will be generated after Phase II of the Removal Action is complete. The Removal Action Area will be subdivided into nine subareas for the Recontamination Analysis, as shown in Figure 2-1.

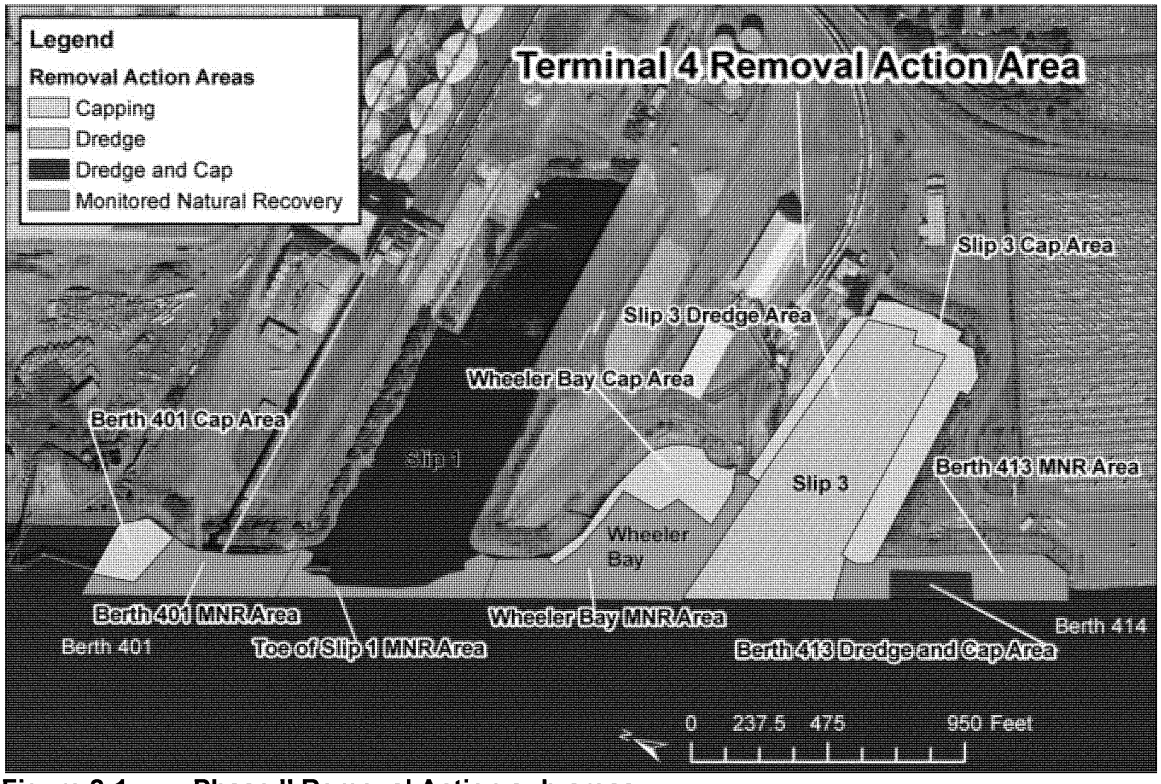

Figure 2-1: Phase II Removal Action sub-areas.

Three areas will be unaffected (MNR), three areas will be capped, one area will be dredged, one area will be dredged and capped, and one area will be converted into a CDF. These subareas are listed in Table 2-1 with their respective areas in square feet.

Table 2-1: Removal Action subareas and their approximate areas in square feet.

Removal Action Subarea	Approximate Area (sq ft)
1 – Berth 413 MNR Area	95,000
2 – Berth 413 Dredge and Cap Area	30,000
3 – Slip 3 Cap Area	165,000
4 – Slip 3 Dredge Area	385,000
5 – Wheeler Bay Cap Area	85,000
6 – Wheeler Bay MNR Area	195,000
7 – Toe of Slip 1 MNR Area	55,000
8 – Berth 401 MNR Area	90,000
9 – Berth 401 Cap Area	40,000

The subareas were delineated based on their different planned actions and their locations relative to potential sources of sediment recontamination (i.e. stormwater outfalls or river influence). All areas will be considered in the Recontamination Analysis, except Slip 1. The design plan for Slip 1 consists of converting it into a CDF to contain dredged material from other areas of Terminal 4 and Portland Harbor.

2.2 Identification of COIs

The COIs that will be considered for the Removal Action Area at Terminal 4 include:

- Benzo(a)pyrene
- Benzo(a)anthracene
- Dibenzo(a,h)anthracene
- Pyrene
- Indo(1,2,3)pyrene
- Cadmium
- Lead
- Total PCBs

These chemicals were identified in the Remedial Investigation and risk assessments as the primary chemicals driving risk in Terminal 4 (due to be submitted in October 2009) (LWG, *in preparation*).

2.3 Screening of potential sources

Potential sources of COIs to the Terminal 4 Removal Action Area sediments have been identified as follows:

- upstream suspended sediment,
- stormwater outfalls,
- groundwater,
- bank erosion,
- overland flow,
- existing structures,
- sediment resuspension, and
- atmospheric sources.

These are discussed in more detail in the following subsections.

Upstream Suspended Sediment

Sediment is transported in the river, either in suspended form or as bed load. In general terms, the Willamette River is relatively low energy in the Superfund Site study area and tends to accumulate sediment over time (LWG *in preparation*). There are various sources of sediment and COIs upstream of Terminal 4. The total effect of these has been characterized by the RI in-river sediment sampling. This potential COI source will be evaluated in the recontamination analysis.

Stormwater Outfalls

Recent in-line stormwater sampling at Terminal 4 and at other locations at the Superfund Site have demonstrated that sediment suspended in stormwater discharges is a potential source of COIs to sediment. This will be evaluated in the recontamination analysis.

Groundwater

A previous analysis of groundwater contribution showed that the relative load of COIs from groundwater was low (BBL/Arcadis, 2006). Hydraulic gradients measured near Slip 3 are only 0.2 ft/ft and groundwater flow paths near Slip 3 are variable in direction (ACA 2009a). The Bank Excavation and Backfill Remedial Action (BEBRA) project, completed in 2004, involved excavation of petroleum contaminated soils from approximately 200 ft along the head of Slip 3 and replacement with an organoclay material. A portion of this area overlaps with the cap placed at the head of Slip 3 as part of the Phase I Removal

Action in 2008. Groundwater modeling showed that placement of the organoclay material effectively met the compliance levels at the point where groundwater reaches the surface water at the head of Slip 3 (ACA 2009a). The most recent quarterly report for the Terminal 4 upland facility shows that groundwater flow paths in the area south of Slip 3 are directed toward the west, however have very low hydraulic gradients, so likely produce only a negligible input to the main channel of the Willamette River (ACA 2009b). Groundwater flow modeling for the proposed CDF in Slip 1 also suggests negligible contribution by groundwater to downstream Removal Action Areas (Anchor 2009). Thus, groundwater sources will not be considered in the recontamination analysis.

Bank Erosion

No significant bank erosion will exist at Terminal 4 following the Phase II Removal Action. The shoreline along Wheeler Bay was stabilized as part of the Phase I Removal Action, and erodible soil and source control work at the head of slip 3 is slated for fall 2009. The observed erosion at former Pier 5 in Slip 3 and former Berth 413 upland source area has been identified for action. While erodible soils in Slip 1 were sampled and found to not require any source control action, bank erosion in Slip 1 will be halted by its conversion to a CDF. Bank erosion sources will not be considered in the recontamination analysis.

Overland Flow

The majority of Terminal 4 is drained by stormwater outfalls. Overland flow in the Terminal 4 area is not significant and will not be considered in the recontamination analysis.

Existing Structures

Some creosote-treated pilings exist at the Pier 4 area of Slip 3, and some pilings in the former Pier 5 area also may have been treated with creosote. Creosote is an oil-borne wood treatment product made from coal tar, and is primarily composed of polycyclic aromatic hydrocarbons (PAHs) (Stratus Consulting, 2006). PAHs can leach from treated wood that is exposed in the environment. Numerous laboratory and field studies have been conducted on PAH leaching rates and factors that affect these rates. Studies generally agree that a series of factors can affect the leaching rate:

- wood species,
- density,

- surface area exposed,
- treatment formula,
- PAH compounds present,
- water temperature chemistry,
- temperature and flow,
- disturbance/abrasion, and
- time since treatment.

Multiple models designed to predict leaching rates of creosote from pilings have been developed (for example Brooks, 1994; 1997; Poston, 1996; Xiao et al., 2002). The Brooks (1994, 1997) model (CREOSS) is well-documented, and provides reasonable agreement with field observations. The CREOSS model estimates a leaching rate based on a migration factor (water temperature and salinity), piling retention factor, and a piling age factor. The age factor is 1 at the time of treatment, and decays in an exponential fashion. Leaching rate is proportional to the age factor. The model estimates that after 20 years, the leaching rate would be 14% of the original rate and after 40 years, the leaching rate would be 2% of the original. Given the much higher rate of leaching in the years just following piling installation, the amount of leachable PAH mass left in the pilings will be greatly reduced. For example, using the numbers above, approximately 96% of the leachable PAH mass would be estimated to have leached from the pilings after 40 years. Therefore, even if the pilings were a historical source of PAHs to sediments, the remaining mass and leaching rate would be almost two orders of magnitude lower than initial rates and below levels of concern for future sediment recontamination.

Pilings were installed in 1961 at Pier 5 and in 1959 at Pier 4. Some of the original pilings have been replaced over time with non-creosote treated pilings for maintenance purposes. With respect to the original pilings that remain, given the time that has elapsed, they are not predicted to be a significant potential sources of PAHs in the future and are not considered further in the recontamination analysis.

Sediment Resuspension

Sediment resuspension due to propeller wash has been observed to be a significant process occurring in Slip 3 and the Terminal 4 area (BBL, 2004a; BBL, 2005a). Although sediment resuspension may cause redistribution of sediment near the vessel travel path, resuspension of existing sediment is not a significant source of new COI mass to sediment in the Removal Action Area. Since sediment traps placed within the Removal Action Area collect both resuspended sediment and sediment entering the Area from outside sources, the sedimentation rate in the traps was not used to estimate net sedimentation rate for the Removal Action Area.

Sedimentation rates measured in sediment traps placed at Terminal 4 range from approximately 18.3 to 84.3 cm/yr (based on a sediment density of 1.53 g/cc). In contrast, the net sedimentation rate for Terminal 4 estimated based on bathymetric surveys is approximately 4 cm/yr (see Section 3.1.1.2). This suggests that a significant amount of sediment is disturbed by propeller wash or river currents, which supports the assumption of a mixed surface sediment layer for Removal Action subareas.

Atmospheric Sources

Chemicals present in the atmosphere as a result of emissions from stationary sources (e.g., industrial smokestacks), mobile sources (e.g., vehicle emissions) and non-point sources (e.g., fugitive dust) produce a load to the river through the processes of dry and wet deposition. Dry deposition refers to the deposition of air pollutants from atmospheric suspension in the absence of precipitation. Wet deposition refers to deposition of air pollutants from atmospheric suspension via liquid and/or frozen precipitation.

Deposition occurs throughout the Portland Harbor Superfund Site study area. Particles that are deposited on the land can be transported to the river by stormwater. Particles deposited in the river will be represented by sediment load within the river (both upstream and downstream of Terminal 4). Atmospheric deposition to the entire Portland Harbor Site is being assessed in the Remedial Investigation (RI) Report (due to be submitted in October 2009) (LWG, *in progress*). The RI will be used to form the basis for evaluation of atmospheric deposition as a potential recontamination source, however it is anticipated that it will not be a significant source for the Portland Harbor Site, and even less so for Terminal 4 Removal Action because of the relatively small area where removal actions will occur. Based on the current operations and activities at Terminal 4, there are no localized atmospheric sources of COIs.

Summary

Potential sources to be carried forward for further evaluation in the Recontamination Analysis are as follows:

- Upstream sources, and
- Stormwater sources.

A more detailed screening to eliminate minor or insignificant sources will be performed in the Recontamination Analysis.

2.4 Description of Removal Action Subareas and Primary Potential Sediment Recontamination Sources

As discussed above, the primary sources of potential sedimentation recontamination are anticipated to be upstream sediment and stormwater sediment. Upstream sediment sources will be characterized using the same upstream data for all Removal Action subareas (see Section 3.1.3.1). Stormwater sediment sources, however, will vary in load based upon which stormwater basins discharge to each subarea.

2.4.1 Subarea 1 – Former Berth 413 MNR Area

The MNR Area located adjacent to the former Berth 413 receives sediment input from upstream, in addition to sediment input from the primary outfall of stormwater Basin D (Figure 2-2). Basin D is approximately 17 acres. The former Berth 413 MNR area is the closest Removal Action subarea to the City of Portland stormwater outfall 53, which discharges to the Willamette River main channel approximately 1800 feet upstream of the former Berth 413. Stormwater from an offsite residential area discharges through this outfall and becomes part of the upstream source component at the former Berth 413 area.

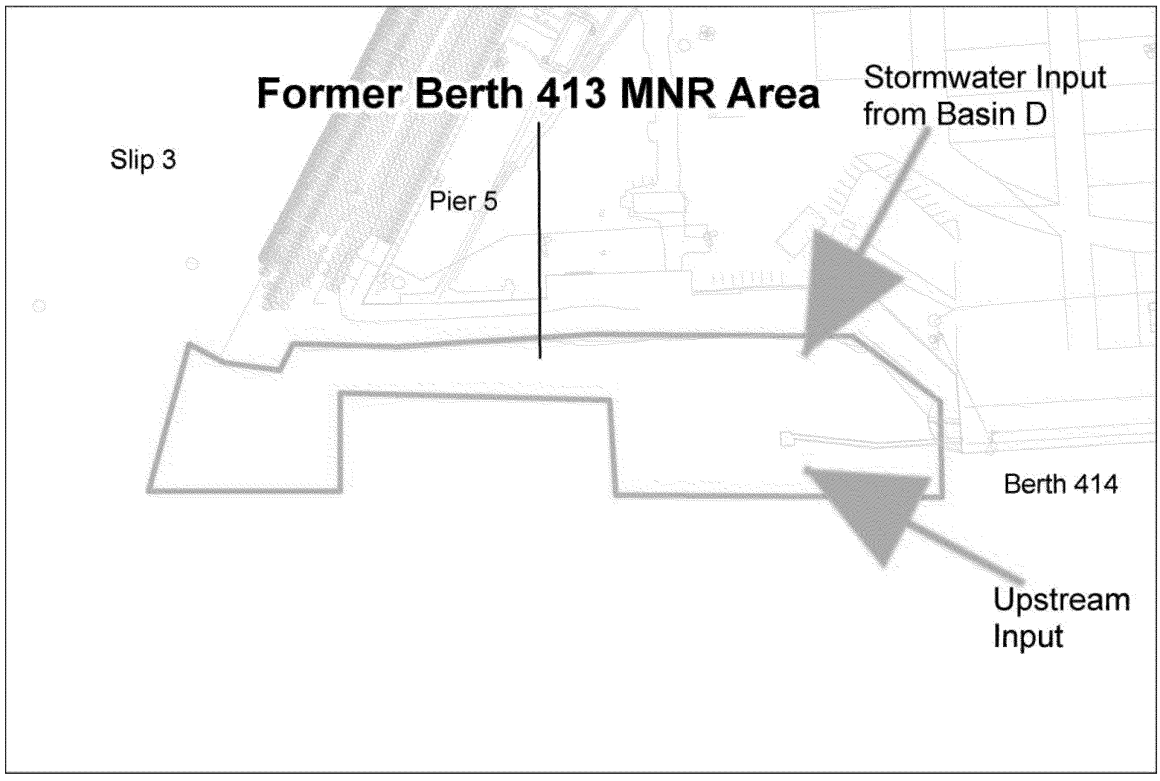

Figure 2-2: Former Berth 413 MNR subarea and potential recontamination sources.

2.4.2 Subarea 2 – Former Berth 413 Dredge and Cap Area

The dredge and cap area located adjacent to the former Berth 413 (north of Berth 414) receives sediment input from upstream, in addition to sediment input from the primary outfall of stormwater Basin D (Figure 2-3). Basin D is approximately 17 acres.

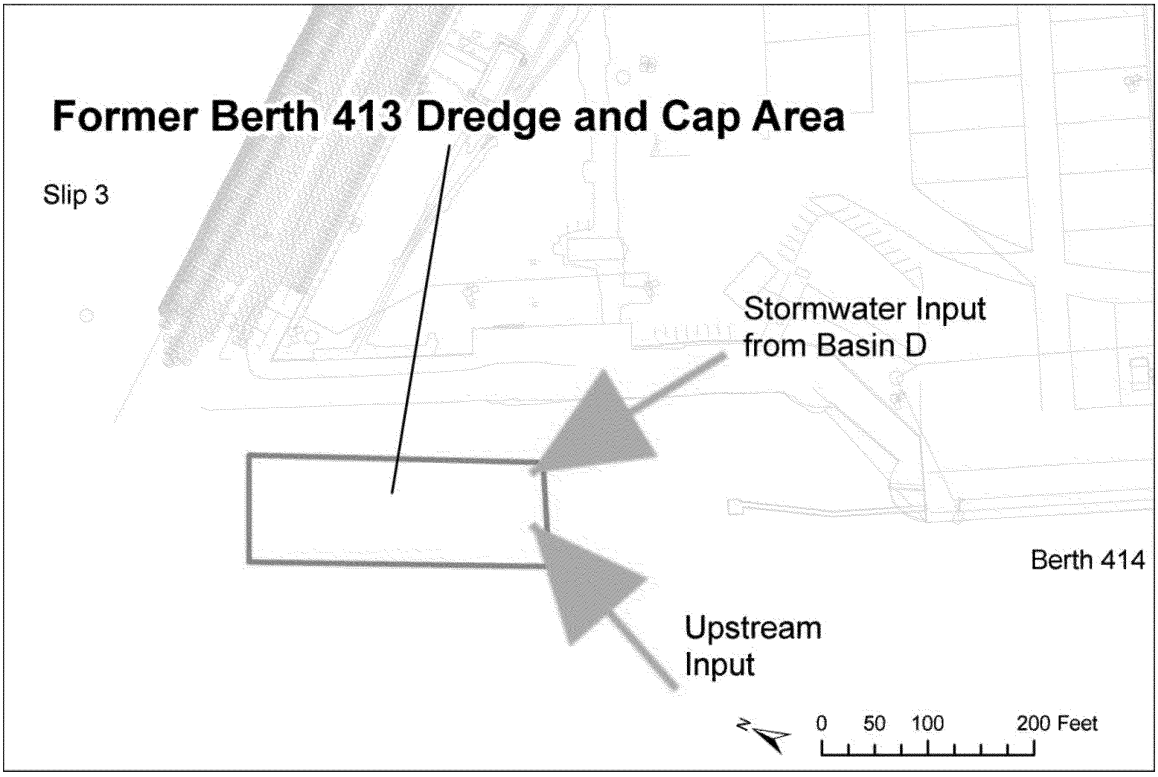

Figure 2-3: Former Berth 413 dredge and cap subarea and potential recontamination sources.

2.4.3 Subarea 3 – Slip 3 Cap Area

The capped area in Slip 3 receives sediment input from upstream and stormwater sediment from outfalls (Figure 2-4). Stormwater sediment in Slip 3 comes from Basins J, K and three minor catchments from Basin D. Basins J and K are 2.6 and 1.5 acres, respectively. Basin D is 17 acres total, however the catchments draining to Slip 3 are relatively small.

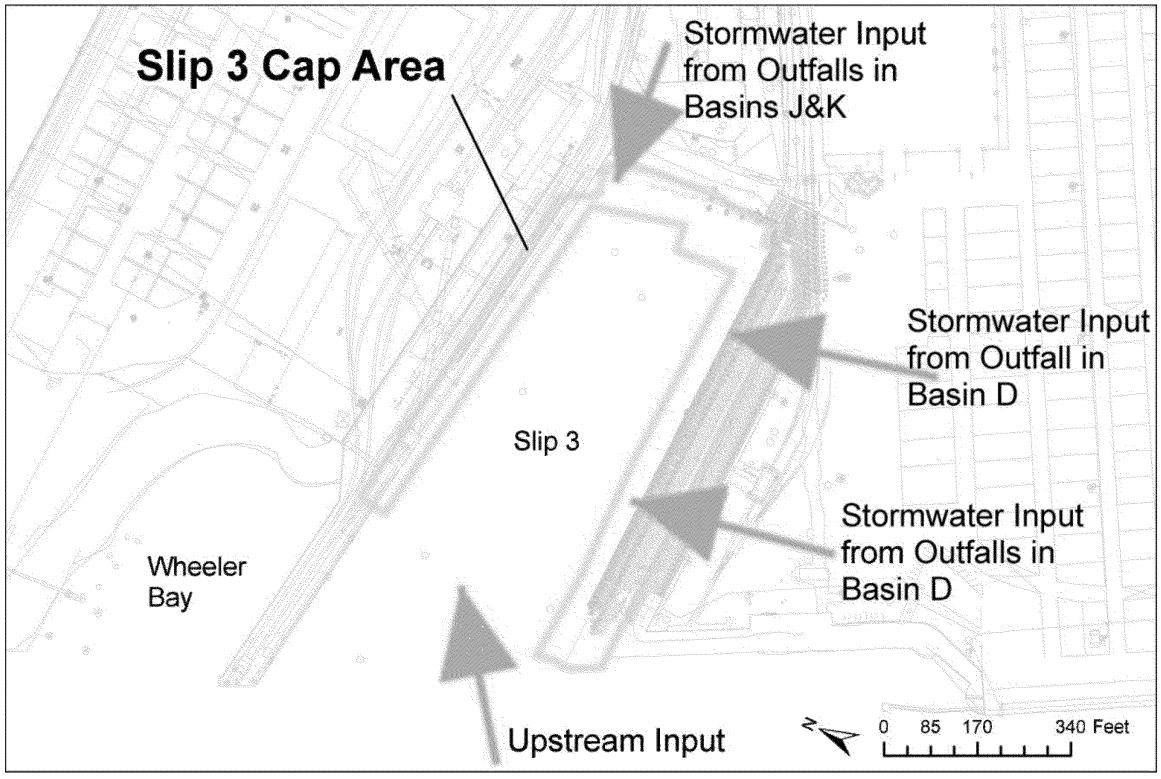

Figure 2-4: Slip 3 cap subarea and potential recontamination sources.

2.4.4 Subarea 4 – Slip 3 Dredge Area

The dredged area in Slip 3 receives sediment input from upstream and stormwater sediment from outfalls (Figure 2-5). Stormwater sediment in Slip 3 comes from Basins J, K and three minor catchments from Basin D. Basins J and K are 2.6 and 1.5 acres, respectively. Basin D is 17 acres total, however the catchments draining to Slip 3 are relatively small.

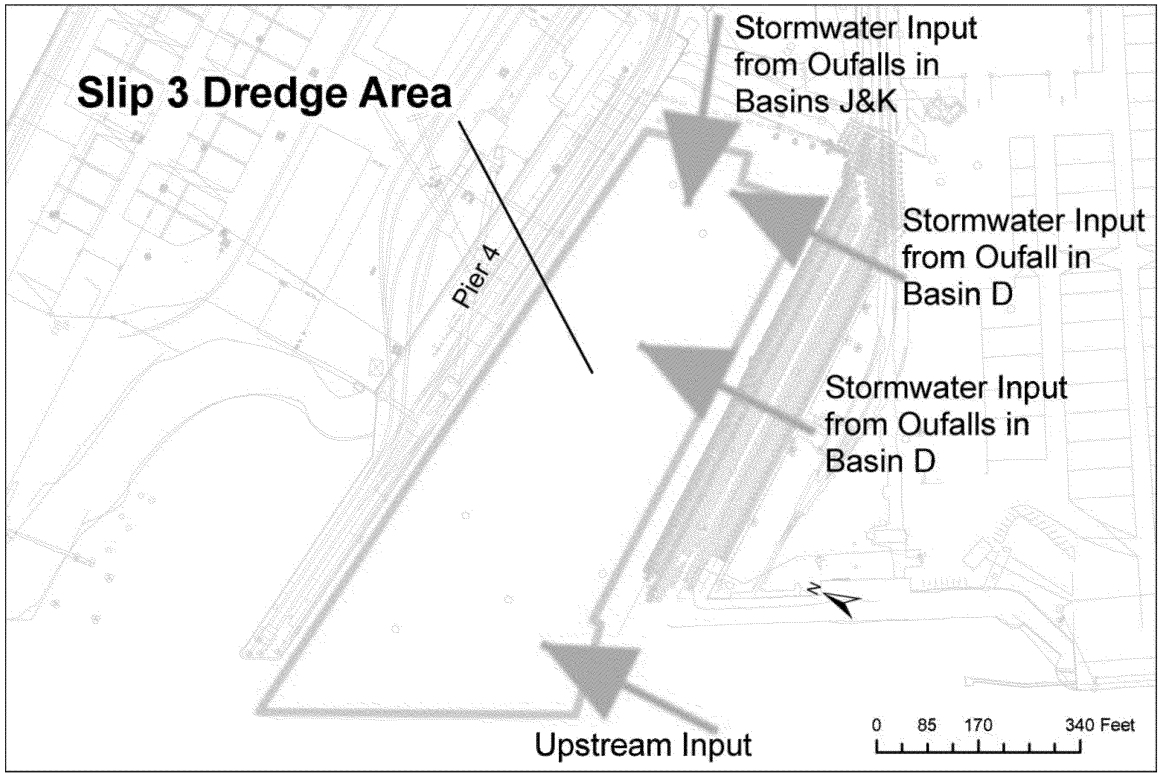

Figure 2-5: Slip 3 dredge subarea and potential recontamination sources.

2.4.5 Subarea 5 – Wheeler Bay Cap Area

The Wheeler Bay capped area receives sediment from upstream and stormwater outfalls (Figure 2-6). The outfall for Basin L discharges to Wheeler Bay. Basin L covers approximately 17.2 acres, and is the third largest stormwater basin in Terminal 4.

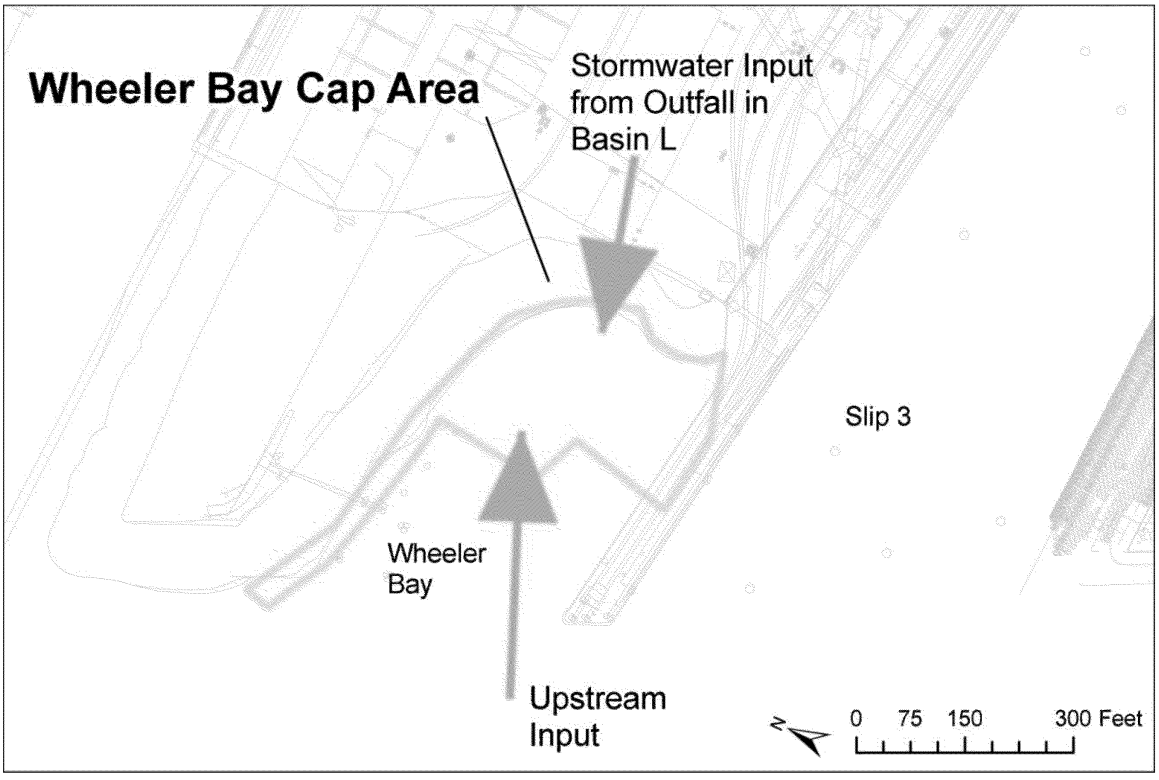

Figure 2-6: Wheeler Bay cap subarea and potential recontamination sources.

2.4.6 Subarea 6 – Wheeler Bay MNR Area

The Wheeler Bay MNR area receives sediment from upstream and stormwater outfalls, and may be affected by sediment input from upstream and stormwater outfalls (Figure 2-7). This area includes all MNR areas downstream of the Slip 3 dredged area. Following the construction of the CDF, the proposed relocation of the outfall for Basin M is downstream of Wheeler Bay. The outfall for Basin L discharges to Wheeler Bay. Basin L covers approximately 17.2 acres, and is the third largest stormwater basin in Terminal 4.

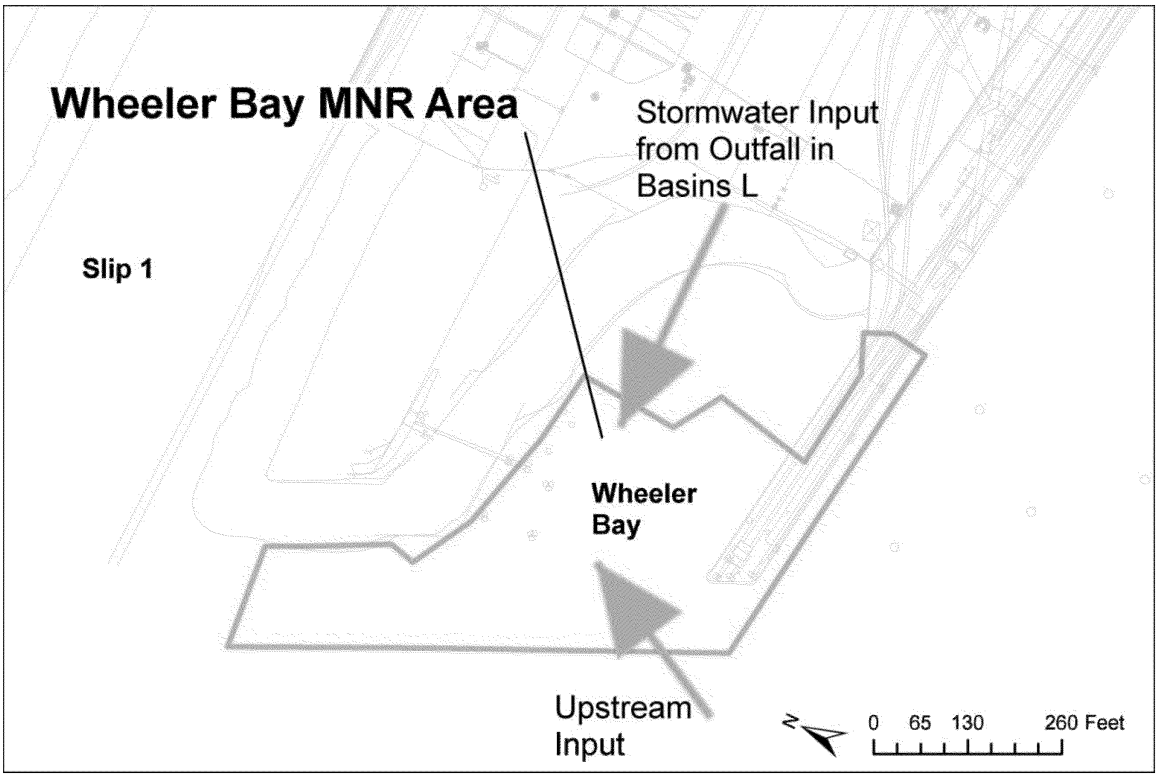

Figure 2-7: Wheeler Bay MNR subarea and potential recontamination sources.

2.4.7 Subarea 7 – Toe of Slip 1 MNR Area

The toe of slip 1 MNR area extends from the proposed reroute location for the stormwater outfall for Basin M to the reroute location for the outfall servicing Basins N, O, Q, R and T (Figure 2-8). Under the rerouted stormwater piping plan, this area will be affected by sediment input from upstream and stormwater from Basin M. Basin M covers approximately 29.1 acres. All of the sediment transported by stormwater will be assumed to affect this area.

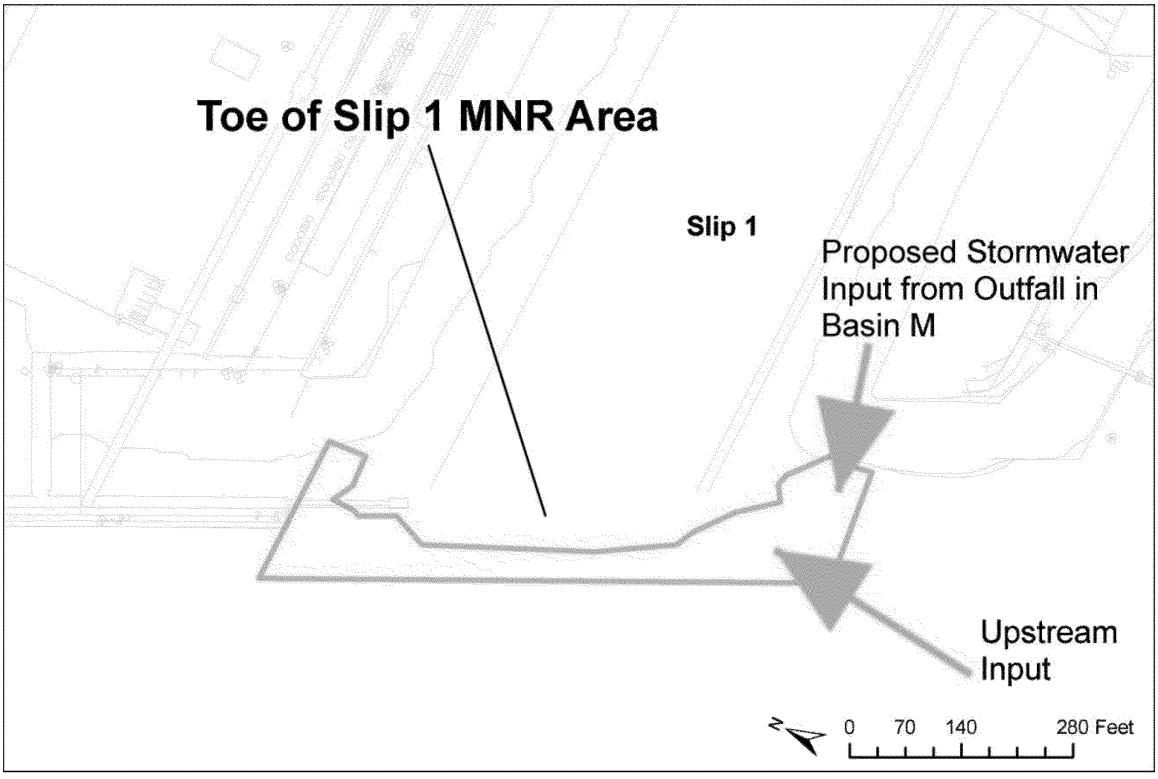

Figure 2-8: Toe of Slip 1 MNR subarea and potential recontamination sources.

2.4.8 Subarea 8 – Berth 401 MNR Area

The Berth 401 MNR area includes the MNR designated area downstream of the proposed reroute location for the stormwater outfall servicing Basins N, O, Q, R, and T (Figure 2-9). Basin T is drained by city outfall 52-C. This area ends downstream when the action becomes capping or the Removal Action Area terminates. Stormwater from Basins N, O, Q, R, and T drains approximately 63.5 acres in total.

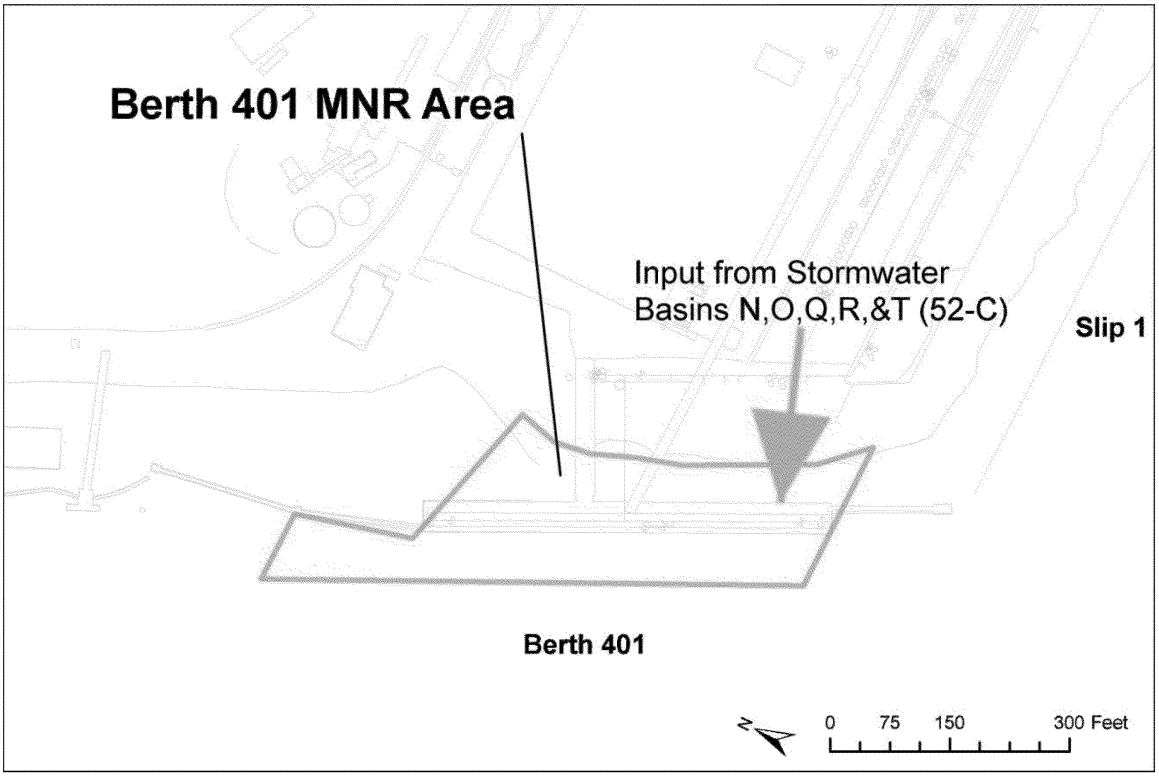

Figure 2-9: Berth 401 MNR subarea and potential recontamination sources.

2.4.9 Subarea 9 – Berth 401 Capped Area

The Berth 401 capped area is the furthest downstream Removal Action subarea. It will be affected by upstream and stormwater deposited sediment (Figure 2-10). Stormwater from Basins N, O, Q, R, T and S drains approximately 64.5 acres in total.

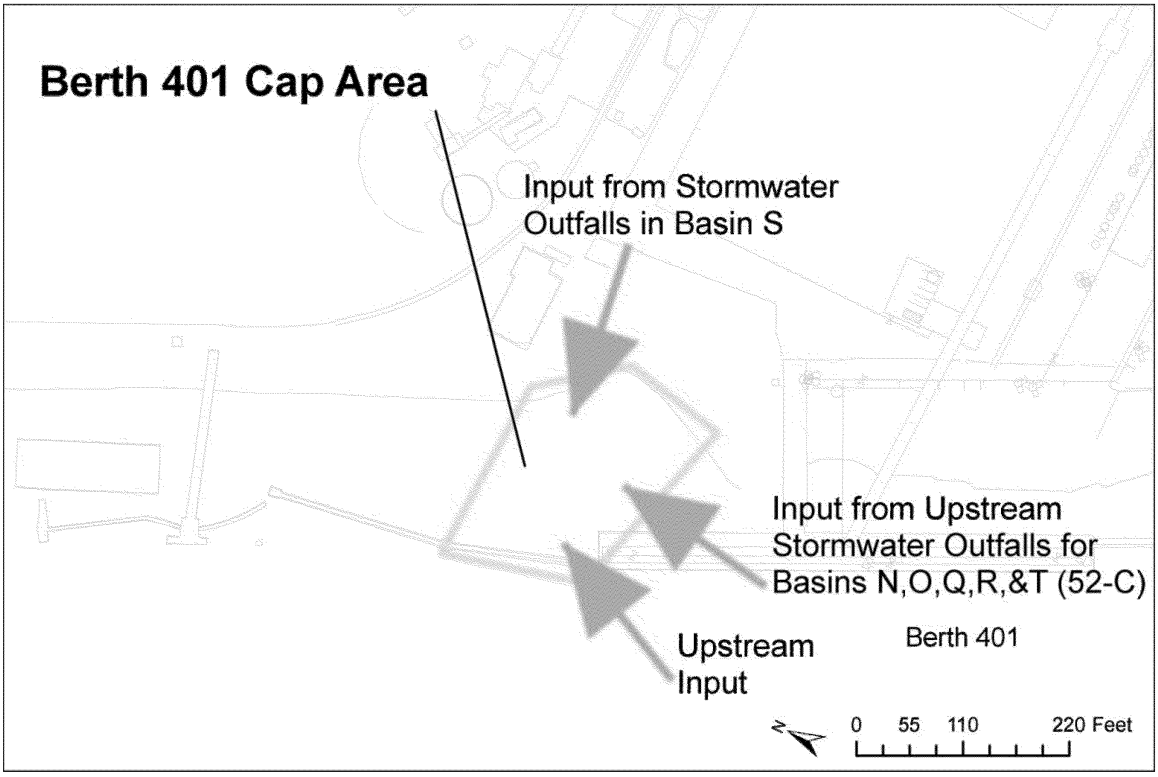

Figure 2-10: Berth 401 cap subarea and potential recontamination sources.

3.0 RECONTAMINATION ANALYSIS METHODOLOGY

The overall methodology for assessing sediment recontamination potential is described in the following sections, including the equations to be used in calculation of predicted COI concentrations in surface sediments after removal action construction is complete.

3.1 Overall Approach

The overall recontamination approach will consist of using the mathematical model, SEDCAM, to predict COI concentrations in surface sediments over time after the removal action construction is complete, considering sediment accumulation, mixing, and contaminant degradation (Jacobs et al., 1988). Source inputs and predicted concentrations over time will depend on the assumption of complete mixing within the Removal Action subarea, however, the recontamination analysis will be conducted on a point-by-point basis. The required inputs to the SEDCAM model are initial COI concentrations in surface sediment present after Phase II Removal Action construction is completed, estimated sediment and COI loads from primary sources, estimated degradation rates for each COI, and an assumed thickness of sediment mixing. Predicted concentrations will be assessed for decreasing trend, and if shown to increase will be compared to harbor-wide cleanup goals for each COI.

3.1.1 Sedimentation Rate

The first step in the analysis is to estimate net sedimentation rates in each of the Removal Action subareas. Available bathymetric, sediment trap and sediment stake data will be reviewed to provide an estimate of the annual average net sedimentation rate.

3.1.1.1 Methodology

An annual net sedimentation rate will be estimated for the Removal Action Area. The net mass of sediment deposited will be equal to the sum of the mass of sediment contributed by the upstream and stormwater sources:

$$M_{net\ gain,RAA} = M_{upstream} + M_{stormwater}$$

where

$M_{net\ gain,\ RAA}$ is the net mass of sediment gained annually in the RAA,

$M_{upstream}$ is the mass of sediment contributed annually by upstream sources and

$M_{stormwater}$ is the mass of sediment contributed annually by stormwater sources.

The net mass gain of sediment ($M_{net\ gain,\ RAA}$) in the Removal Action Area can be calculated from the deposition rate ($R_{deposition}$), area of the Removal Action subarea (A_{RAA}) and bulk density of sediment (p_b):

$$M_{net\ gain,RAA} = R_{deposition} * A_{RAA} * \rho_b$$

Data to be used

Data sources used to estimate the annual net sedimentation rate at Terminal 4 primarily include bathymetric surveys. In-water sediment traps were deployed in 2004 to 2005 by BBL (BBL/Arcadis, 2006), however sedimentation in traps will represent both net sedimentation and sediment resuspended due to propeller wash. Since propeller wash is a significant contributor to water velocities in Slips and other waters at Terminal 4, these data will not be used to evaluate the net sedimentation, since the combination with resuspended sediment would over-estimate the net sedimentation rate. Bathymetric surveys have been conducted at Terminal 4 on a regular basis since 2000. There have been multiple studies attempting to evaluate the sedimentation behavior indicated by these surveys (Port of Portland, 2002; Striplin, 2002; Striplin, 2003; Integral Consulting and David Evans Associates, 2004). Only a subset of the data acquired from these studies was available for quantitative review. In review of the data, it was necessary to ensure that dredged areas were not evaluated in net sedimentation estimates. Table 3-1 summarizes the available bathymetric data that was reviewed and the indicated annual net sedimentation rates. A preliminary average net sedimentation rate for Terminal 4 was calculated from this data to be 4 cm/yr. Due to the limited amount of data available for subareas, an average net sedimentation rate was calculated for the entire Removal Action Area. As additional bathymetric or other datasets become available, this estimate will be revisited to be more specific to subareas. Also, the Lower Willamette Group is currently preparing a harborwide RI/FS that will consider sedimentation over the greater Portland Harbor site (LWG, *in preparation*). Estimated sedimentation rates from the harborwide RI/FS will be used to guide the sedimentation rate used in the recontamination analysis for Terminal 4.

Table 3-1: Summary of sedimentation rates for Terminal 4.

Source	Method	Time Frame	Location	Sedimentation Rate (cm/yr)
Port of Portland, 2002	bathymetric surveys[1]	2000 - 2001	Berth 401	-3.6
Port of Portland, 2002	bathymetric surveys[1]	1999 - 2000	Berth 401	9.6
Port of Portland, 2002	bathymetric surveys[1]	1998 - 1999	Berth 401	1.2
Striplin, 2002	bathymetric surveys	Jan 2002 - July 2002	Berth 401	15.6
Port of Portland, 2002	bathymetric surveys[1]	2000 - 2001	Slip 3	-8.3
Port of Portland, 2002	bathymetric surveys[1]	1999 - 2000	Slip 3	10.3
Port of Portland, 2002	bathymetric surveys[1]	1998 - 1999	Slip 3	-4.2
Port of Portland, 2002	bathymetric surveys[1]	1995 - 1997	Slip 3	-3.0
Striplin, 2002	bathymetric surveys	Jan 2002 - July 2002	Slip 3	7.3
Port of Portland, 2002	bathymetric surveys[1]	2000 - 2001	north of Berth 414	-10.2
Port of Portland, 2002	bathymetric surveys[1]	1999 - 2000	north of Berth 414	15.9
Port of Portland, 2002	bathymetric surveys[1]	1998 - 1999	north of Berth 414	11.5
Port of Portland, 2002	bathymetric surveys[1]	1995 - 1997	north of Berth 414	36.3
Striplin, 2002	bathymetric surveys	Jan 2002 - July 2002	former Berth 413	-23.1

[1]*Bathymetric surveys were evaluated for dredge prism areas only.*

A sediment stake study was conducted by the LWG (Anchor, 2003) in order to assess sediment elevation changes in near-shore environments, which bathymetric surveys are not able to capture. Sediment stakes were placed at low, medium and high locations relative to the shoreline at eight locations along the Willamette River. One stake was located in Wheeler Bay. Results from the five month sediment stake deployment showed relatively little change. However, no correlation was apparent between sediment stake results and bathymetric surveys. The sediment stake deployment did not capture the high-stage timeframe, and sediment stakes in different locations were subject to varying wetted periods.

Uncertainty

Sedimentation rates will be based primarily on bathymetric survey data. Bathymetric surveys were conducted using high-resolution multibeam sonar technology. Horizontal positioning was conducted using GPS. Vertical accuracy of the survey data is within +/- 0.25 ft. Post-processing errors may include positioning differences of vessels over time, outer sonar beam noise, and errors near vertical structures (Integral and David Evan Associates, 2004). Data processing produced contoured bathymetry grids with 3 ft by 3 ft cells using inverse distance weighting and beam grazing angle algorithms (Integral and David Evan Associates, 2004). The analysis of data from 2002 (Striplin, 2002) limited the analysis areas in order to minimize the inclusion of data errors near vertical structures. Data reviewed by the Port (Port of Portland, 2002) limited the analysis extent to dredge prisms only. The spatial restrictions applied to the data analysis improves accuracy by reducing the inclusion of data errors, but may decrease accuracy by limiting the spatial extent to areas that may experience preferential deposition or scour due to vessel traffic or river currents.

3.1.2 Sediment Mass Balance

While COI mass can be input to the system from various sources (see Section 2.3 for an example list), the primary sources of sediment are typically limited to upstream river sediment and suspended sediment in stormwater runoff. For the Terminal 4 removal action areas, stormwater sediment loads can be estimated from the recent sampling effort, which included in-line sediment traps and collection of water samples for analysis of COIs and TSS. Therefore the sediment input from the upstream river can be estimated by subtracting the stormwater sediment load from the total sediment load (from the average sedimentation rate and depositional area). As well as providing necessary input parameters for the SEDCAM model, this step provides an indication of the relative sediment load coming from upstream.

3.1.3 Quantify Primary Potential Recontamination Sources

Initial screening (Section 2.3) suggests that upstream and stormwater sediment are potentially significant sources. The load of sediment contributed by stormwater can be calculated based on TSS measurements collected during the recent sampling events. Stormwater sediment contributions to Removal Action subareas located in the main channel of the Willamette River (i.e. Berth 401 and Berth 414) will be adjusted based on their proximity to the outfall. Using the net mass of sediment gained/lost and the stormwater sediment load, the upstream sediment contribution can be calculated, as described above.

Next, concentrations of COIs in stormwater and upstream sediment inputs will be assigned. A combined input concentration to Removal Action subareas will be calculated based on a weighted average of the source input concentrations and relative sediment loading. Stormwater COI concentrations were measured in 2007 through 2008 (Ash Creek, 2008). An upstream in-water sediment trap (dry weather data) and stormwater data from immediately upstream will be used to estimate the concentration of COIs in the upstream suspended sediment.

3.1.3.1 Upstream

The upstream source includes all sediment originating upstream of Terminal 4 that gets deposited in the Removal Action Areas. Upstream sediment may have been impacted by other site activities, including stormwater runoff, atmospheric deposition, bank erosion, overwater spills, or other activities occurring upstream of Terminal 4.

Data to be used

COI concentrations for the upstream contribution will be obtained from the mid-Willamette sediment trap. This sediment trap was located toward the center of the river, slightly upstream of Berth 414 and Terminal 4.

Deployment of the mid-Willamette sediment trap was conducted as part of the BBL Supplemental Field Work (BBL, 2005b). Details regarding the location selection, sediment trap deployment, preparation and trap recovery can be found in the Terminal 4 Early Action Characterization Report (BBL, 2004a). The trap was deployed from January to March 2005, however, this deployment interval represents primarily dry weather conditions. COI concentrations in the river may be higher during wet weather conditions, primarily due to increases in upstream inputs to the river (i.e. upstream stormwater outfalls). Data from outfall 53, located upstream of the mid-Willamette sediment trap, will be used to determine if the mid-Willamette concentrations would be impacted during wet weather conditions. COI concentrations from the mid-Willamette sediment trap and the outfall 53 stormwater sediment trap are shown in Tables 3-1 and 3-2.

Table 3-2: Upstream COI concentrations measured in the mid-Willamette sediment trap from the January to March 2005 deployment.

COI	Mid-Willamette Sed Trap, Jan-Mar 2005
Benzo(a)pyrene	54 µg/kg
Benzo(a)anthracene	52 µg/kg
Dibenzo(a,h)anthracene	6 µg/kg
Pyrene	110 µg/kg
Indo (1,2,3) pyrene	57 µg/kg
Cadmium	0.48 mg/kg
Lead	27.1 mg/kg
Total PCBs	64 µg/kg

Table 3-3: Stormwater COI concentrations measured in the Outfall 53 sediment trap in February 2008.

COI	Outfall 53 Sed Trap, Feb 2008
Benzo(a)pyrene	830 µg/kg
Benzo(a)anthracene	510 µg/kg
Dibenzo(a,h)anthracene	150 µg/kg
Pyrene	1100 µg/kg
Indo (1,2,3) pyrene	790 µg/kg
Cadmium	1.04 mg/kg
Lead	97.3 mg/kg
Total PCBs	377 µg/kg

The COI concentrations in stormwater from outfall 53 are higher than those measured in the mid-Willamette trap. These data will be used to adjust the mid-Willamette data to account for wet-weather flow in the annual average upstream load estimate.

Evaluating load

The contribution of COIs by upstream sources will be calculated by first estimating the sediment load due to upstream sources. The net sedimentation rate estimated for the subarea can be used to calculate a net mass of sediment gained/lost from the subarea on an annual basis, as:

$$M_{net\ gain,RAA} = R_{deposition} * A_{slip} * \rho_b$$

where the net gain of sediment in the Removal Action subarea is $M_{net\ gain,\ RAA}$,

$R_{deposition}$ is the average annual rate of sediment deposition,

A_{RAA} is the area of the Removal Action subarea, and

p_b is the sediment bulk density.

The net sediment gain should then equal the sum of the individual source sediment contributions:

$$M_{net\ gain,RAA} = \sum M_{sources}$$

The primary sources of sediment to the Removal Action Areas are upstream and stormwater. The load of sediment contributed by upstream sources can be deduced by subtracting the sediment load from stormwater sources from the total net sediment gain for the Removal Action subarea.

Uncertainty

Use of the average annual sedimentation rate to calculate the net sediment gained in the Removal Action subarea and ultimately to deduce the sediment load contributed by the upstream sources make this source load term dependent on the accuracy of the average annual net sedimentation rate. Uncertainties related to this value are described in Section 3.1.1.1. Deployment of the mid-Willamette sediment trap extended from January to March 2005 only. This time interval does not span the season flow changes in the river, when more or less sediment may be transported. However, since the sediment trap data is being used for the COI concentration only, and not the mass loading, the extent of this uncertainty should be minimized.

3.1.3.2 Stormwater

Stormwater runoff suspends sediment from paved and unpaved areas and transports this sediment through the stormwater drainage system to the Removal Action Areas.

The effects of stormwater discharge will be evaluated based on the revised configuration proposed as discussed in the 60% Design Analysis Report (Anchor, 2006). Table 3-3 summarizes which basins discharge stormwater to which Removal Action subareas under the reconfigured plan.

Table 3-4: Summary of stormwater basins and the Removal Action subareas that they may affect.

Removal Action Subarea	Stormwater Basin
1 – Berth 414 MNR Area	D
2 – Berth 414 Dredge and Cap Area	D
3 – Slip 3 Cap Area	J, K, part of D
4 – Slip 3 Dredge Area	J, K, part of D
5 – Wheeler Bay Cap Area	L
6 – Wheeler Bay MNR Area	L
7 – Toe of Slip 1 MNR Area	M
8 – Berth 401 MNR Area	N, O, Q, R, S
9 – Berth 401 Cap Area	N, O, Q, R, S

Data to be used

Stormwater and stormwater sediment was sampled as part of a stormwater characterization program conducted by the Port between 2007 and 2008. This program is summarized in the Final Terminal 4 Slips 1 and 3 Stormwater Data Summary Report (ACA, 2009). The stormwater characterization program was conducted in response to stormwater data gaps identified in the Recontamination Analysis prepared by BBL in 2006. Sampling procedures were based on the field sampling plan developed by Anchor Environmental and Integral Consulting for the LWG Round 3A stormwater sampling (LWG, 2007). In-line sediment traps were deployed twice in Basins D, L, M, and R for a period of approximately five months (January to June 2007) and another period of approximately five months (September/October 2007 to February 2008). Bulk stormwater samples were retrieved from drainage lines in Basins D, L, M, Q and R using programmable composite samplers. The composite samplers collected samples on a flow- or time-weighted basis to capture multiple storm events throughout the sampling period. Stormwater from basins J, K, O, N, and S was not sampled, based on a combination of the following factors: similar land use to other basins, limited historical and current land use, a small percentage of the overall drained area, and a lack of surface sources. The rationale for selection of basins for additional sampling is due to their potential to be significant sources of COIs and is described further in the DEQ approved Storm Water Evaluation Work Plan (ACA and NewFields, 2007). City outfall 53 was sampled by the City of Portland in February 2008. The Final Terminal 4 Slips 1

and 3 Stormwater Data Summary Report provides concentrations of COIs and TSS in stormwater lines (ACA, 2009).

BBL also collected stormwater sediment data for the Recontamination Analysis conducted in 2006, however, since the 2007-2008 dataset is more complete and seasonally non-biased, this data will be utilized for the analysis. Annual rainfall was measured by the Portland HYDRA network data. The average annual rainfall from the 50th percentile flow year, 2002, was used in the loading calculation (Anchor QEA, 2009). The land cover impervious fraction is estimated in the Removal Action Area EE/CA (BBL, 2005a). Basin areas are provided in the Final Terminal 4 Slips 1 and 3 Stormwater Data Summary Report (ACA, 2009).

Evaluating load

The SIMPLE method (Schueler, 1987) is a runoff model that estimates pollutant loading. The SIMPLE method is a simple spreadsheet model that is appropriate for smaller watersheds (less than 640 acres) with limited site data. The entire Terminal 4 facility covers less than 300 acres. The SIMPLE model is the runoff model being used in the harborwide RI/FS for Portland Harbor (LWG *in preparation*). The SIMPLE model will be used to estimate the load of suspended COIs in stormwater caused by storm events, using the total suspended solids (TSS) concentration and the measured concentration of COIs in sediment from traps. Storm events are assumed to produce most of the COI load. The SIMPLE method modifies the volume of water or suspended sediment produced by rainfall events by a runoff coefficient and a fraction of annual rainfall that produces runoff. The runoff coefficient takes the surface cover type into account (i.e. fraction that is impervious). The TSS load will be calculated as:

$$TSS_{load} = RO * C_{TSS} * A_{basin}$$

where RO is runoff, C_{TSS} is the concentration of TSS in stormwater, and A_{basin} is the area of the basin being drained. Runoff can be described as:

$$RO = R * R_v * 0.9$$

where R is the annual rainfall, R_v is the runoff coefficient, and 0.9 is a standard factor representing the percentage of rainfall that produces runoff. The runoff coefficient can be described as:

$$R_v = 0.05 + 0.9 * I_a$$

where I_a is the fraction of surface area in the basin that is impervious.

The TSS load represents the sediment contributed to the Removal Action Area by stormwater sources. This load will then be used to calculate the load of each COI

contributed by stormwater sources. The assumption that all of the stormwater sediment from the outfall lands in the nearby Removal Action subareas provides a conservative estimate of its recontamination potential.

Uncertainty

The sediment trap deployment period was extended based on data gaps identified during the Recontamination Analysis conducted by BBL in 2006. Two deployment periods were used in order to obtain enough sample mass for analysis and to capture the "first flush" storm events that occur in the fall season. The deployment periods adequately (January through June and September/October through February) cover seasonal variations. The dataset used represents only one year, so annual variations may still exist. The SIMPLE model is based on urban land use so the runoff coefficient contains uncertainty when applied to an industrial site, however the harborwide RI/FS has determined that the SIMPLE model is the most appropriate for the site (LWG *in preparation*). COI loads from stormwater basins that were not directly sampled were estimated from other basins with similar land use. Basin sampling was determined based primarily on areas that were likely sources of contamination due to historical activities (ACA/NewFields, 2007). Therefore, when substituting these values for other basins, the resulting total COI load estimate will be conservative. The rationale for selection of basins for additional sampling is due to their potential to be significant sources of COIs and is described further in the DEQ approved Storm Water Evaluation Work Plan (ACA and NewFields, 2007).

3.2 SEDCAM Recontamination Model for Removal Action Areas

The recontamination analysis assesses the potential for post-Removal Action recontamination of surface sediment within the Removal Action Area using the SEDCAM model (Jacobs et al., 1988). The model estimates COI concentrations in surface sediments (a "mixed layer" of defined thickness) by considering initial conditions (i.e., concentrations immediately after removal action construction is complete) and changes with time due to accumulation, burial and loss from diffusion and chemical degradation (see Figure 3-1).

The model contains several simplifying assumptions, such as a well-mixed surface sediment layer of defined thickness and a single term covering chemical degradation and diffusion. However, the model's relative simplicity is one of its main strengths and it has been used for sediment evaluations at multiple sites (Jacobs et al., 1988; Ecology, 1991), and in preliminary evaluation of monitored natural recovery at the Portland Harbor Superfund Site (Anchor, 2005).

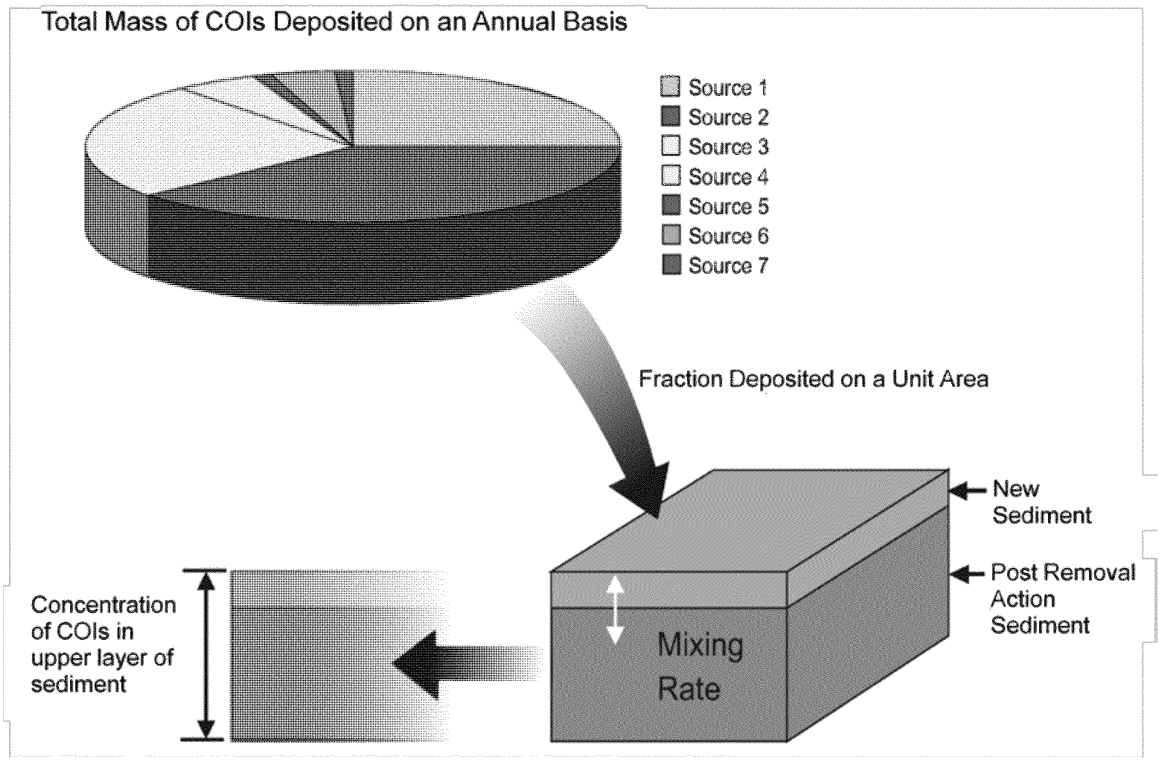

Figure 3-1: Schematic explaning the SEDCAM model.

The form of the SEDCAM model equation presented in the draft Recontamination Analysis (BBL/Arcadis, 2006) was:

$$M_C(t) = \frac{M}{(M + kS)} M_p \left[1 - e^{\frac{-(kS+M)t}{S}} \right] + M_o e^{\frac{-(kS+M)t}{S}}$$

where:

$M_C(t)$ = mass of COI in surface sediment at time t (mg or µg)

M = sedimentation rate (g/cm^2 -yr)

k = combined first-order rate constant for contaminant loss through decay and diffusion processes (yr-1)

M_p = mass of COI in particles being deposited on the sediment (mg or µg)

t = time (yr)

M_o = initial mass of COI in surface sediment (mg or µg)

S = sediment accumulation in the mixed layer (g/cm^2)

To provide clarity on how collected data are used in the analysis, this equation has been converted as follows (see Appendix A):

$$C_C(t) = \frac{1}{(1+kTs)} C_p \left[1 - e^{\frac{-(1+kTs)t}{Ts}} \right] + C_o e^{\frac{-(1+kTs)t}{Ts}}$$

Ts = ML/Rs

where:

$C_c(t)$ = concentration of COI is surface sediment (mixed layer) at time t (mg/kg or µg/kg)

C_p = average concentration of COI in particles being deposited on the sediment (mg/kg or µg/kg)

C_o = average concentration of COI in surface sediment (mixed layer) at time zero (i.e., immediately after sediment removal or capping activities are completed) (mg/kg or µg/kg)

ML = thickness of mixed layer (cm)

Rs = sedimentation rate (cm/year)

C_p represents the average COI in new particles deposited on the sediment. The mass of COI in particles being deposited on the sediment (M_p) is related to concentration (C_p) as follows:

$$M_p = C_p \; M_s$$

where C_p = Average COI concentration on sediment particles

M_s = Mass of sediment particles deposited.

Further

$$C_p = \Sigma C_i M_i / \Sigma M_i$$

where C_i = COI concentration on sediment particles from source "i" (mg/kg)

M_i = mass of sediment particles from source "i" (kg)

And $\Sigma C_i M_i$ is therefore the sum of particulate-based COI load (COI concentration on the particulate multiplied by mass of particulate) for all sources (i.e., individual stormwater upstream sources etc.)

The sediment mass input to the system is equal to the sum of all inputs (i.e., $M_s = \Sigma M_i$) and further for an individual area, the sum of the sediment particle inputs must balance with the total sedimentation rate, such that

$$M_s = Rs \ A_{dep} \ \rho_b$$

3.2.1 SEDCAM Model Parameters

The following sections discuss the remaining input parameters necessary for the SEDCAM model.

3.2.1.1 Sediment mixed layer thickness

The mixed layer thickness depends on water velocities, ship traffic, and activity of benthic organisms. This value typically ranges between 0 and 25 cm thick (Ecology, 1991). For Slip 3, a value of 15 cm was chosen based on the low current velocities within the slip, coupled with periodic redistribution of sediment due to propeller wash which affects areas well beyond the path of the vessel (BBL, 2005a). For example, using an estimated net deposition rate of 4 cm/yr and density of 1.53 g/cc, sediment trap data from 2004 through 2005 suggests that propeller wash may disturb a thickness of 14.3 to 80.3 cm/yr. For Removal Action subareas that lie within the main channel of the Willamette River, a mixed layer thickness of 25 cm will be used, since these areas are affected both by propeller wash and the Willamette River current, which can reach 1.5 feet per second (BBL, 2005a).

3.2.1.2 Sediment density

The estimated sediment density used in the Recontamination Analysis will be based on the analysis presented in the harborwide RI/FS (LWG, *in progress*). As a preliminary

estimate, all available sediment specific gravity measurements from river mile 4 to 5 of the Willamette River were considered. An average of 100 specific gravity measurements for surface sediment from 0 to 30 cm deep was calculated to be 1.53 g/cc.

3.2.1.3 Initial COI concentration in surface sediment

The initial COI concentration in surface sediment will be characterized by sampling after the Phase II Removal Action construction is complete. Recontamination will be assessed on a point-by-point basis using the maximum observed value for each COI by subarea.

3.2.1.1 Degradation Rate

Degradation rates will be based on the values presented in the harborwide RI/FS (LWG, *in progress*).

3.2.1.2 Area

The area of each sub-area used for calculation in the SEDCAM model will be estimated in ArcGIS.

3.3 Primary data sources

Data sources to be used for the Recontamination Analysis may include previous reports, site field data, and bathymetric survey data. The following list provides the main data sources available for use in the Recontamination Analysis, organized by data type:

Sedimentation:

- Port of Portland, 2002. Sedimentation at the Port of Portland Terminals. February.
- Anchor Environmental, LLC, 2003. Draft Sediment Stake Erosion/Accretion Monitoring Report, Round 1A, Portland Harbor RI/FS. May.
- Striplin, 2002. Draft Integration of Sediment Trend Analysis Survey Results with Historic Bathymetry in the Lower Willamette River. Striplin Environmental Associates, Inc. April 26.
- Striplin, 2003. Draft Lower Willamette River May 2003 Multibeam Bathymetry Survey Report. Stripling Environmental Associates, Inc. October 8.
- Integral Consulting, Inc. and David Evans Associates, Inc., 2004. Lower Willamette River, Winter 2004, Multibeam Bathymetric Survey Report. September.
- Field sediment trap data acquired by BBL from 2004 to 2005 for Terminal 4.

River dynamics:

- BBL, 2004a. Terminal 4 Early Action Characterization Report. September.

- Appendix G: Summary of Hydraulics and Sedimentation Characteristics, in BBL, 2005a. Engineering Evaluation and Cost Analysis.

River COI concentrations:

- In-water sediment traps (Mid-Willamette location) deployed during 2004 and 2005.

Stormwater COI concentrations:

- Stormwater in-line sediment traps deployed during 2007 and 2008 (ACA and NewFields, 2009).

Additional data sources regarding the evaluation of additional sources of COIs will be evaluated as needed. For example, the Port is currently preparing a storm water source control evaluation report for the Oregon Department of Environmental Quality on the Terminal 4 Slip 1 and Slip 3 Upland Facilities.

4.0 EXAMPLE RECONTAMINATION ANALYSIS

To show how the methods and data explained above will be used to estimate sediment recontamination potential at Terminal 4, an example calculation is described below. Although the example follows the prescribed methodology, it is included only for demonstrative purposes and does not represent the final recontamination analysis for this subarea. As additional data are acquired, implementation of the methodology will adapt to accommodate the new information.

4.1 Example Setup

The recontamination assessment was conducted for the dredged area of Slip 3 to demonstrate implementation of the methodology. Since post-Phase II Removal Action Area surface sediment concentrations have not yet been obtained, the maximum post-Phase I Removal Action dredging in Slip 3 was used as a conservative initial level for this example. The recontamination methodology calls for comparison of sediment concentrations predicted by the SEDCAM model to harborwide cleanup goals, however, since these were not available, the Terminal 4 hill-topping benchmark value was used for the example.

A net average sedimentation rate of 4 cm/yr was estimated for Terminal 4 based on review of the available local bathymetric survey data. Although the sedimentation patterns in Slip 3 consist of preferential scour near Pier 4 and accumulation toward Pier 5, the average net sedimentation rate for the slip should represent long-term conditions. Using this rate, a net annual sediment load was calculated for Slip 3 as:

$$M_s = R_s * A * \rho_b$$

where M_s is the annual net mass of sediment deposited, R_s is the average sedimentation rate, A is the area of the Removal Action sub-area and p_b is the sediment bulk density. Using this equation, a net sediment load of 2,188,981 kg/yr was estimated based on a preliminary estimate of sediment density of 1.53 g/cc (see Section 3.2.1.2).

Sediment load due to stormwater was estimated based on Basins J and K which discharge to Slip 3. Three small catchments from Basin D also discharge into Slip 3, however these are negligible in size compared to the sum of Basins J and K. The total annual sediment load from stormwater was calculated from measured total suspended solids concentration from a stormwater trap in Basin L (see Section 3.1.3.2). The total sediment load was estimated to be 769 kg/yr. Subtracting the stormwater sediment load from the net sedimentation leaves an upstream sediment input of 2,188,212 kg/yr. This indicates that upstream sediment contributes 99.96% of the sediment to Slip 3, while stormwater contributes 0.04%. Because the upstream source dominates, it allows flexibility with respect to estimation of where sediment from individual stormwater outfalls

settles. In particular, conservatively assuming that all stormwater sediment settles in a particular area does not affect the outcome of the analysis and therefore detailed modeling to refine those estimates is not required.

The example calculation was conducted for benzo(a)pyrene. The input concentrations of benzo(a)pyrene from stormwater (31,000 µg/kg) and upstream sources (54 µg/kg from the mid-Willamette sediment trap) were used to calculate a weighted average benzo(a)pyrene concentration based on their relative sediment contributions. The SEDCAM model was conducted for 10 years on a 1-year time step.

4.2 Recontamination Analysis for Slip 3 dredged area

The following sections describe the data input into the SEDCAM model as well as the example model results, uncertainties and a brief sensitivity analysis. Input values used in this example are not necessarily the final input values for this subarea. The example is to demonstrate the implementation of the methodology, not to provide recontamination analysis results.

4.2.1 Summary of model inputs

Model inputs are summarized in Table 4-1. The mixed layer thickness is an assumed value of 0.5 feet (15.24 cm). The degradation rate for benzo(a)pyrene was extrapolated from literature values for degradation of total PAHs. Since grain size information has not been acquired for stormwater transported sediment, a conservative assumption was made that all stormwater solids from the applicable basins would land in the Slip 3 dredged area.

Table 4-2 shows the calculation used to estimate the weighted average COI concentration from the two input sources: stormwater and upstream. As the Table 4-2 shows, the estimated sediment input from upstream sources is four orders of magnitude larger than the measured stormwater sediment input. Based on the relative magnitude of the upstream and stormwater sources, the upstream sediment input will dominate the sedimentation in the Removal Action Area, thus detailed stormwater sediment deposition modeling is not warranted.

Table 4-1: Summary of model input values for the example calculation.

Model Input Values		
Area of Removal Action subarea	385,000	ft^2
Total load of sediment to subarea[1]	2,188,981	kg/yr
Weighted average input BaP concentration[2]	64.87	µg/kg
Mixing layer thickness[3]	15.24	cm
BaP degradation rate[4]	0.5	yr^{-1}
Initial concentration at maximum point in subarea[5]	41,100	µg/kg
Time step	1	yr

[1]Based on an annual net sedimentation rate of 4 cm/yr.
[2]Weighted average of stormwater and upstream source inputs based on relative magnitude of sediment load (see Table 4-2).
[3]Assumed value.
[4]Mean degradation rate for Total PAHs from BBL/Arcadis, 2006. This rate will be revised for the Recontamination Analysis based on the harborwide RI/FS.
[5]Maximum post-Phase I construction concentration for Slip 3.This value will be revised for the Recontamination Analysis based on post-Removal Action construction sampling at Terminal 4.

Table 4-2: Weighted average COI concentration calculation.

	Sedimentation Rate (kg/yr)	COI Concentration (µg/kg)	Weighted COI load (kg/yr)
Stormwater sedimentation input rate	769	31,000	0.024
Upstream sedimentation input rate	2,188,212	54	0.118
Net sedimentation rate	2,188,981	***64.87***	0.142

4.2.2 SEDCAM modeling results

The SEDCAM model was conducted for a 10 year time period on a 1-year time step. Table 4-3 summarizes the predicted surface sediment concentration by year. Figure 4-1 shows the results graphically, compared to the Terminal 4 hill-topping benchmark value.

The results show that for benzo(a)pyrene, surface sediment concentration will decrease from the initial concentration used in this example. The initial benzo(a)pyrene concentration exceeded the goal concentration, however decreasing concentrations will allow for achievement of the goal concentration in less than four years. Based on the definition of recontamination presented in section 1.4, decreasing concentrations indicate no recontamination.

Table 4-3: SEDCAM model predicted sediment concentrations of benzo(a)pyrene (BaP) in the Slip 3 dredged area.

Years elapsed	Maximum concentration of BaP at any point in Slip 3, Cc(t) (µg/kg)
0	41,100
1	16,701
2	6,797
3	2,776
4	1,144
5	482
6	213
7	103
8	59
9	41
10	34

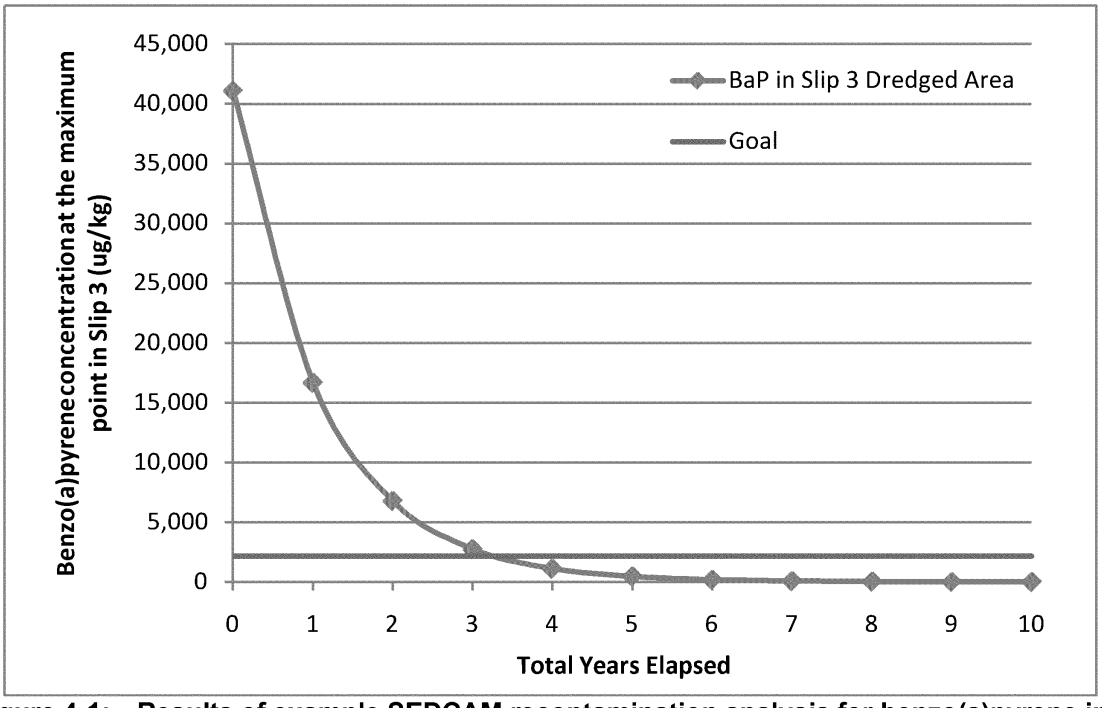

Figure 4-1: Results of example SEDCAM recontamination analysis for benzo(a)pyrene in the dredged area of Slip 3. The goal level indicates the Terminal 4 hill-topping benchmark value.

4.2.3 Uncertainties

The SEDCAM model requires that a number of assumptions be made. It was assumed that sediment in the top 0.5 feet throughout the Removal Action subarea would be completely mixed. This assumption is supported by observations indicating that propeller wash affects areas within the slip beyond the direct line of vessel traffic, and may be responsible for significant sediment resuspension (BBL, 2005a). Although the net deposition in Slip 3 is estimated at 4 cm/yr, sediment trap data from 2004 through 2005 suggests that propeller wash may disturb a thickness of 14.3 to 80.3 cm/yr. The weighted average input concentration also assumes that stormwater sediment input and upstream sediment input is completely mixed within the Removal Action subarea. The degradation rate for benzo(a)pyrene was estimated based on the mean degradation rate for Total PAHs from the literature (Herbes and Schwall, 1978; Heitkamp and Cerniglia, 1987; Shiaris, 1989; Lun et al., 1998; Krieger-Brockett et al., 1999; Geiselbrecht, 2000; Mackay and Hickie, 2000). Loading of upstream sediment into Slip 3 was estimated based on the net sedimentation rate, calculated by comparison of available bathymetric surveys over time. The multibeam sonar technology used for obtaining bathymetric measurements has a vertical measurement error of +/- 0.25 ft. The estimated value of 4 cm/yr was chosen as a conservative estimate based on the available data. Other data uncertainties were reviewed in Section 3.

4.2.4 Sensitivity analysis

A simple sensitivity analysis was performed on the SEDCAM model using the example from the previous sections. The mixed layer thickness, COI degradation rate, input COI concentration and net sedimentation rate were tested. Table 4-4 summarizes the results of the sensitivity analysis.

The results show that the model is most sensitive to an increase in the COI degradation rate and an increase in the net sedimentation rate. However, for these variables, an increase would create an overall reduction in recontamination potential. The results suggest that the estimated values used in the example analysis provide a conservative estimation of recontamination potential.

Table 4-4: Results of sensitivity analysis performed on SEDCAM model using benzo(a)pyrene as an example COI and the Slip 3 dredged area as an example analysis subarea.

Sensitivity analysis	Increase/Reduction in predicted concentration and number of orders of magnitude of change from original scenario after:	
	1 year	10 years
Mixed layer thickness		
Reduce by half (7.62 cm)	Reduction, 1	Reduction, 1
Double (30.48 cm)	Increase, <1	Increase, <1
Degradation rate		
Decrease 10x (0.05 yr^{-1})	Increase, <1	Increase, 1
Increase 10x (5 yr^{-1})	Reduction, 2	Reduction, 1
Input Concentration		
Increase 10x (649 µg/kg)	Increase, <1	Increase, 1
Net sedimentation rate		
Decrease 10x (0.4 cm/yr)	Increase, <1	Increase, 1
Increase 10x (40 cm/yr)	Reduction, 2	Increase, <1

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APPENDIX A

SEDCAM Model Equation Conversion

APPENDIX A – SEDCAM Model Equation Conversion

For this analysis, the SEDCAM model was used to estimate future sediment COI mass. The mass of COI at some time after natural recovery begins can be estimated as follows (Jacobs et al., 1988):

$$M_C(t) = \frac{M}{(M + kS)} M_p \left[1 - e^{\frac{-(kS+M)t}{S}}\right] + M_o e^{\frac{-(kS+M)t}{S}}$$

Where:

$M_C(t)$ = mass of COI in surface sediment at time t (mg or µg)

M = sedimentation rate (g/cm^2-yr)

k = combined first-order rate constant for contaminant loss through decay and diffusion processes (yr^{-1})

M_p = mass of COI in particles being deposited on the sediment (mg or µg)

t = time (yr)

M_o = initial mass of COI in surface sediment (mg or µg)

S = sediment accumulation in the mixed layer (g/cm^2)

The total accumulation of sediment in the mixed layer (S) is calculated as follows:

$$S = ML \times \rho_b$$

Where:

ML = thickness of mixed layer (cm)

ρ_b = bulk density of sediment (g/cm^3)

Bulk density is related to particle density (ρ_p) as follows

$$\rho_p = \rho_b \times (1-\Phi)$$

where Φ = porosity of sediment (cm^3 voids/cm^3 material)]

This equation was converted to physical/chemical parameters that are directly measured or estimated in the recontamination study:

$C_C(t)$ = concentration of COI in surface sediment at time t (mg/Kg or µg/Kg)

C_p = concentration of COI in particles being deposited on the sediment (mg/Kg or µg/Kg)

C_o = initial concentration of COI in surface sediment (mg/Kg or µg/Kg)

Rs = sedimentation rate (cm/year)

The relationships used in the conversions were:

$$Mc\ (t) = Cc(t) \times A_{dep} \times ML \times \rho_b$$

$$M = Rs \times \rho_b$$

Where:

Cc(t) = concentration of a contaminant in sediment at time t (mg/kg or µg/kg)

A_{dep} = area of the sediment deposition in Removal Action Subarea (cm^2)

ML = thickness of mixed layer (cm)

Conversion of the individual terms is as follows:

$$M/(M + kS) = Rs\ \rho_b / (Rs\ \rho_b + k\ ML\ \rho_b)$$

$$= Rs/(Rs + k\ ML)$$

Defining a parameter that is the number of years of sedimentation that corresponds to the thickness of the mixed layer:

$$Ts = ML/Rs$$

Therefore

$$M/(M + kS) = 1/(1 + kTs)$$

Similarly

$$(kS + M)/S = (k\ ML\ \rho_b + Rs\ \rho_b)/ ML\ \rho_b$$

$$= (k\ ML + Rs)/ML$$

$$= (k\ Ts + 1)/ Ts$$

Inserting these terms into the SEDCAM equation yields.

$$C_C(t) = \frac{1}{(1 + kTs)} C_p \left[1 - e^{\frac{-(1+kTs)t}{Ts}} \right] + C_o e^{\frac{-(1+kTs)t}{Ts}}$$

The mass of COI in particles being deposited on the sediment (Mp) is related to concentration (Cp) as follows:

Mp = Cp Ms

Where Cp = Average COI concentration on sediment particles

Ms = Mass of sediment particles deposited.

Further

Cp = Σ Ci Mi / Σ Mi

And Ms = Σ Mi

Where Ci = COI concentration on sediment particles from source i (mg/Kg)

Mi = mass of sediment particles from source i (Kg)

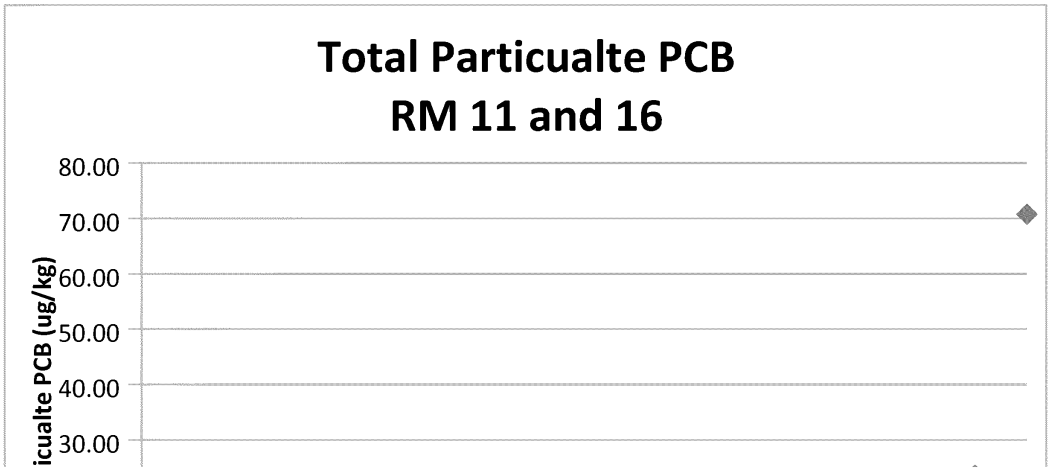
The sum of the sediment particle inputs must balance with the total sedimentation rate, such that

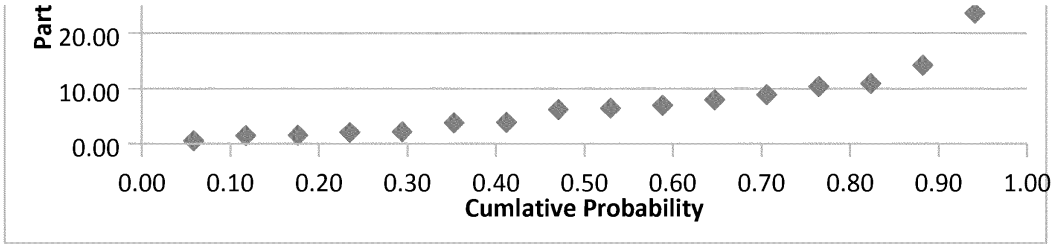
$Ms = Rs \ A_{dep} \ \rho_b$

LocationID	LocationName	X	Y	Z	RiverMile	SampleDate	SampleTime
XAD Filter							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:11
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	17:25
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
XAD Column							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:20
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	16:52
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
TSS							
LW2-W023	W023	642505.89	690067.93	-49	11	15-Nov-04	22:34
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	11-Jul-05	14:10
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	10:00
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	11:35

SampleID	Analyte	detect_flag	VALUE	Qualifiers	Units
LW2-W023 F	Pentachlorobiphenyl homologs	Y	56.8	T	pg/l
LW2-W2023 F	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW2-W3023 F	Pentachlorobiphenyl homologs	Y	26.7	JT	pg/l
LW3-W1023 F	Pentachlorobiphenyl homologs	Y	33.4	JT	pg/l
LW3-W2023-M-F	Pentachlorobiphenyl homologs	Y	24.1	JT	pg/l
LW3-W2023-W-F	Pentachlorobiphenyl homologs	Y	16.7	JT	pg/l
LW3-W2023-E-F	Pentachlorobiphenyl homologs	Y	75.8	T	pg/l
LW3-W3023-M-F	Pentachlorobiphenyl homologs	Y	11.4	JT	pg/l
LW3-W3023-E-F	Pentachlorobiphenyl homologs	Y	77.9	JT	pg/l
LW3-W3023-W-F	Pentachlorobiphenyl homologs	Y	34.1	JT	pg/l
LW3-W4023-M-F	Pentachlorobiphenyl homologs	Y	1.97	JT	pg/l
LW3-W4023-M2-F	Pentachlorobiphenyl homologs	Y	17.1	JT	pg/l
LW3-W4023-E-F	Pentachlorobiphenyl homologs	Y	25.3	JT	pg/l
LW3-W4023-W-F	Pentachlorobiphenyl homologs	Y	17.6	JT	pg/l
LW2-W023 C	Pentachlorobiphenyl homologs	Y	8.86	JT	pg/l
LW2-W2023 C	Pentachlorobiphenyl homologs	Y	17.3	JT	pg/l
LW2-W3023 C	Pentachlorobiphenyl homologs	Y	48.5	T	pg/l
LW3-W1023 C	Pentachlorobiphenyl homologs	Y	15.1	JT	pg/l
LW3-W2023-M-C	Pentachlorobiphenyl homologs	Y	34.8	JT	pg/l
LW3-W2023-W-C	Pentachlorobiphenyl homologs	Y	39.5	T	pg/l
LW3-W2023-E-C	Pentachlorobiphenyl homologs	Y	45.2	T	pg/l
LW3-W3023-M-C	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW3-W3023-E-C	Pentachlorobiphenyl homologs	Y	23.3	JT	pg/l
LW3-W3023-W-C	Pentachlorobiphenyl homologs	Y	21.5	JT	pg/l
LW3-W4023-M-C	Pentachlorobiphenyl homologs	Y	6.21	JT	pg/l
LW3-W4023-M2-C	Pentachlorobiphenyl homologs	Y	7.29	JT	pg/l
LW3-W4023-E-C	Pentachlorobiphenyl homologs	Y	12.3	JT	pg/l
LW3-W4023-W-C	Pentachlorobiphenyl homologs	Y	10.7	JT	pg/l
LW2-W023	Total suspended solids	Y	8	T	mg/l
LW2-W2023	Total suspended solids	Y	6.5	T	mg/l
LW2-W3023	Total suspended solids	Y	17	J	mg/l
LW3-W1023-1	Total suspended solids	Y	62	T	mg/l
LW3-W1023-2	Total suspended solids	Y	54		mg/l

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)
17-Nov-04	LW2-W023	11	566	8	70.75
07-Mar-05	LW2-W023	11	67.4	6.5	10.37
12-Jul-05	LW2-W023	11	118	17	6.94
20-Jan-06	LW2-W023	11	127	58	2.19
05-Sep-06	LW3-W023M	10.9	106	1	106.00
06-Sep-06	LW3-W023W	11	64.6	10	6.46
02-Nov-06	LW3-W023M	10.9	43.7	4	10.93
02-Nov-06	LW3-W023W	11	117	1	117.00
15-Jan-07	LW3-W023M	10.9	7.33	13	0.56
02-Mar-07	LW3-W023M	10.9	70.3	18	3.91
04-Mar-07	LW3-W023W	11	76	20	3.80
19-Jan-06	LW3-W024	15.9	77.9	49	1.59
13-Sep-06	LW3-W024	15.9	42.6	3	14.20
13-Sep-06	LW3-W024	15.9	26.7	3	8.90
03-Nov-06	LW3-W024	15.9	118	5	23.60
03-Nov-06	LW3-W024	15.9	39.9	5	7.98
18-Jan-07	LW3-W024	15.9	22.9	11	2.08
18-Jan-07	LW3-W024	15.9	20.9	14	1.49
06-Sep-06	LW3-W023E	11	663	5	132.6
02-Nov-06	LW3-W023E	11	408	4	102
03-Mar-07	LW3-W023E	11	99.7	16	6.23125

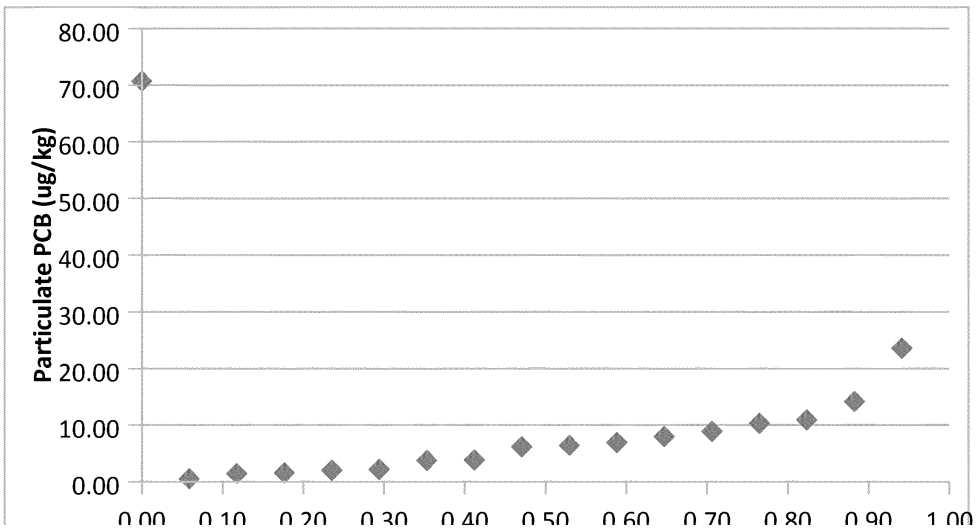


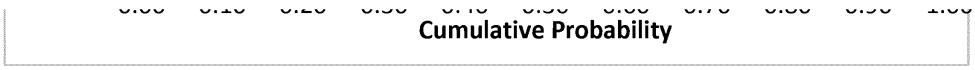

Part
20.00
10.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Cumlative Probability

Notes	Suspended Particle PCB (ug/kg)	Rank	Cumlative Probability
	0.56	1	0.06
	1.49	2	0.12
	1.59	3	0.18
	2.08	4	0.24
TSS Result is ND	2.19	5	0.29
	3.80	6	0.35
	3.91	7	0.41
TSS Result is ND	6.23	8	0.47
	6.46	9	0.53
	6.94	10	0.59
	7.98	11	0.65
	8.90	12	0.71
	10.37	13	0.76
	10.93	14	0.82
	14.20	15	0.88
	23.60	16	0.94
	70.75	17	1.00

RM 11E Location

1




Cumulative Probability

LocationID	RiverMile	SampleDate	ampleTim	SampleID	Method	AnalysisDate	nalysisTim
LW2-W023	11	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05	13:23
LW2-W023	11	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05	03:38
LW2-W023	11	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05	18:30
LW2-W023	11	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	16:54
LW3-W023M	10.9	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	13:52
LW3-W023W	11	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	05:09
LW3-W023M	10.9	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	01:01
LW3-W023W	11	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	02:05
LW3-W023M	10.9	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07	16:28
LW3-W023M	10.9	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	13:42
LW3-W023W	11	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	14:46
LW3-W023E	11	06-Sep-06	13:36	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	04:04
LW3-W023E	11	02-Nov-06	18:55	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07	23:56
LW3-W023E	11	03-Mar-07	11:00	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	12:37

AnalyteGroup	cas_rn	Analyte	al_or_dissol	detect_flag	VALUE	Qualifiers	Units
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l

SampleDate	ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
15-Nov-04	22:34	LW2-W023	E160.2	22-Nov-04	12:00	Conventionals	TSS
07-Mar-05	13:16	LW2-W2023	E160.2	14-Mar-05	12:00	Conventionals	TSS
11-Jul-05	14:10	LW2-W3023	E160.2	10-Aug-05	00:30	Conventionals	TSS
20-Jan-06	10:00	LW3-W1023-1	E160.2	27-Jan-06	12:00	Conventionals	TSS
05-Sep-06	13:41	LW3-W2023-M	E160.2	07-Sep-06	00:01	Conventionals	TSS
06-Sep-06	15:25	LW3-W2023-W	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	13:00	LW3-W3023-M	E160.2	09-Nov-06	12:00	Conventionals	TSS
02-Nov-06	16:10	LW3-W3023-W	E160.2	09-Nov-06	12:00	Conventionals	TSS
15-Jan-07	13:08	LW3-W4023-M	E160.2	22-Jan-07	12:00	Conventionals	TSS
02-Mar-07	13:00	LW3-W4023-M2	E160.2	07-Mar-07	11:42	Conventionals	TSS
04-Mar-07	14:00	LW3-W4023-W	E160.2	07-Mar-07	11:42	Conventionals	TSS
06-Sep-06	13:36	LW3-W2023-E	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	18:55	LW3-W3023-E	E160.2	09-Nov-06	12:00	Conventionals	TSS
03-Mar-07	11:00	LW3-W4023-E	E160.2	07-Mar-07	11:42	Conventionals	TSS

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
Total suspended solids	NA	Y	8	T	mg/l
Total suspended solids	NA	Y	6.5	T	mg/l
Total suspended solids	NA	Y	17	J	mg/l
Total suspended solids	NA	Y	58	T	mg/l
Total suspended solids	NA	N	1	U	mg/l
Total suspended solids	NA	Y	10		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	N	1	UJ	mg/l
Total suspended solids	NA	Y	13		mg/l
Total suspended solids	NA	Y	18		mg/l
Total suspended solids	NA	Y	20		mg/l
Total suspended solids	NA	Y	5		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	Y	16		mg/l

LocationID	cationNam	X	Y	Z	RiverMile	Task	SampleDate	SampleTime
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS1	19-Jan-06	16:30
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:14
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:13
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	12:03
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	11:53

SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	15:50	PCB_Congeners	1336-36-3
LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	14:56	PCB_Congeners	1336-36-3
LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06	15:30	PCB_Congeners	1336-36-3
LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	04:14	PCB_Congeners	1336-36-3
LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07	18:38	PCB_Congeners	1336-36-3
LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	01:34	PCB_Congeners	1336-36-3
LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	00:30	PCB_Congeners	1336-36-3

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory	SampleDate
Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA	QA2Cat1	19-Jan-06
Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	118	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA	QA2Cat1	15-Jan-07
Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA	QA2Cat1	15-Jan-07

ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn	Analyte	l_or_disso
11:15	LW3-W1024	E160.2	27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NB	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NS	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:10	LW3-W3024-NB	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:04	LW3-W3024-NS	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NB	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NS	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA

detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory
Y	49	J	mg/l	NA	QA2Cat1
Y	3		mg/l	NA	QA2Cat1
Y	3	T	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	11	T	mg/l	NA	QA2Cat1
Y	14	T	mg/l	NA	QA2Cat1

LocationID	cationNam	RiverMile	Task	SampleDate	ampleTim	SampleID	Method	AnalysisDate
LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	20:00	LW3-W2025-E-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	19:27	LW3-W2025-M-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	18:01	LW3-W2025-W-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:38	LW3-W3025-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	17:02	LW3-W3025-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	13:15	LW3-W3025-E-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:38	LW3-W4025-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	17:50	LW3-W4025-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	15:45	LW3-W4025-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	15:53	LW3-W4025-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:09	LW3-W3026-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:11	LW3-W3026-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:30	LW3-W4026-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:23	LW3-W4026-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NB-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NS-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NS-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	13:26	LW3-W4027-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	12:44	LW3-W4027-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW2-W005	W005	3.9	B01-01-48H_WS1	23-Nov-04	06:27	LW2-W005 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	22:23	LW2-W3005 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	16:40	LW3-W1005 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:16	LW3-W2005-NB-F	AXYS METHOD MLA-010 Rev 08	29-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:21	LW3-W2005-NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3005-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:55	LW3-W3005-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:26	LW3-W4005-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:23	LW3-W4005-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NS-F	AXYS METHOD MLA-010 Rev 08	14-Jan-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:50	LW3-W4029-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:40	LW3-W4029-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	12:43	LW3-W4030-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	14:17	LW3-W4030-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:38	LW3-W4031-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:08	LW3-W4031-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW2-W011	W011	6.3	B01-01-48H_WS1	18-Nov-04	18:23	LW2-W011 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W011	W011	6.3	B01-01-48H_WS2	08-Mar-05	22:05	LW2-W2011 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	21:41	LW2-W3011 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NB-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07		LW3-W4011-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07	11:44	LW3-W4011-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W013	W013-1	6.7	B01-01-48H_WS1	09-Nov-04	03:35	LW2-W013-1 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	23:06	LW2-W013-2 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	21:29	LW2-W3013-1 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW2-W015	W015	6.9	B01-01-48H_WS1	30-Nov-04	00:05	LW2-W015 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05

LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	23:27	LW2-W3015 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:43	LW3-W4033-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:27	LW3-W4033-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW2-W016	W016-1	7.2	B01-01-48H_WS1	01-Dec-04	01:15	LW2-W016 F	AXYS METHOD MLA-010 Rev 05	03-Jun-05
LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	22:54	LW2-W3016 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:50	LW3-W3034-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:49	LW3-W3034-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW2-W018	W018	8.3	B01-01-48H_WS1	10-Nov-04	11:15	LW2-W018	E160.2	12-Nov-04
LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	21:52	LW2-W3018 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	11:41	LW3-W3035-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	10:56	LW3-W3035-NS-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	16:05	LW3-W4035-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	15:35	LW3-W4035-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:26	LW3-W3036-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:28	LW3-W3036-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:08	LW3-W4036-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:14	LW3-W4036-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:32	LW3-W4037-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:30	LW3-W4037-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:57	LW3-W3038-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:48	LW3-W4038-NB-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:50	LW3-W4038-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07

LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W023	W023	11	B01-01-48H_WS1	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W023	W023	11	B01-01-48H_WS3	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	17:21	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	19:49	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07

LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	15:30	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	16:30	LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:14	LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:13	LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07
LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	12:03	LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07
LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	11:53	LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07

nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	15.4	JT	pg/l	NA
16:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	17.8	JT	pg/l	NA
17:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	13.5	JT	pg/l	NA
21:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
11:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.5	JT	pg/l	NA
05:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	336	JT	pg/l	NA
17:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	34.3	JT	pg/l	NA
15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.2	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	40.2	JT	pg/l	NA
16:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
14:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	263	JT	pg/l	NA

13:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	239	JT	pg/l	NA
04:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	114	JT	pg/l	NA
05:41	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	96	JT	pg/l	NA
17:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	237	JT	pg/l	NA
18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	248	JT	pg/l	NA
23:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	143	JT	pg/l	NA
22:48	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	130	JT	pg/l	NA
19:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	176	JT	pg/l	NA
20:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	150	JT	pg/l	NA
16:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76.9	JT	pg/l	NA
15:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	457	JT	pg/l	NA

06:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.1	JT	pg/l	NA
12:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	175	JT	pg/l	NA
15:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93	JT	pg/l	NA
05:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	166	JT	pg/l	NA
16:21	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	213	JT	pg/l	NA
17:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	136	JT	pg/l	NA
23:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	481	JT	pg/l	NA
00:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	189	JT	pg/l	NA
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	222	JT	pg/l	NA
14:53	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	210	JT	pg/l	NA
03:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	313	JT	pg/l	NA

05:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	69.9	JT	pg/l	NA
17:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA
00:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	94.6	JT	pg/l	NA
13:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.4	JT	pg/l	NA
14:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.3	JT	pg/l	NA
01:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	162	JT	pg/l	NA
18:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	216	JT	pg/l	NA
16:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72.9	JT	pg/l	NA
17:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	33.7	JT	pg/l	NA
04:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA
03:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	125	JT	pg/l	NA

11:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	348	JT	pg/l	NA
12:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	89.8	JT	pg/l	NA
14:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	171	JT	pg/l	NA
04:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	259	JT	pg/l	NA
17:26	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	199	JT	pg/l	NA
03:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	513	JT	pg/l	NA
01:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	245	JT	pg/l	NA
18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	135	JT	pg/l	NA
17:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA
06:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA
07:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72	JT	pg/l	NA

10:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	2620	T	pg/l	NA
11:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1890	T	pg/l	NA
14:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	9560	JT	pg/l	NA
15:33	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1380	JT	pg/l	NA
03:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	5920	JT	pg/l	NA
02:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	270	JT	pg/l	NA
00:57	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	321	JT	pg/l	NA
12:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	195	JT	pg/l	NA
13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	121	JT	pg/l	NA
16:35	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1290	T	pg/l	NA
11:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	285	JT	pg/l	NA

00:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	398	JT	pg/l	NA
02:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	179	JT	pg/l	NA
05:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	141	JT	pg/l	NA
04:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	157	JT	pg/l	NA
03:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	161	JT	pg/l	NA
14:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	122	JT	pg/l	NA
15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.6	JT	pg/l	NA
11:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	238	JT	pg/l	NA
12:19	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	201	JT	pg/l	NA
01:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	695	JT	pg/l	NA
06:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	123	JT	pg/l	NA

05:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA
13:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	102	JT	pg/l	NA
15:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	90.6	JT	pg/l	NA
17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1120	JT	pg/l	NA
02:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	341	JT	pg/l	NA
04:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	449	JT	pg/l	NA
03:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	295	JT	pg/l	NA
16:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	480	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	496	JT	pg/l	NA
09:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	156	JT	pg/l	NA

02:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
18:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	223	JT	pg/l	NA
16:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	165	JT	pg/l	NA
12:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	172	JT	pg/l	NA
11:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	53.4	JT	pg/l	NA
17:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	225	JT	pg/l	NA
02:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	186	JT	pg/l	NA
14:17	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	23.1	JT	pg/l	NA
13:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	87.4	JT	pg/l	NA
03:44	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
04:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.8	JT	pg/l	NA

13:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l	NA
01:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l	NA
16:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l	NA
13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l	NA
13:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l	NA
03:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
18:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
16:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l	NA
04:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l	NA
05:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l	NA
23:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l	NA

02:05	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l	NA
12:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l	NA
14:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA
15:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA
14:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA
15:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA
04:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
18:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA
01:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA
00:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA

DVCategory		LocationID	ocationNam	RiverMile	Task	SampleDate	ampleTim	SampleID	Method
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	17:00	LW3-W2025-E	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	13:38	LW3-W2025-M	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	14:30	LW3-W2025-W	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:56	LW3-W3025-M	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	16:44	LW3-W3025-W	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	12:59	LW3-W3025-E	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:25	LW3-W4025-M	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	13:50	LW3-W4025-E	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	10:17	LW3-W4025-W	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	10:27	LW3-W4025-M2	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:04	LW3-W3026-NB	E160.2

QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:03	LW3-W3026-NS	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:23	LW3-W4026-NB	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:00	LW3-W4026-NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	20:04	LW3-W2027-1NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	19:53	LW3-W2027-1NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:23	LW3-W4027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:14	LW3-W4027-NS	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:40	LW3-W3028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:30	LW3-W3028-NS	E160.2

QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS1	22-Nov-04	19:40	LW2-W005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	12:50	LW2-W3005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	10:00	LW3-W1005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:24	LW3-W2005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:17	LW3-W2005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:25	LW3-W3005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:15	LW3-W3005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:03	LW3-W4005-NB	E160.2

QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:01	LW3-W4005-NS	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	17:09	LW3-W3029-NB	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	16:36	LW3-W3029-NS	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:45	LW3-W4029-NB	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:10	LW3-W4029-NS	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:45	LW3-W3030-NB	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:15	LW3-W3030-NS	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:00	LW3-W4030-NB	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:30	LW3-W4030-NS	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:58	LW3-W3031-NB	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:54	LW3-W3031-NS	E160.2

QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	10:45	LW3-W4031-NB	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	09:40	LW3-W4031-NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS1	17-Nov-04	17:31	LW2-W011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS2	17-Mar-05	14:20	LW2-W2011B	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	11:36	LW2-W3011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:26	LW3-W2011-1NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:13	LW3-W2011-1NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:32	LW3-W4011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:30	LW3-W4011-NS	E160.2

QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS1	08-Nov-04	15:42	LW2-W013-1	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	12:43	LW2-W013-2	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	09:45	LW2-W3013-1	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NB	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NS	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:53	LW3-W4032-NB	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:30	LW3-W4032-NS	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS1	29-Nov-04	11:48	LW2-W015	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015	E160.2

QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	09:20	LW2-W3015	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NS	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NS	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	12:22	LW3-W4033-2-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	11:56	LW3-W4033-2-NS	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS1	30-Nov-04	13:35	LW2-W016-1	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016-1	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	09:03	LW2-W3016-1	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:28	LW3-W3034-NB	E160.2

QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:27	LW3-W3034-NS	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:10	LW3-W4034-NB	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:00	LW3-W4034-NS	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS1	11-Nov-04	00:04	LW2-W018 F	AXYS METHOD MLA-010 Rev 05
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	08:55	LW2-W3018	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:40	LW3-W3035-NB	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:30	LW3-W3035-NS	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:25	LW3-W4035-NB	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:15	LW3-W4035-NS	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:40	LW3-W3036-NB	E160.2

QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:30	LW3-W3036-NS	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:34	LW3-W4036-NB	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:15	LW3-W4036-NS	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:57	LW3-W3037-NB	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	12:11	LW3-W3037-NS	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:28	LW3-W4037-NB	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:26	LW3-W4037-NS	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:47	LW3-W3038-NB	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:36	LW3-W4038-NB	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:43	LW3-W4038-NS	E160.2

QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	13:41	LW3-W2023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:00	LW3-W3023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	13:08	LW3-W4023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	13:00	LW3-W4023-M2	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS1	15-Nov-04	22:34	LW2-W023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS3	11-Jul-05	14:10	LW2-W3023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	10:00	LW3-W1023-1	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	13:36	LW3-W2023-E	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	15:25	LW3-W2023-W	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	18:55	LW3-W3023-E	E160.2

QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	16:10	LW3-W3023-W	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	11:00	LW3-W4023-E	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	14:00	LW3-W4023-W	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	11:15	LW3-W1024	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:10	LW3-W3024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:04	LW3-W3024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NS	E160.2

nalysisDat	nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	12		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	12	T	mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
06-Mar-07	09:35	Conventionals	TSS	Total suspended solids	NA	Y	36		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	29		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l
27-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l

07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
08-Mar-07	10:05	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
08-Mar-07	10:05	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	19	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	60		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
24-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
24-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	25	J	mg/l
19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l
19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	22	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l

12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
08-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11.5	T	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
28-Feb-07	11:18	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
28-Feb-07	11:18	Conventionals	TSS	Total suspended solids	NA	Y	14		mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l

10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	24		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
18-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	UT	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	7	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
16-May-05	12:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	277	JT	pg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	32		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	30		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	23		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	22		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
28-Feb-07	11:19	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
28-Feb-07	11:19	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l

07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	N	1	U	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
22-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	8	T	mg/l
14-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6.5	T	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	17	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	58	T	mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l

09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	N	1	UJ	mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20		mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49	J	mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	T	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11	T	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	14	T	mg/l

Basis	DVCategory
NA	QA2Cat1
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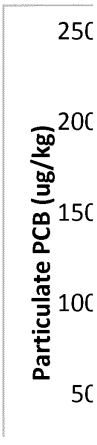
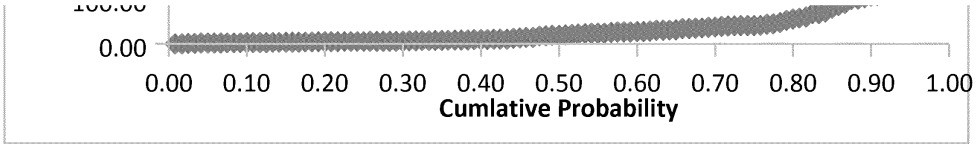
NA QA2Cat1

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)
04-Sep-06	W025E	2	15.4	8	1.93
04-Sep-06	W025M	2	17.8	6	2.97
05-Sep-06	W025W	2	13.5	4	3.38
02-Nov-06	W025M	2	103	5	20.60
02-Nov-06	W025W	2	64.5	5	12.90
03-Nov-06	W025E	2	336	5	67.20
15-Jan-07	W025M	2	34.3	12	2.86
08-Mar-07	W025E	2	88.2	9	9.80
09-Mar-07	W025W	2	40.2	10	4.02
10-Mar-07	W025M	2	67.4	9	7.49
04-Nov-06	W026	2.1	263	7	37.57
04-Nov-06	W026	2.1	239	4	59.75
26-Feb-07	W026	2.1	114	13	8.77
26-Feb-07	W026	2.1	96	13	7.38
07-Sep-06	W027	2.9	237	12	19.75
07-Sep-06	W027	2.9	248	6	41.33
04-Nov-06	W027	2.9	143	4	35.75
04-Nov-06	W027	2.9	130	3	43.33
28-Feb-07	W027	2.9	176	36	4.89
28-Feb-07	W027	2.9	150	29	5.17
04-Nov-06	W028	3.6	76.9	4	19.23
04-Nov-06	W028	3.6	457	4	114.25
01-Mar-07	W028	3.6	54.1	20	2.71
01-Mar-07	W028	3.6	175	18	9.72
23-Nov-04	W005	3.9	93	7	13.29
10-Mar-05	W005	3.9	166	6	27.67
13-Jul-05	W005	3.9	213	8	26.63
21-Jan-06	W005	3.9	136	49	2.78
08-Sep-06	W005	3.9	481	16	30.06
08-Sep-06	W005	3.9	189	8	23.63
04-Nov-06	W005	3.9	222	6	37.00
04-Nov-06	W005	3.9	210	6	35.00
04-Mar-07	W005	3.9	313	17	18.41
04-Mar-07	W005	3.9	69.9	15	4.66
03-Nov-06	W029	4.4	85	6	14.17
03-Nov-06	W029	4.4	94.6	5	18.92
05-Mar-07	W029	4.4	93.4	17	5.49
05-Mar-07	W029	4.4	88.3	16	5.52
04-Nov-06	W030	5.5	162	4	40.50
04-Nov-06	W030	5.5	216	2	108.00
01-Mar-07	W030	5.5	72.9	20	3.65
01-Mar-07	W030	5.5	33.7	19	1.77

05-Nov-06	W031	6.1	110	2	55.00
05-Nov-06	W031	6.1	125	4	31.25
24-Feb-07	W031	6.1	348	60	5.80
24-Feb-07	W031	6.1	89.8	17	5.28
18-Nov-04	W011	6.3	171	5	34.20
08-Mar-05	W011	6.3	259	5	51.80
12-Jul-05	W011	6.3	199	25	7.96
12-Sep-06	W011	6.3	513	15	34.20
12-Sep-06	W011	6.3	245	6	40.83
03-Nov-06	W011	6.3	135	5	27.00
03-Nov-06	W011	6.3	85	3	28.33
02-Mar-07	W011	6.3	76	22	3.45
02-Mar-07	W011	6.3	72	18	4.00
09-Nov-04	W013-1	6.7	2620	5	524.00
09-Nov-04	W013-2	6.7	1890	5	378.00
01-Mar-05	W013-1	6.7	9560	5	1912.00
02-Mar-05	W013-2	6.7	1380	11.5	120.00
06-Jul-05	W013-1	6.7	5920	8	740.00
05-Nov-06	W032	6.7	270	4	67.50
05-Nov-06	W032	6.7	321	3	107.00
21-Feb-07	W032	6.7	195	18	10.83
21-Feb-07	W032	6.7	121	14	8.64
30-Nov-04	W015	6.9	1290	5	258.00
14-Mar-05	W015	6.9	285	7	40.71
19-Jul-05	W015	6.9	398	5	79.60
03-Nov-06	W033	7	179	4	44.75
03-Nov-06	W033	7	141	6	23.50
03-Nov-06	W033	7	157	6	26.17
03-Nov-06	W033	7	161	6	26.83
26-Feb-07	W033	7	122	24	5.08
26-Feb-07	W033	7	93.6	17	5.51
01-Dec-04	W016-1	7.2	238	5	47.60
15-Mar-05	W016-1	7.2	201	5	40.20
18-Jul-05	W016-1	7.2	695	7	99.29
04-Nov-06	W034	7.5	123	3	41.00
04-Nov-06	W034	7.5	110	4	27.50
24-Feb-07	W034	7.5	102	17	6.00
24-Feb-07	W034	7.5	90.6	16	5.66
10-Nov-04	W018	8.3	5	277	0.02
03-Mar-05	W018	8.3	1120	5	224.00
14-Jul-05	W018	8.3	341	4	85.25
04-Nov-06	W035	8.5	449	5	89.80
04-Nov-06	W035	8.5	295	3	98.33
25-Feb-07	W035	8.5	480	16	30.00
25-Feb-07	W035	8.5	496	16	31.00

04-Nov-06	W036	8.6	156	4	39.00
04-Nov-06	W036	8.6	118	5	23.60
27-Feb-07	W036	8.6	223	32	6.97
27-Feb-07	W036	8.6	165	30	5.50
05-Nov-06	W037	9.6	172	3	57.33
05-Nov-06	W037	9.6	53.4	3	17.80
23-Feb-07	W037	9.6	225	23	9.78
23-Feb-07	W037	9.6	186	22	8.45
05-Nov-06	W038	9.9	23.1	5	4.62
05-Nov-06	W038	9.9	87.4	4	21.85
22-Feb-07	W038	9.9	103	18	5.72
22-Feb-07	W038	9.9	54.8	17	3.22
05-Sep-06	W023M	10.9	106	1	106.00
02-Nov-06	W023M	10.9	43.7	4	10.93
15-Jan-07	W023M	10.9	7.33	13	0.56
02-Mar-07	W023M	10.9	70.3	18	3.91
17-Nov-04	W023	11	566	8	70.75
07-Mar-05	W023	11	67.4	6.5	10.37
12-Jul-05	W023	11	118	17	6.94
20-Jan-06	W023	11	127	58	2.19
06-Sep-06	W023E	11	663	5	132.60
06-Sep-06	W023W	11	64.6	10	6.46
02-Nov-06	W023E	11	408	4	102.00
02-Nov-06	W023W	11	117	1	117.00
03-Mar-07	W023E	11	99.7	16	6.23
04-Mar-07	W023W	11	76	20	3.80
19-Jan-06	W024	15.9	77.9	49	1.59
13-Sep-06	W024	15.9	42.6	3	14.20
13-Sep-06	W024	15.9	26.7	3	8.90
03-Nov-06	W024	15.9	118	5	23.60
03-Nov-06	W024	15.9	39.9	5	7.98
18-Jan-07	W024	15.9	22.9	11	2.08
18-Jan-07	W024	15.9	20.9	14	1.49

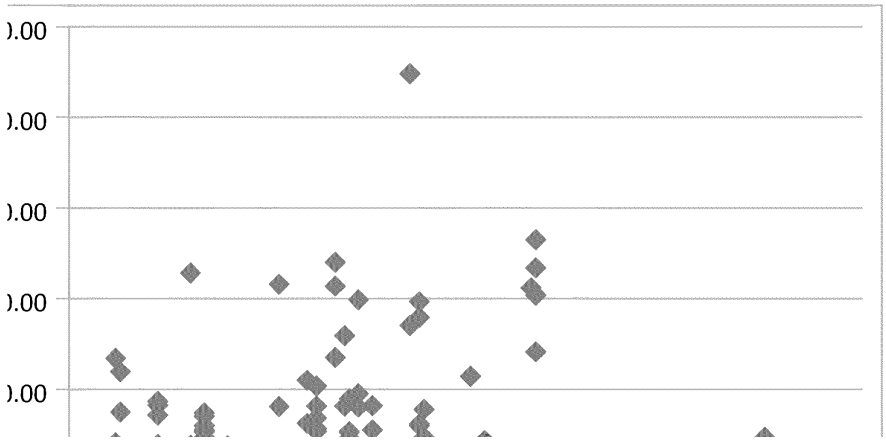


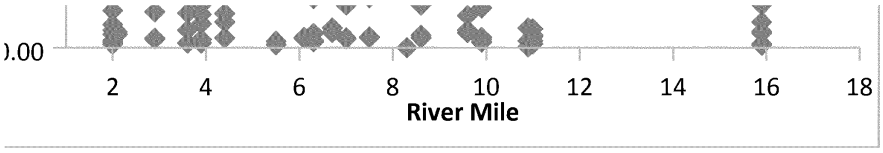

0.00
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
Cumlative Probability

Notes	Suspended Particle PCB (ug/kg)	Rank	Cumlative Probability
	0.02	1	0.01
	0.56	2	0.02
	1.49	3	0.03
	1.59	4	0.03
	1.77	5	0.04
	1.93	6	0.05
	2.08	7	0.06
	2.19	8	0.07
	2.71	9	0.08
	2.78	10	0.08
	2.86	11	0.09
	2.97	12	0.10
	3.22	13	0.11
	3.38	14	0.12
	3.45	15	0.13
	3.65	16	0.13
	3.80	17	0.14
	3.91	18	0.15
	4.00	19	0.16
	4.02	20	0.17
	4.62	21	0.18
	4.66	22	0.18
	4.89	23	0.19
	5.08	24	0.20
	5.17	25	0.21
	5.28	26	0.22
	5.49	27	0.23
	5.50	28	0.23
	5.51	29	0.24
	5.52	30	0.25
	5.66	31	0.26
	5.72	32	0.27
	5.80	33	0.28
	6.00	34	0.28
	6.23	35	0.29
	6.46	36	0.30
	6.94	37	0.31
	6.97	38	0.32
	7.38	39	0.33
	7.49	40	0.33
	7.96	41	0.34
	7.98	42	0.35

8.45	43	0.36
8.64	44	0.37
8.77	45	0.38
8.90	46	0.38
9.72	47	0.39
9.78	48	0.40
9.80	49	0.41
10.37	50	0.42
10.83	51	0.43
10.93	52	0.43
12.90	53	0.44
13.29	54	0.45
14.17	55	0.46
14.20	56	0.47
17.80	57	0.48
18.41	58	0.48
18.92	59	0.49
19.23	60	0.50
19.75	61	0.51
20.60	62	0.52
21.85	63	0.53
23.50	64	0.53
23.60	65	0.54
23.60	66	0.55
23.63	67	0.56
26.17	68	0.57
26.63	69	0.58
26.83	70	0.58
27.00	71	0.59
27.50	72	0.60
27.67	73	0.61
28.33	74	0.62
30.00	75	0.63
30.06	76	0.63
31.00	77	0.64
31.25	78	0.65
34.20	79	0.66
34.20	80	0.67
35.00	81	0.68
35.75	82	0.68
37.00	83	0.69
37.57	84	0.70
39.00	85	0.71
40.20	86	0.72
40.50	87	0.73

40.71	88	0.73
40.83	89	0.74
41.00	90	0.75
41.33	91	0.76
43.33	92	0.77
44.75	93	0.78
47.60	94	0.78
51.80	95	0.79
55.00	96	0.80
57.33	97	0.81
59.75	98	0.82
67.20	99	0.83
67.50	100	0.83
70.75	101	0.84
79.60	102	0.85
85.25	103	0.86
89.80	104	0.87
98.33	105	0.88
99.29	106	0.88
102.00	107	0.89
106.00	108	0.90
107.00	109	0.91
108.00	110	0.92
114.25	111	0.93
117.00	112	0.93
120.00	113	0.94
132.60	114	0.95
224.00	115	0.96
258.00	116	0.97
378.00	117	0.98
524.00	118	0.98
740.00	119	0.99
1912.00	120	1.00

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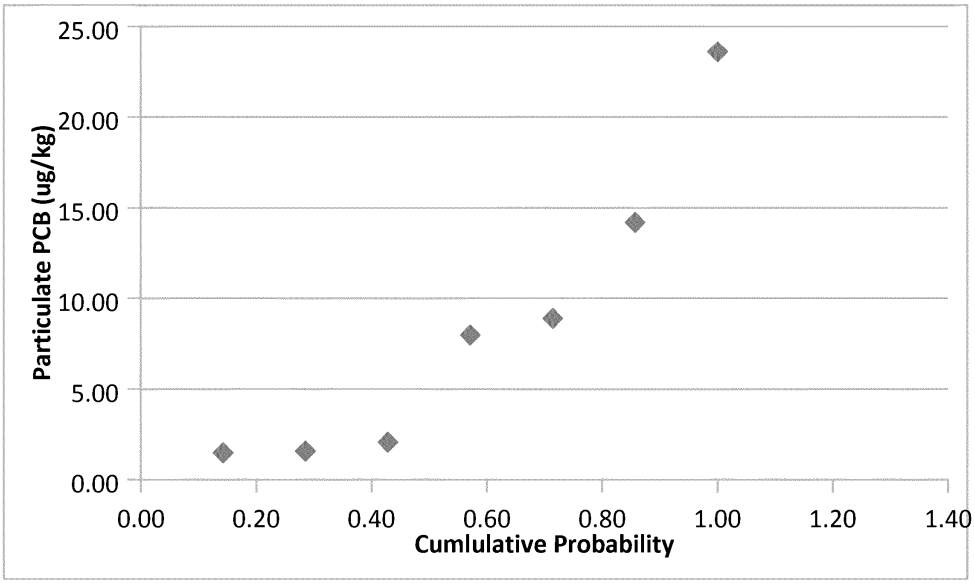
18
River Mile

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)	Rank	Cumlative Probability
18-Jan-07	LW3-W024	15.9	20.9	14	1.49	1	0.14
19-Jan-06	LW3-W024	15.9	77.9	49	1.59	2	0.29
18-Jan-07	LW3-W024	15.9	22.9	11	2.08	3	0.43
03-Nov-06	LW3-W024	15.9	39.9	5	7.98	4	0.57
13-Sep-06	LW3-W024	15.9	26.7	3	8.90	5	0.71
13-Sep-06	LW3-W024	15.9	42.6	3	14.20	6	0.86
03-Nov-06	LW3-W024	15.9	118	5	23.60	7	1.00

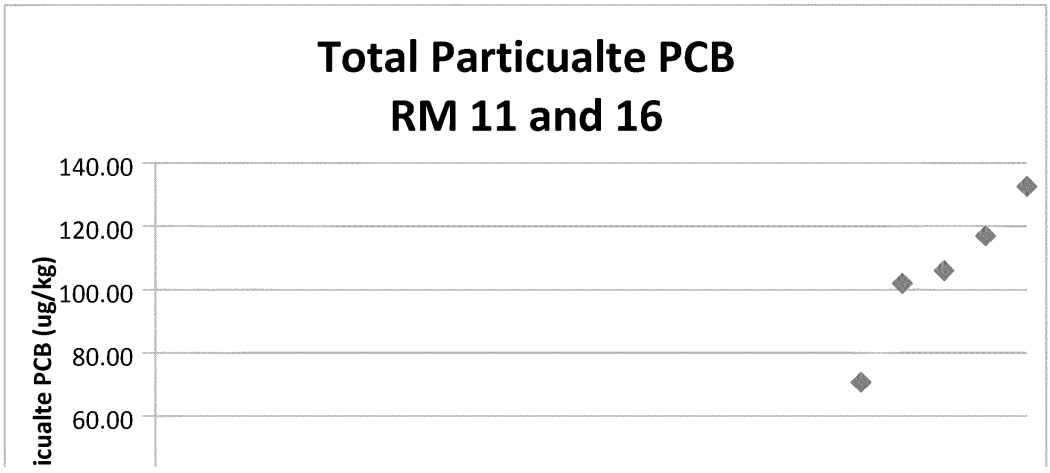


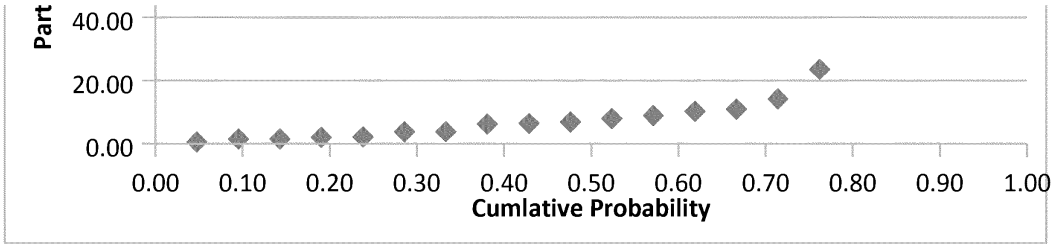
Mean	8.55
Median	7.98

LocationID	LocationName	X	Y	Z	RiverMile	SampleDate	SampleTime
XAD Filter							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:11
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	17:25
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
XAD Column							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:20
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	16:52
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
TSS							
LW2-W023	W023	642505.89	690067.93	-49	11	15-Nov-04	22:34
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	11-Jul-05	14:10
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	10:00
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	11:35

SampleID	Analyte	detect_flag	VALUE	Qualifiers	Units
LW2-W023 F	Pentachlorobiphenyl homologs	Y	56.8	T	pg/l
LW2-W2023 F	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW2-W3023 F	Pentachlorobiphenyl homologs	Y	26.7	JT	pg/l
LW3-W1023 F	Pentachlorobiphenyl homologs	Y	33.4	JT	pg/l
LW3-W2023-M-F	Pentachlorobiphenyl homologs	Y	24.1	JT	pg/l
LW3-W2023-W-F	Pentachlorobiphenyl homologs	Y	16.7	JT	pg/l
LW3-W2023-E-F	Pentachlorobiphenyl homologs	Y	75.8	T	pg/l
LW3-W3023-M-F	Pentachlorobiphenyl homologs	Y	11.4	JT	pg/l
LW3-W3023-E-F	Pentachlorobiphenyl homologs	Y	77.9	JT	pg/l
LW3-W3023-W-F	Pentachlorobiphenyl homologs	Y	34.1	JT	pg/l
LW3-W4023-M-F	Pentachlorobiphenyl homologs	Y	1.97	JT	pg/l
LW3-W4023-M2-F	Pentachlorobiphenyl homologs	Y	17.1	JT	pg/l
LW3-W4023-E-F	Pentachlorobiphenyl homologs	Y	25.3	JT	pg/l
LW3-W4023-W-F	Pentachlorobiphenyl homologs	Y	17.6	JT	pg/l
LW2-W023 C	Pentachlorobiphenyl homologs	Y	8.86	JT	pg/l
LW2-W2023 C	Pentachlorobiphenyl homologs	Y	17.3	JT	pg/l
LW2-W3023 C	Pentachlorobiphenyl homologs	Y	48.5	T	pg/l
LW3-W1023 C	Pentachlorobiphenyl homologs	Y	15.1	JT	pg/l
LW3-W2023-M-C	Pentachlorobiphenyl homologs	Y	34.8	JT	pg/l
LW3-W2023-W-C	Pentachlorobiphenyl homologs	Y	39.5	T	pg/l
LW3-W2023-E-C	Pentachlorobiphenyl homologs	Y	45.2	T	pg/l
LW3-W3023-M-C	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW3-W3023-E-C	Pentachlorobiphenyl homologs	Y	23.3	JT	pg/l
LW3-W3023-W-C	Pentachlorobiphenyl homologs	Y	21.5	JT	pg/l
LW3-W4023-M-C	Pentachlorobiphenyl homologs	Y	6.21	JT	pg/l
LW3-W4023-M2-C	Pentachlorobiphenyl homologs	Y	7.29	JT	pg/l
LW3-W4023-E-C	Pentachlorobiphenyl homologs	Y	12.3	JT	pg/l
LW3-W4023-W-C	Pentachlorobiphenyl homologs	Y	10.7	JT	pg/l
LW2-W023	Total suspended solids	Y	8	T	mg/l
LW2-W2023	Total suspended solids	Y	6.5	T	mg/l
LW2-W3023	Total suspended solids	Y	17	J	mg/l
LW3-W1023-1	Total suspended solids	Y	62	T	mg/l
LW3-W1023-2	Total suspended solids	Y	54		mg/l

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)
17-Nov-04	LW2-W023	11	566	8	70.75
07-Mar-05	LW2-W023	11	67.4	6.5	10.37
12-Jul-05	LW2-W023	11	118	17	6.94
20-Jan-06	LW2-W023	11	127	58	2.19
05-Sep-06	LW3-W023M	10.9	106	1	106.00
06-Sep-06	LW3-W023W	11	64.6	10	6.46
02-Nov-06	LW3-W023M	10.9	43.7	4	10.93
02-Nov-06	LW3-W023W	11	117	1	117.00
15-Jan-07	LW3-W023M	10.9	7.33	13	0.56
02-Mar-07	LW3-W023M	10.9	70.3	18	3.91
04-Mar-07	LW3-W023W	11	76	20	3.80
19-Jan-06	LW3-W024	15.9	77.9	49	1.59
13-Sep-06	LW3-W024	15.9	42.6	3	14.20
13-Sep-06	LW3-W024	15.9	26.7	3	8.90
03-Nov-06	LW3-W024	15.9	118	5	23.60
03-Nov-06	LW3-W024	15.9	39.9	5	7.98
18-Jan-07	LW3-W024	15.9	22.9	11	2.08
18-Jan-07	LW3-W024	15.9	20.9	14	1.49
06-Sep-06	LW3-W023E	11	663	5	132.6
02-Nov-06	LW3-W023E	11	408	4	102
03-Mar-07	LW3-W023E	11	99.7	16	6.23125
Average					
Standard Deviation					
95% UCL					




Part
40.00
20.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Cumlative Probability

Notes

	30.46		
	44.58		
	47.28		
TSS Result is ND	0.56	1	0.05
	1.49	2	0.10
	1.59	3	0.14
TSS Result is ND	2.08	4	0.19
	2.19	5	0.24
	3.80	6	0.29
	3.91	7	0.33
	6.23	8	0.38
	6.46	9	0.43
	6.94	10	0.48
	7.98	11	0.52
	8.90	12	0.57
	10.37	13	0.62
	10.93	14	0.67
RM 11E Location	14.20	15	0.71
	23.60	16	0.76
	70.75	17	0.81
1	102.00	18	0.86
	106.00	19	0.90
	117.00	20	0.95
	132.60	21	1.00
	21		

LocationID	RiverMile	SampleDate	ampleTime	SampleID	Method	AnalysisDate	nalysisTim
LW2-W023	11	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05	13:23
LW2-W023	11	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05	03:38
LW2-W023	11	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05	18:30
LW2-W023	11	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	16:54
LW3-W023M	10.9	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	13:52
LW3-W023W	11	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	05:09
LW3-W023M	10.9	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	01:01
LW3-W023W	11	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	02:05
LW3-W023M	10.9	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07	16:28
LW3-W023M	10.9	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	13:42
LW3-W023W	11	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	14:46
LW3-W023E	11	06-Sep-06	13:36	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	04:04
LW3-W023E	11	02-Nov-06	18:55	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07	23:56
LW3-W023E	11	03-Mar-07	11:00	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	12:37

AnalyteGroup	cas_rn	Analyte	al_or_dissol	detect_flag	VALUE	Qualifiers	Units
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l

SampleDate	ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
15-Nov-04	22:34	LW2-W023	E160.2	22-Nov-04	12:00	Conventionals	TSS
07-Mar-05	13:16	LW2-W2023	E160.2	14-Mar-05	12:00	Conventionals	TSS
11-Jul-05	14:10	LW2-W3023	E160.2	10-Aug-05	00:30	Conventionals	TSS
20-Jan-06	10:00	LW3-W1023-1	E160.2	27-Jan-06	12:00	Conventionals	TSS
05-Sep-06	13:41	LW3-W2023-M	E160.2	07-Sep-06	00:01	Conventionals	TSS
06-Sep-06	15:25	LW3-W2023-W	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	13:00	LW3-W3023-M	E160.2	09-Nov-06	12:00	Conventionals	TSS
02-Nov-06	16:10	LW3-W3023-W	E160.2	09-Nov-06	12:00	Conventionals	TSS
15-Jan-07	13:08	LW3-W4023-M	E160.2	22-Jan-07	12:00	Conventionals	TSS
02-Mar-07	13:00	LW3-W4023-M2	E160.2	07-Mar-07	11:42	Conventionals	TSS
04-Mar-07	14:00	LW3-W4023-W	E160.2	07-Mar-07	11:42	Conventionals	TSS
06-Sep-06	13:36	LW3-W2023-E	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	18:55	LW3-W3023-E	E160.2	09-Nov-06	12:00	Conventionals	TSS
03-Mar-07	11:00	LW3-W4023-E	E160.2	07-Mar-07	11:42	Conventionals	TSS

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
Total suspended solids	NA	Y	8	T	mg/l
Total suspended solids	NA	Y	6.5	T	mg/l
Total suspended solids	NA	Y	17	J	mg/l
Total suspended solids	NA	Y	58	T	mg/l
Total suspended solids	NA	N	1	U	mg/l
Total suspended solids	NA	Y	10		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	N	1	UJ	mg/l
Total suspended solids	NA	Y	13		mg/l
Total suspended solids	NA	Y	18		mg/l
Total suspended solids	NA	Y	20		mg/l
Total suspended solids	NA	Y	5		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	Y	16		mg/l

LocationID	cationNam	X	Y	Z	RiverMile	Task	SampleDate	SampleTime
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS1	19-Jan-06	16:30
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:14
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:13
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	12:03
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	11:53

SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	15:50	PCB_Congeners	1336-36-3
LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	14:56	PCB_Congeners	1336-36-3
LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06	15:30	PCB_Congeners	1336-36-3
LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	04:14	PCB_Congeners	1336-36-3
LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07	18:38	PCB_Congeners	1336-36-3
LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	01:34	PCB_Congeners	1336-36-3
LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	00:30	PCB_Congeners	1336-36-3

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory	SampleDate
Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA	QA2Cat1	19-Jan-06
Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	118	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA	QA2Cat1	15-Jan-07
Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA	QA2Cat1	15-Jan-07

ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn	Analyte	l_or_disso
11:15	LW3-W1024	E160.2	27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NB	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NS	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:10	LW3-W3024-NB	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:04	LW3-W3024-NS	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NB	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NS	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA

detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory
Y	49	J	mg/l	NA	QA2Cat1
Y	3		mg/l	NA	QA2Cat1
Y	3	T	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	11	T	mg/l	NA	QA2Cat1
Y	14	T	mg/l	NA	QA2Cat1

LocationID	cationNam	RiverMile	Task	SampleDate	ampleTim	SampleID	Method	AnalysisDate
LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	20:00	LW3-W2025-E-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	19:27	LW3-W2025-M-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	18:01	LW3-W2025-W-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:38	LW3-W3025-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	17:02	LW3-W3025-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	13:15	LW3-W3025-E-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:38	LW3-W4025-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	17:50	LW3-W4025-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	15:45	LW3-W4025-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	15:53	LW3-W4025-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:09	LW3-W3026-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:11	LW3-W3026-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:30	LW3-W4026-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:23	LW3-W4026-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NB-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NS-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NS-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	13:26	LW3-W4027-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	12:44	LW3-W4027-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW2-W005	W005	3.9	B01-01-48H_WS1	23-Nov-04	06:27	LW2-W005 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	22:23	LW2-W3005 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	16:40	LW3-W1005 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:16	LW3-W2005-NB-F	AXYS METHOD MLA-010 Rev 08	29-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:21	LW3-W2005-NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3005-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:55	LW3-W3005-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:26	LW3-W4005-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:23	LW3-W4005-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NS-F	AXYS METHOD MLA-010 Rev 08	14-Jan-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:50	LW3-W4029-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:40	LW3-W4029-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	12:43	LW3-W4030-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	14:17	LW3-W4030-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:38	LW3-W4031-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:08	LW3-W4031-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW2-W011	W011	6.3	B01-01-48H_WS1	18-Nov-04	18:23	LW2-W011 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W011	W011	6.3	B01-01-48H_WS2	08-Mar-05	22:05	LW2-W2011 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	21:41	LW2-W3011 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NB-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07		LW3-W4011-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07	11:44	LW3-W4011-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W013	W013-1	6.7	B01-01-48H_WS1	09-Nov-04	03:35	LW2-W013-1 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	23:06	LW2-W013-2 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	21:29	LW2-W3013-1 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW2-W015	W015	6.9	B01-01-48H_WS1	30-Nov-04	00:05	LW2-W015 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05

LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	23:27	LW2-W3015 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:43	LW3-W4033-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:27	LW3-W4033-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW2-W016	W016-1	7.2	B01-01-48H_WS1	01-Dec-04	01:15	LW2-W016 F	AXYS METHOD MLA-010 Rev 05	03-Jun-05
LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	22:54	LW2-W3016 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:50	LW3-W3034-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:49	LW3-W3034-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW2-W018	W018	8.3	B01-01-48H_WS1	10-Nov-04	11:15	LW2-W018	E160.2	12-Nov-04
LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	21:52	LW2-W3018 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	11:41	LW3-W3035-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	10:56	LW3-W3035-NS-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	16:05	LW3-W4035-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	15:35	LW3-W4035-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:26	LW3-W3036-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:28	LW3-W3036-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:08	LW3-W4036-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:14	LW3-W4036-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:32	LW3-W4037-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:30	LW3-W4037-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:57	LW3-W3038-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:48	LW3-W4038-NB-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:50	LW3-W4038-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07

LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W023	W023	11	B01-01-48H_WS1	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W023	W023	11	B01-01-48H_WS3	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	17:21	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	19:49	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07

LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	15:30	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	16:30	LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:14	LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:13	LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07
LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	12:03	LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07
LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	11:53	LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07

nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	15.4	JT	pg/l	NA
16:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	17.8	JT	pg/l	NA
17:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	13.5	JT	pg/l	NA
21:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
11:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.5	JT	pg/l	NA
05:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	336	JT	pg/l	NA
17:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	34.3	JT	pg/l	NA
15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.2	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	40.2	JT	pg/l	NA
16:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
14:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	263	JT	pg/l	NA

13:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	239	JT	pg/l	NA
04:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	114	JT	pg/l	NA
05:41	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	96	JT	pg/l	NA
17:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	237	JT	pg/l	NA
18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	248	JT	pg/l	NA
23:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	143	JT	pg/l	NA
22:48	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	130	JT	pg/l	NA
19:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	176	JT	pg/l	NA
20:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	150	JT	pg/l	NA
16:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76.9	JT	pg/l	NA
15:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	457	JT	pg/l	NA

06:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.1	JT	pg/l	NA
12:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	175	JT	pg/l	NA
15:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93	JT	pg/l	NA
05:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	166	JT	pg/l	NA
16:21	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	213	JT	pg/l	NA
17:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	136	JT	pg/l	NA
23:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	481	JT	pg/l	NA
00:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	189	JT	pg/l	NA
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	222	JT	pg/l	NA
14:53	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	210	JT	pg/l	NA
03:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	313	JT	pg/l	NA

05:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	69.9	JT	pg/l	NA
17:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA
00:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	94.6	JT	pg/l	NA
13:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.4	JT	pg/l	NA
14:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.3	JT	pg/l	NA
01:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	162	JT	pg/l	NA
18:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	216	JT	pg/l	NA
16:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72.9	JT	pg/l	NA
17:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	33.7	JT	pg/l	NA
04:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA
03:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	125	JT	pg/l	NA

11:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	348	JT	pg/l	NA
12:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	89.8	JT	pg/l	NA
14:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	171	JT	pg/l	NA
04:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	259	JT	pg/l	NA
17:26	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	199	JT	pg/l	NA
03:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	513	JT	pg/l	NA
01:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	245	JT	pg/l	NA
18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	135	JT	pg/l	NA
17:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA
06:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA
07:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72	JT	pg/l	NA

10:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	2620	T	pg/l	NA
11:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1890	T	pg/l	NA
14:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	9560	JT	pg/l	NA
15:33	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1380	JT	pg/l	NA
03:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	5920	JT	pg/l	NA
02:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	270	JT	pg/l	NA
00:57	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	321	JT	pg/l	NA
12:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	195	JT	pg/l	NA
13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	121	JT	pg/l	NA
16:35	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1290	T	pg/l	NA
11:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	285	JT	pg/l	NA

00:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	398	JT	pg/l	NA
02:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	179	JT	pg/l	NA
05:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	141	JT	pg/l	NA
04:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	157	JT	pg/l	NA
03:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	161	JT	pg/l	NA
14:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	122	JT	pg/l	NA
15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.6	JT	pg/l	NA
11:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	238	JT	pg/l	NA
12:19	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	201	JT	pg/l	NA
01:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	695	JT	pg/l	NA
06:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	123	JT	pg/l	NA

05:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA
13:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	102	JT	pg/l	NA
15:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	90.6	JT	pg/l	NA
17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1120	JT	pg/l	NA
02:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	341	JT	pg/l	NA
04:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	449	JT	pg/l	NA
03:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	295	JT	pg/l	NA
16:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	480	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	496	JT	pg/l	NA
09:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	156	JT	pg/l	NA

02:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
18:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	223	JT	pg/l	NA
16:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	165	JT	pg/l	NA
12:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	172	JT	pg/l	NA
11:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	53.4	JT	pg/l	NA
17:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	225	JT	pg/l	NA
02:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	186	JT	pg/l	NA
14:17	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	23.1	JT	pg/l	NA
13:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	87.4	JT	pg/l	NA
03:44	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
04:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.8	JT	pg/l	NA

13:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l	NA
01:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l	NA
16:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l	NA
13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l	NA
13:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l	NA
03:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
18:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
16:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l	NA
04:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l	NA
05:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l	NA
23:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l	NA

02:05	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l	NA
12:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l	NA
14:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA
15:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA
14:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA
15:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA
04:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
18:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA
01:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA
00:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA

DVCategory		LocationID	ocationNam	RiverMile	Task	SampleDate	ampleTim	SampleID	Method
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	17:00	LW3-W2025-E	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	13:38	LW3-W2025-M	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	14:30	LW3-W2025-W	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:56	LW3-W3025-M	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	16:44	LW3-W3025-W	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	12:59	LW3-W3025-E	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:25	LW3-W4025-M	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	13:50	LW3-W4025-E	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	10:17	LW3-W4025-W	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	10:27	LW3-W4025-M2	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:04	LW3-W3026-NB	E160.2

QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:03	LW3-W3026-NS	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:23	LW3-W4026-NB	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:00	LW3-W4026-NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	20:04	LW3-W2027-1NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	19:53	LW3-W2027-1NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:23	LW3-W4027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:14	LW3-W4027-NS	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:40	LW3-W3028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:30	LW3-W3028-NS	E160.2

QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS1	22-Nov-04	19:40	LW2-W005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	12:50	LW2-W3005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	10:00	LW3-W1005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:24	LW3-W2005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:17	LW3-W2005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:25	LW3-W3005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:15	LW3-W3005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:03	LW3-W4005-NB	E160.2

QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:01	LW3-W4005-NS	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	17:09	LW3-W3029-NB	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	16:36	LW3-W3029-NS	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:45	LW3-W4029-NB	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:10	LW3-W4029-NS	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:45	LW3-W3030-NB	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:15	LW3-W3030-NS	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:00	LW3-W4030-NB	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:30	LW3-W4030-NS	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:58	LW3-W3031-NB	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:54	LW3-W3031-NS	E160.2

QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	10:45	LW3-W4031-NB	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	09:40	LW3-W4031-NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS1	17-Nov-04	17:31	LW2-W011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS2	17-Mar-05	14:20	LW2-W2011B	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	11:36	LW2-W3011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:26	LW3-W2011-1NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:13	LW3-W2011-1NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:32	LW3-W4011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:30	LW3-W4011-NS	E160.2

QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS1	08-Nov-04	15:42	LW2-W013-1	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	12:43	LW2-W013-2	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	09:45	LW2-W3013-1	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NB	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NS	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:53	LW3-W4032-NB	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:30	LW3-W4032-NS	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS1	29-Nov-04	11:48	LW2-W015	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015	E160.2

QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	09:20	LW2-W3015	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NS	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NS	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	12:22	LW3-W4033-2-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	11:56	LW3-W4033-2-NS	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS1	30-Nov-04	13:35	LW2-W016-1	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016-1	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	09:03	LW2-W3016-1	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:28	LW3-W3034-NB	E160.2

QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:27	LW3-W3034-NS	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:10	LW3-W4034-NB	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:00	LW3-W4034-NS	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS1	11-Nov-04	00:04	LW2-W018 F	AXYS METHOD MLA-010 Rev 05
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	08:55	LW2-W3018	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:40	LW3-W3035-NB	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:30	LW3-W3035-NS	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:25	LW3-W4035-NB	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:15	LW3-W4035-NS	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:40	LW3-W3036-NB	E160.2

QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:30	LW3-W3036-NS	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:34	LW3-W4036-NB	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:15	LW3-W4036-NS	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:57	LW3-W3037-NB	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	12:11	LW3-W3037-NS	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:28	LW3-W4037-NB	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:26	LW3-W4037-NS	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:47	LW3-W3038-NB	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:36	LW3-W4038-NB	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:43	LW3-W4038-NS	E160.2

QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	13:41	LW3-W2023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:00	LW3-W3023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	13:08	LW3-W4023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	13:00	LW3-W4023-M2	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS1	15-Nov-04	22:34	LW2-W023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS3	11-Jul-05	14:10	LW2-W3023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	10:00	LW3-W1023-1	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	13:36	LW3-W2023-E	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	15:25	LW3-W2023-W	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	18:55	LW3-W3023-E	E160.2

QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	16:10	LW3-W3023-W	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	11:00	LW3-W4023-E	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	14:00	LW3-W4023-W	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	11:15	LW3-W1024	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:10	LW3-W3024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:04	LW3-W3024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NS	E160.2

nalysisDat	nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	12		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	12	T	mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
06-Mar-07	09:35	Conventionals	TSS	Total suspended solids	NA	Y	36		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	29		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l
27-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l

07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
08-Mar-07	10:05	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
08-Mar-07	10:05	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	19	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	60		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
24-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
24-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	25	J	mg/l
19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l
19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	22	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l

12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
08-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11.5	T	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
28-Feb-07	11:18	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
28-Feb-07	11:18	Conventionals	TSS	Total suspended solids	NA	Y	14		mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l

10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	24		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
18-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	UT	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	7	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
16-May-05	12:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	277	JT	pg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	32		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	30		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	23		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	22		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
28-Feb-07	11:19	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
28-Feb-07	11:19	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l

07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	N	1	U	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
22-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	8	T	mg/l
14-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6.5	T	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	17	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	58	T	mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l

09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	N	1	UJ	mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20		mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49	J	mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	T	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11	T	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	14	T	mg/l

Basis	DVCategory
NA	QA2Cat1
NA	QA2Cat1
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NA	QA2Cat1

NA QA2Cat1

NA QA2Cat1

NA QA2Cat1

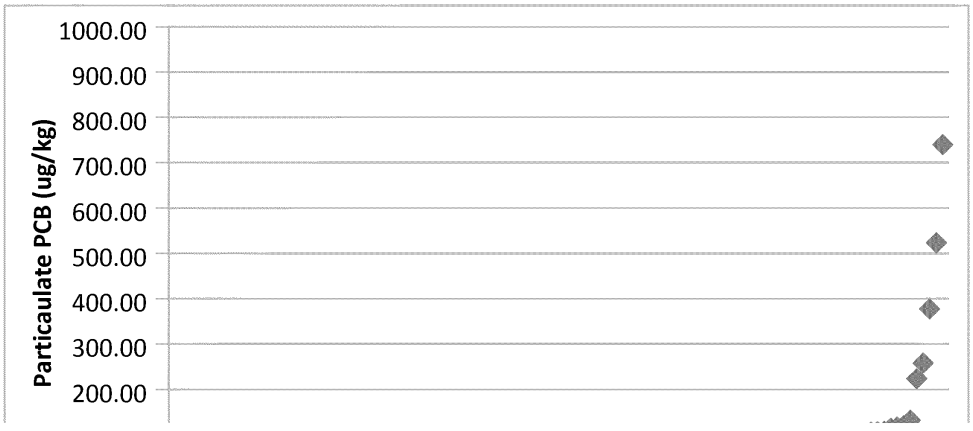
NA	QA2Cat1
NA	QA2Cat1

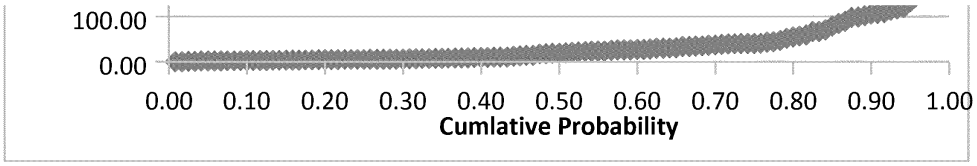
NA QA2Cat1

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)
04-Sep-06	W025E	2	15.4	8	1.93
04-Sep-06	W025M	2	17.8	6	2.97
05-Sep-06	W025W	2	13.5	4	3.38
02-Nov-06	W025M	2	103	5	20.60
02-Nov-06	W025W	2	64.5	5	12.90
03-Nov-06	W025E	2	336	5	67.20
15-Jan-07	W025M	2	34.3	12	2.86
08-Mar-07	W025E	2	88.2	9	9.80
09-Mar-07	W025W	2	40.2	10	4.02
10-Mar-07	W025M	2	67.4	9	7.49
04-Nov-06	W026	2.1	263	7	37.57
04-Nov-06	W026	2.1	239	4	59.75
26-Feb-07	W026	2.1	114	13	8.77
26-Feb-07	W026	2.1	96	13	7.38
07-Sep-06	W027	2.9	237	12	19.75
07-Sep-06	W027	2.9	248	6	41.33
04-Nov-06	W027	2.9	143	4	35.75
04-Nov-06	W027	2.9	130	3	43.33
28-Feb-07	W027	2.9	176	36	4.89
28-Feb-07	W027	2.9	150	29	5.17
04-Nov-06	W028	3.6	76.9	4	19.23
04-Nov-06	W028	3.6	457	4	114.25
01-Mar-07	W028	3.6	54.1	20	2.71
01-Mar-07	W028	3.6	175	18	9.72
23-Nov-04	W005	3.9	93	7	13.29
10-Mar-05	W005	3.9	166	6	27.67
13-Jul-05	W005	3.9	213	8	26.63
21-Jan-06	W005	3.9	136	49	2.78
08-Sep-06	W005	3.9	481	16	30.06
08-Sep-06	W005	3.9	189	8	23.63
04-Nov-06	W005	3.9	222	6	37.00
04-Nov-06	W005	3.9	210	6	35.00
04-Mar-07	W005	3.9	313	17	18.41
04-Mar-07	W005	3.9	69.9	15	4.66
03-Nov-06	W029	4.4	85	6	14.17
03-Nov-06	W029	4.4	94.6	5	18.92
05-Mar-07	W029	4.4	93.4	17	5.49
05-Mar-07	W029	4.4	88.3	16	5.52
04-Nov-06	W030	5.5	162	4	40.50
04-Nov-06	W030	5.5	216	2	108.00
01-Mar-07	W030	5.5	72.9	20	3.65
01-Mar-07	W030	5.5	33.7	19	1.77

05-Nov-06	W031	6.1	110	2	55.00
05-Nov-06	W031	6.1	125	4	31.25
24-Feb-07	W031	6.1	348	60	5.80
24-Feb-07	W031	6.1	89.8	17	5.28
18-Nov-04	W011	6.3	171	5	34.20
08-Mar-05	W011	6.3	259	5	51.80
12-Jul-05	W011	6.3	199	25	7.96
12-Sep-06	W011	6.3	513	15	34.20
12-Sep-06	W011	6.3	245	6	40.83
03-Nov-06	W011	6.3	135	5	27.00
03-Nov-06	W011	6.3	85	3	28.33
02-Mar-07	W011	6.3	76	22	3.45
02-Mar-07	W011	6.3	72	18	4.00
09-Nov-04	W013-1	6.7	2620	5	524.00
09-Nov-04	W013-2	6.7	1890	5	378.00
01-Mar-05	W013-1	6.7	9560	5	1912.00
02-Mar-05	W013-2	6.7	1380	11.5	120.00
06-Jul-05	W013-1	6.7	5920	8	740.00
05-Nov-06	W032	6.7	270	4	67.50
05-Nov-06	W032	6.7	321	3	107.00
21-Feb-07	W032	6.7	195	18	10.83
21-Feb-07	W032	6.7	121	14	8.64
30-Nov-04	W015	6.9	1290	5	258.00
14-Mar-05	W015	6.9	285	7	40.71
19-Jul-05	W015	6.9	398	5	79.60
03-Nov-06	W033	7	179	4	44.75
03-Nov-06	W033	7	141	6	23.50
03-Nov-06	W033	7	157	6	26.17
03-Nov-06	W033	7	161	6	26.83
26-Feb-07	W033	7	122	24	5.08
26-Feb-07	W033	7	93.6	17	5.51
01-Dec-04	W016-1	7.2	238	5	47.60
15-Mar-05	W016-1	7.2	201	5	40.20
18-Jul-05	W016-1	7.2	695	7	99.29
04-Nov-06	W034	7.5	123	3	41.00
04-Nov-06	W034	7.5	110	4	27.50
24-Feb-07	W034	7.5	102	17	6.00
24-Feb-07	W034	7.5	90.6	16	5.66
10-Nov-04	W018	8.3	5	277	0.02
03-Mar-05	W018	8.3	1120	5	224.00
14-Jul-05	W018	8.3	341	4	85.25
04-Nov-06	W035	8.5	449	5	89.80
04-Nov-06	W035	8.5	295	3	98.33
25-Feb-07	W035	8.5	480	16	30.00
25-Feb-07	W035	8.5	496	16	31.00

04-Nov-06	W036	8.6	156	4	39.00
04-Nov-06	W036	8.6	118	5	23.60
27-Feb-07	W036	8.6	223	32	6.97
27-Feb-07	W036	8.6	165	30	5.50
05-Nov-06	W037	9.6	172	3	57.33
05-Nov-06	W037	9.6	53.4	3	17.80
23-Feb-07	W037	9.6	225	23	9.78
23-Feb-07	W037	9.6	186	22	8.45
05-Nov-06	W038	9.9	23.1	5	4.62
05-Nov-06	W038	9.9	87.4	4	21.85
22-Feb-07	W038	9.9	103	18	5.72
22-Feb-07	W038	9.9	54.8	17	3.22
05-Sep-06	W023M	10.9	106	1	106.00
02-Nov-06	W023M	10.9	43.7	4	10.93
15-Jan-07	W023M	10.9	7.33	13	0.56
02-Mar-07	W023M	10.9	70.3	18	3.91
17-Nov-04	W023	11	566	8	70.75
07-Mar-05	W023	11	67.4	6.5	10.37
12-Jul-05	W023	11	118	17	6.94
20-Jan-06	W023	11	127	58	2.19
06-Sep-06	W023E	11	663	5	132.60
06-Sep-06	W023W	11	64.6	10	6.46
02-Nov-06	W023E	11	408	4	102.00
02-Nov-06	W023W	11	117	1	117.00
03-Mar-07	W023E	11	99.7	16	6.23
04-Mar-07	W023W	11	76	20	3.80
19-Jan-06	W024	15.9	77.9	49	1.59
13-Sep-06	W024	15.9	42.6	3	14.20
13-Sep-06	W024	15.9	26.7	3	8.90
03-Nov-06	W024	15.9	118	5	23.60
03-Nov-06	W024	15.9	39.9	5	7.98
18-Jan-07	W024	15.9	22.9	11	2.08
18-Jan-07	W024	15.9	20.9	14	1.49




100.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Cumlative Probability

Notes	Suspended Particle PCB (ug/kg)	Rank	Cumlative Probability
	0.02	1	0.01
	0.56	2	0.02
	1.49	3	0.03
	1.59	4	0.03
	1.77	5	0.04
	1.93	6	0.05
	2.08	7	0.06
	2.19	8	0.07
	2.71	9	0.08
	2.78	10	0.08
	2.86	11	0.09
	2.97	12	0.10
	3.22	13	0.11
	3.38	14	0.12
	3.45	15	0.13
	3.65	16	0.13
	3.80	17	0.14
	3.91	18	0.15
	4.00	19	0.16
	4.02	20	0.17
	4.62	21	0.18
	4.66	22	0.18
	4.89	23	0.19
	5.08	24	0.20
	5.17	25	0.21
	5.28	26	0.22
	5.49	27	0.23
	5.50	28	0.23
	5.51	29	0.24
	5.52	30	0.25
	5.66	31	0.26
	5.72	32	0.27
	5.80	33	0.28
	6.00	34	0.28
	6.23	35	0.29
	6.46	36	0.30
	6.94	37	0.31
	6.97	38	0.32
	7.38	39	0.33
	7.49	40	0.33
	7.96	41	0.34
	7.98	42	0.35

8.45	43	0.36
8.64	44	0.37
8.77	45	0.38
8.90	46	0.38
9.72	47	0.39
9.78	48	0.40
9.80	49	0.41
10.37	50	0.42
10.83	51	0.43
10.93	52	0.43
12.90	53	0.44
13.29	54	0.45
14.17	55	0.46
14.20	56	0.47
17.80	57	0.48
18.41	58	0.48
18.92	59	0.49
19.23	60	0.50
19.75	61	0.51
20.60	62	0.52
21.85	63	0.53
23.50	64	0.53
23.60	65	0.54
23.60	66	0.55
23.63	67	0.56
26.17	68	0.57
26.63	69	0.58
26.83	70	0.58
27.00	71	0.59
27.50	72	0.60
27.67	73	0.61
28.33	74	0.62
30.00	75	0.63
30.06	76	0.63
31.00	77	0.64
31.25	78	0.65
34.20	79	0.66
34.20	80	0.67
35.00	81	0.68
35.75	82	0.68
37.00	83	0.69
37.57	84	0.70
39.00	85	0.71
40.20	86	0.72
40.50	87	0.73

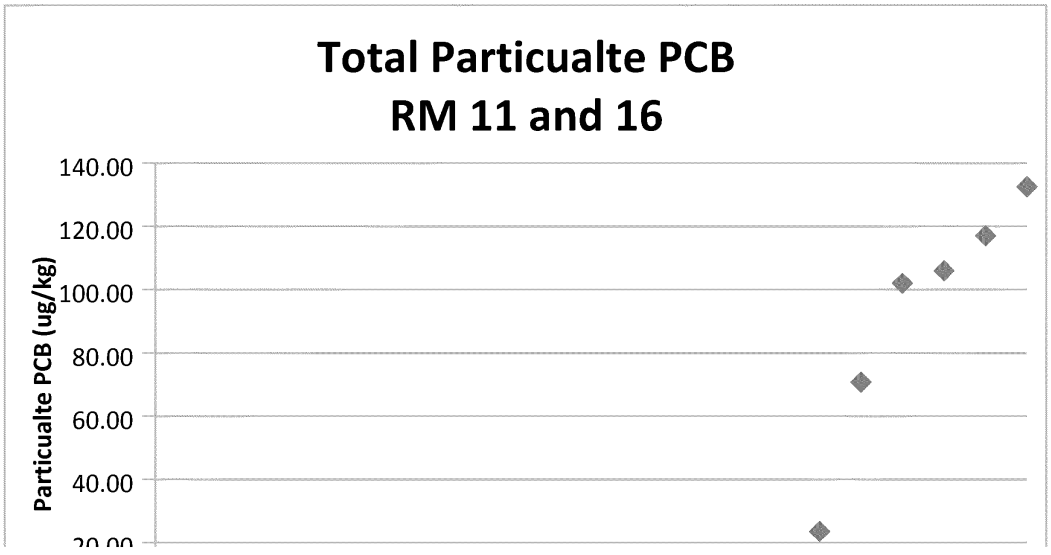
40.71	88	0.73
40.83	89	0.74
41.00	90	0.75
41.33	91	0.76
43.33	92	0.77
44.75	93	0.78
47.60	94	0.78
51.80	95	0.79
55.00	96	0.80
57.33	97	0.81
59.75	98	0.82
67.20	99	0.83
67.50	100	0.83
70.75	101	0.84
79.60	102	0.85
85.25	103	0.86
89.80	104	0.87
98.33	105	0.88
99.29	106	0.88
102.00	107	0.89
106.00	108	0.90
107.00	109	0.91
108.00	110	0.92
114.25	111	0.93
117.00	112	0.93
120.00	113	0.94
132.60	114	0.95
224.00	115	0.96
258.00	116	0.97
378.00	117	0.98
524.00	118	0.98
740.00	119	0.99
1912.00	120	1.00

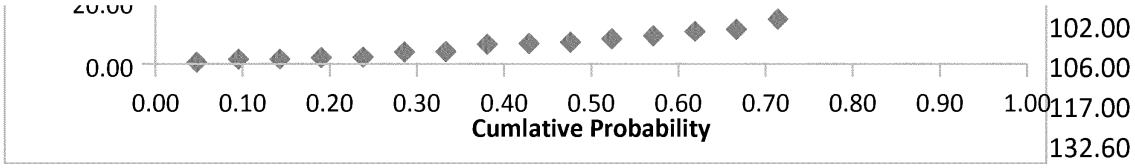
LocationID	LocationName	X	Y	Z	RiverMile	SampleDate	SampleTime
XAD Filter							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:11
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	17:25
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
XAD Column							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:20
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	16:52
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
TSS							
LW2-W023	W023	642505.89	690067.93	-49	11	15-Nov-04	22:34
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	11-Jul-05	14:10
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	10:00
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	11:35

SampleID	Analyte	detect_flag	VALUE	Qualifiers	Units
LW2-W023 F	Pentachlorobiphenyl homologs	Y	56.8	T	pg/l
LW2-W2023 F	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW2-W3023 F	Pentachlorobiphenyl homologs	Y	26.7	JT	pg/l
LW3-W1023 F	Pentachlorobiphenyl homologs	Y	33.4	JT	pg/l
LW3-W2023-M-F	Pentachlorobiphenyl homologs	Y	24.1	JT	pg/l
LW3-W2023-W-F	Pentachlorobiphenyl homologs	Y	16.7	JT	pg/l
LW3-W2023-E-F	Pentachlorobiphenyl homologs	Y	75.8	T	pg/l
LW3-W3023-M-F	Pentachlorobiphenyl homologs	Y	11.4	JT	pg/l
LW3-W3023-E-F	Pentachlorobiphenyl homologs	Y	77.9	JT	pg/l
LW3-W3023-W-F	Pentachlorobiphenyl homologs	Y	34.1	JT	pg/l
LW3-W4023-M-F	Pentachlorobiphenyl homologs	Y	1.97	JT	pg/l
LW3-W4023-M2-F	Pentachlorobiphenyl homologs	Y	17.1	JT	pg/l
LW3-W4023-E-F	Pentachlorobiphenyl homologs	Y	25.3	JT	pg/l
LW3-W4023-W-F	Pentachlorobiphenyl homologs	Y	17.6	JT	pg/l
LW2-W023 C	Pentachlorobiphenyl homologs	Y	8.86	JT	pg/l
LW2-W2023 C	Pentachlorobiphenyl homologs	Y	17.3	JT	pg/l
LW2-W3023 C	Pentachlorobiphenyl homologs	Y	48.5	T	pg/l
LW3-W1023 C	Pentachlorobiphenyl homologs	Y	15.1	JT	pg/l
LW3-W2023-M-C	Pentachlorobiphenyl homologs	Y	34.8	JT	pg/l
LW3-W2023-W-C	Pentachlorobiphenyl homologs	Y	39.5	T	pg/l
LW3-W2023-E-C	Pentachlorobiphenyl homologs	Y	45.2	T	pg/l
LW3-W3023-M-C	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW3-W3023-E-C	Pentachlorobiphenyl homologs	Y	23.3	JT	pg/l
LW3-W3023-W-C	Pentachlorobiphenyl homologs	Y	21.5	JT	pg/l
LW3-W4023-M-C	Pentachlorobiphenyl homologs	Y	6.21	JT	pg/l
LW3-W4023-M2-C	Pentachlorobiphenyl homologs	Y	7.29	JT	pg/l
LW3-W4023-E-C	Pentachlorobiphenyl homologs	Y	12.3	JT	pg/l
LW3-W4023-W-C	Pentachlorobiphenyl homologs	Y	10.7	JT	pg/l
LW2-W023	Total suspended solids	Y	8	T	mg/l
LW2-W2023	Total suspended solids	Y	6.5	T	mg/l
LW2-W3023	Total suspended solids	Y	17	J	mg/l
LW3-W1023-1	Total suspended solids	Y	62	T	mg/l
LW3-W1023-2	Total suspended solids	Y	54		mg/l

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)
17-Nov-04	LW2-W023	11	566	8	70.75
07-Mar-05	LW2-W023	11	67.4	6.5	10.37
12-Jul-05	LW2-W023	11	118	17	6.94
20-Jan-06	LW2-W023	11	127	58	2.19
05-Sep-06	LW3-W023M	10.9	106	1	106.00
06-Sep-06	LW3-W023W	11	64.6	10	6.46
02-Nov-06	LW3-W023M	10.9	43.7	4	10.93
02-Nov-06	LW3-W023W	11	117	1	117.00
15-Jan-07	LW3-W023M	10.9	7.33	13	0.56
02-Mar-07	LW3-W023M	10.9	70.3	18	3.91
04-Mar-07	LW3-W023W	11	76	20	3.80
19-Jan-06	LW3-W024	15.9	77.9	49	1.59
13-Sep-06	LW3-W024	15.9	42.6	3	14.20
13-Sep-06	LW3-W024	15.9	26.7	3	8.90
03-Nov-06	LW3-W024	15.9	118	5	23.60
03-Nov-06	LW3-W024	15.9	39.9	5	7.98
18-Jan-07	LW3-W024	15.9	22.9	11	2.08
18-Jan-07	LW3-W024	15.9	20.9	14	1.49
06-Sep-06	LW3-W023E	11	663	5	132.6
02-Nov-06	LW3-W023E	11	408	4	102
03-Mar-07	LW3-W023E	11	99.7	16	6.23125

0.56
1.49
1.59
2.08
2.19
3.80
3.91
6.23
6.46
6.94
7.98
8.90
10.37
10.93
14.20
23.60
70.75




20.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Cumlative Probability
102.00
106.00
117.00
132.60

21

Notes

TSS Result is ND

TSS Result is ND

RM 11E Location

1

1	0.05
2	0.10
3	0.14
4	0.19
5	0.24
6	0.29
7	0.33
8	0.38
9	0.43
10	0.48
11	0.52
12	0.57
13	0.62
14	0.67
15	0.71
16	0.76
17	0.81

18	0.86
19	0.90
20	0.95
21	1.00

LocationID	RiverMile	SampleDate	ampleTim	SampleID	Method	AnalysisDate	nalysisTim
LW2-W023	11	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05	13:23
LW2-W023	11	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05	03:38
LW2-W023	11	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05	18:30
LW2-W023	11	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	16:54
LW3-W023M	10.9	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	13:52
LW3-W023W	11	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	05:09
LW3-W023M	10.9	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	01:01
LW3-W023W	11	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	02:05
LW3-W023M	10.9	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07	16:28
LW3-W023M	10.9	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	13:42
LW3-W023W	11	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	14:46
LW3-W023E	11	06-Sep-06	13:36	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	04:04
LW3-W023E	11	02-Nov-06	18:55	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07	23:56
LW3-W023E	11	03-Mar-07	11:00	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	12:37

AnalyteGroup	cas_rn	Analyte	al_or_dissol	detect_flag	VALUE	Qualifiers	Units
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l

SampleDate	ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
15-Nov-04	22:34	LW2-W023	E160.2	22-Nov-04	12:00	Conventionals	TSS
07-Mar-05	13:16	LW2-W2023	E160.2	14-Mar-05	12:00	Conventionals	TSS
11-Jul-05	14:10	LW2-W3023	E160.2	10-Aug-05	00:30	Conventionals	TSS
20-Jan-06	10:00	LW3-W1023-1	E160.2	27-Jan-06	12:00	Conventionals	TSS
05-Sep-06	13:41	LW3-W2023-M	E160.2	07-Sep-06	00:01	Conventionals	TSS
06-Sep-06	15:25	LW3-W2023-W	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	13:00	LW3-W3023-M	E160.2	09-Nov-06	12:00	Conventionals	TSS
02-Nov-06	16:10	LW3-W3023-W	E160.2	09-Nov-06	12:00	Conventionals	TSS
15-Jan-07	13:08	LW3-W4023-M	E160.2	22-Jan-07	12:00	Conventionals	TSS
02-Mar-07	13:00	LW3-W4023-M2	E160.2	07-Mar-07	11:42	Conventionals	TSS
04-Mar-07	14:00	LW3-W4023-W	E160.2	07-Mar-07	11:42	Conventionals	TSS
06-Sep-06	13:36	LW3-W2023-E	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	18:55	LW3-W3023-E	E160.2	09-Nov-06	12:00	Conventionals	TSS
03-Mar-07	11:00	LW3-W4023-E	E160.2	07-Mar-07	11:42	Conventionals	TSS

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
Total suspended solids	NA	Y	8	T	mg/l
Total suspended solids	NA	Y	6.5	T	mg/l
Total suspended solids	NA	Y	17	J	mg/l
Total suspended solids	NA	Y	58	T	mg/l
Total suspended solids	NA	N	1	U	mg/l
Total suspended solids	NA	Y	10		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	N	1	UJ	mg/l
Total suspended solids	NA	Y	13		mg/l
Total suspended solids	NA	Y	18		mg/l
Total suspended solids	NA	Y	20		mg/l
Total suspended solids	NA	Y	5		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	Y	16		mg/l

LocationID	cationNam	X	Y	Z	RiverMile	Task	SampleDate	SampleTime
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS1	19-Jan-06	16:30
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:14
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:13
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	12:03
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	11:53

SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	15:50	PCB_Congeners	1336-36-3
LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	14:56	PCB_Congeners	1336-36-3
LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06	15:30	PCB_Congeners	1336-36-3
LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	04:14	PCB_Congeners	1336-36-3
LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07	18:38	PCB_Congeners	1336-36-3
LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	01:34	PCB_Congeners	1336-36-3
LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	00:30	PCB_Congeners	1336-36-3

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory	SampleDate
Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA	QA2Cat1	19-Jan-06
Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	118	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA	QA2Cat1	15-Jan-07
Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA	QA2Cat1	15-Jan-07

ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn	Analyte	l_or_disso
11:15	LW3-W1024	E160.2	27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NB	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NS	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:10	LW3-W3024-NB	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:04	LW3-W3024-NS	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NB	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NS	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA

detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory
Y	49	J	mg/l	NA	QA2Cat1
Y	3		mg/l	NA	QA2Cat1
Y	3	T	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	11	T	mg/l	NA	QA2Cat1
Y	14	T	mg/l	NA	QA2Cat1

LocationID	cationNam	RiverMile	Task	SampleDate	ampleTim	SampleID	Method	AnalysisDate
LW2-W005	W005	3.9	B01-01-48H_WS1	23-Nov-04	06:27	LW2-W005 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	22:23	LW2-W3005 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	16:40	LW3-W1005 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:16	LW3-W2005-NB-F	AXYS METHOD MLA-010 Rev 08	29-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:21	LW3-W2005-NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3005-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:55	LW3-W3005-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:26	LW3-W4005-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:23	LW3-W4005-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W011	W011	6.3	B01-01-48H_WS1	18-Nov-04	18:23	LW2-W011 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W011	W011	6.3	B01-01-48H_WS2	08-Mar-05	22:05	LW2-W2011 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	21:41	LW2-W3011 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NB-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07		LW3-W4011-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07	11:44	LW3-W4011-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W013	W013-1	6.7	B01-01-48H_WS1	09-Nov-04	03:35	LW2-W013-1 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	21:29	LW2-W3013-1 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	23:06	LW2-W013-2 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W015	W015	6.9	B01-01-48H_WS1	30-Nov-04	00:05	LW2-W015 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	23:27	LW2-W3015 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW2-W016	W016-1	7.2	B01-01-48H_WS1	01-Dec-04	01:15	LW2-W016 F	AXYS METHOD MLA-010 Rev 05	03-Jun-05

LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	22:54	LW2-W3016 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW2-W018	W018	8.3	B01-01-48H_WS1	10-Nov-04	11:15	LW2-W018	E160.2	12-Nov-04
LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	21:52	LW2-W3018 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW2-W023	W023	11	B01-01-48H_WS1	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W023	W023	11	B01-01-48H_WS3	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06

LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	17:21	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	19:49	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	15:30	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07

LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	16:30	LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06

LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06

LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:14	LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:13	LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07

LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	12:03	LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07
LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	11:53	LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07
LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	20:00	LW3-W2025-E-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06

LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	13:15	LW3-W3025-E-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	17:50	LW3-W4025-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	19:27	LW3-W2025-M-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:38	LW3-W3025-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:38	LW3-W4025-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	15:53	LW3-W4025-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	18:01	LW3-W2025-W-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	17:02	LW3-W3025-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	15:45	LW3-W4025-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:09	LW3-W3026-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:11	LW3-W3026-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:30	LW3-W4026-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:23	LW3-W4026-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07

LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NB-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NS-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06

LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NS-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07

LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	13:26	LW3-W4027-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	12:44	LW3-W4027-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07

LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NS-F	AXYS METHOD MLA-010 Rev 08	14-Jan-07

LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:50	LW3-W4029-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07

LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:40	LW3-W4029-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:45	LW3-W4029-NB	E160.2	08-Mar-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:10	LW3-W4029-NS	E160.2	08-Mar-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:45	LW3-W3030-NB	E160.2	10-Nov-06
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:15	LW3-W3030-NS	E160.2	10-Nov-06
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	12:43	LW3-W4030-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	14:17	LW3-W4030-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:00	LW3-W4030-NB	E160.2	13-Mar-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:30	LW3-W4030-NS	E160.2	13-Mar-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:58	LW3-W3031-NB	E160.2	10-Nov-06
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:54	LW3-W3031-NS	E160.2	10-Nov-06
LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:38	LW3-W4031-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:08	LW3-W4031-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	10:45	LW3-W4031-NB	E160.2	02-Mar-07
LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	09:40	LW3-W4031-NS	E160.2	02-Mar-07
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NB	E160.2	10-Nov-06
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NS	E160.2	10-Nov-06
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07

LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:53	LW3-W4032-NB	E160.2	28-Feb-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:30	LW3-W4032-NS	E160.2	28-Feb-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NB	E160.2	09-Nov-06
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NS	E160.2	09-Nov-06
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NB	E160.2	09-Nov-06
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NS	E160.2	09-Nov-06
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:43	LW3-W4033-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07

LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:27	LW3-W4033-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	12:22	LW3-W4033-2-NB	E160.2	05-Mar-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	11:56	LW3-W4033-2-NS	E160.2	05-Mar-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	10:46	LW3-W4033-NB	E160.2	05-Mar-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	10:21	LW3-W4033-NS	E160.2	05-Mar-07
LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:50	LW3-W3034-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:49	LW3-W3034-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:28	LW3-W3034-NB	E160.2	10-Nov-06
LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:27	LW3-W3034-NS	E160.2	10-Nov-06
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:10	LW3-W4034-NB	E160.2	02-Mar-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:00	LW3-W4034-NS	E160.2	02-Mar-07

LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	11:41	LW3-W3035-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	10:56	LW3-W3035-NS-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:40	LW3-W3035-NB	E160.2	10-Nov-06
LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:30	LW3-W3035-NS	E160.2	10-Nov-06
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	16:05	LW3-W4035-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	15:35	LW3-W4035-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:25	LW3-W4035-NB	E160.2	02-Mar-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:15	LW3-W4035-NS	E160.2	02-Mar-07
LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:26	LW3-W3036-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:28	LW3-W3036-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:40	LW3-W3036-NB	E160.2	10-Nov-06
LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:30	LW3-W3036-NS	E160.2	10-Nov-06

LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:08	LW3-W4036-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:14	LW3-W4036-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:34	LW3-W4036-NB	E160.2	06-Mar-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:15	LW3-W4036-NS	E160.2	06-Mar-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:57	LW3-W3037-NB	E160.2	10-Nov-06
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	12:11	LW3-W3037-NS	E160.2	10-Nov-06
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:32	LW3-W4037-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:30	LW3-W4037-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:28	LW3-W4037-NB	E160.2	02-Mar-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:26	LW3-W4037-NS	E160.2	02-Mar-07

LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:57	LW3-W3038-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:47	LW3-W3038-NB	E160.2	10-Nov-06
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS	E160.2	10-Nov-06
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:48	LW3-W4038-NB-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:50	LW3-W4038-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:36	LW3-W4038-NB	E160.2	28-Feb-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:43	LW3-W4038-NS	E160.2	28-Feb-07
WLCGSG07GSB7	GS-B7	6.4	WLCGSG07	05-Oct-07	15:30	WLCGSG07GSB7SWSH071005	A2540D	12-Oct-07
WLCGSG07GSB7	GS-B7	6.4	WLCGSG07	05-Oct-07	11:15	WLCGSG07GSB7SWSL071005	A2540D	12-Oct-07
WLCGSG07GSB7	GS-B7	6.4	WLCGSG07	06-Oct-07	12:50	WLCGSG07GSB7SWSL071006	A2540D	12-Oct-07
WLCGSG07GSC7	GS-C7	6.4	WLCGSG07	04-Oct-07	13:10	WLCGSG07GSC7SWSH071004	A2540D	11-Oct-07

WLCGSG07GSC7	GS-C7	6.4	WLCGSG07	04-Oct-07	11:00	WLCGSG07GSC7SWSL071004	A2540D	11-Oct-07
WLCGSG07GSC7	GS-C7	6.4	WLCGSG07	05-Oct-07	14:15	WLCGSG07GSC7SWSH071005	A2540D	12-Oct-07
WLCGSG07GSC7	GS-C7	6.4	WLCGSG07	05-Oct-07	10:00	WLCGSG07GSC7SWSL071005	A2540D	12-Oct-07
WLCGSG07GSC7	GS-C7	6.4	WLCGSG07	06-Oct-07	11:15	WLCGSG07GSC7SWSL071006	A2540D	12-Oct-07
WLCGSG07GSD5	GS-D5	6.4	WLCGSG07	04-Oct-07	14:20	WLCGSG07GSD5SWSH071004	A2540D	11-Oct-07
WLCGSG07GSD5	GS-D5	6.4	WLCGSG07	05-Oct-07	15:00	WLCGSG07GSD5SWSH071005	A2540D	12-Oct-07
WLCGSG07GSD5	GS-D5	6.4	WLCGSG07	05-Oct-07	10:33	WLCGSG07GSD5SWSL071005	A2540D	12-Oct-07
WLCGSG07GSD5	GS-D5	6.4	WLCGSG07	06-Oct-07	11:50	WLCGSG07GSD5SWSL071006	A2540D	12-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	01-Oct-07	10:15	WLCGSG07GSW01ASH071001	A2540D	05-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	01-Oct-07	10:20	WLCGSG07GSW01BSH071001	A2540D	05-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	01-Oct-07	10:40	WLCGSG07GSW01CSH071001	A2540D	05-Oct-07

WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	03-Oct-07	07:40	WLCGSG07GSW01ASL071003	A2540D	09-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	03-Oct-07	07:50	WLCGSG07GSW01BSL071003	A2540D	09-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	03-Oct-07	08:05	WLCGSG07GSW01CSL071003	A2540D	09-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	05-Oct-07	07:25	WLCGSG07GSW01AE071005	A2540D	12-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	05-Oct-07	07:35	WLCGSG07GSW01BE071005	A2540D	12-Oct-07
WLCGSG07GSW01	GSW-01	5.9	WLCGSG07	05-Oct-07	07:48	WLCGSG07GSW01CE071005	A2540D	12-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	02-Oct-07	07:45	WLCGSG07GSW02ASL071002	A2540D	08-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	02-Oct-07	07:51	WLCGSG07GSW02BSL071002	A2540D	08-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	02-Oct-07	08:05	WLCGSG07GSW02CSL071002	A2540D	08-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	04-Oct-07	07:35	WLCGSG07GSW02AE071004	A2540D	11-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	04-Oct-07	07:45	WLCGSG07GSW02BE071004	A2540D	11-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	04-Oct-07	08:00	WLCGSG07GSW02CE071004	A2540D	11-Oct-07

WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	09-Oct-07	17:55	WLCGSG07GSW02ASH071009	A2540D	15-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	09-Oct-07	18:00	WLCGSG07GSW02BSH071009	A2540D	15-Oct-07
WLCGSG07GSW02	GSW-02	6.0	WLCGSG07	09-Oct-07	18:15	WLCGSG07GSW02CSH071009	A2540D	15-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	01-Oct-07	11:01	WLCGSG07GSW03ASH071001	A2540D	05-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	01-Oct-07	11:11	WLCGSG07GSW03BSH071001	A2540D	05-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	01-Oct-07	11:25	WLCGSG07GSW03CSH071001	A2540D	05-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	03-Oct-07	08:20	WLCGSG07GSW03ASL071003	A2540D	09-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	03-Oct-07	08:30	WLCGSG07GSW03BSL071003	A2540D	09-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	03-Oct-07	08:50	WLCGSG07GSW03CSL071003	A2540D	09-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	05-Oct-07	08:05	WLCGSG07GSW03AE071005	A2540D	12-Oct-07
WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	05-Oct-07	08:13	WLCGSG07GSW03BE071005	A2540D	12-Oct-07

WLCGSG07GSW03	GSW-03	6.1	WLCGSG07	05-Oct-07	08:20	WLCGSG07GSW03CE071005	A2540D	12-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	02-Oct-07	08:23	WLCGSG07GSW04ASL071002	A2540D	08-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	02-Oct-07	08:30	WLCGSG07GSW04BSL071002	A2540D	08-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	02-Oct-07	08:44	WLCGSG07GSW04CSL071002	A2540D	08-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	04-Oct-07	08:20	WLCGSG07GSW04AE071004	A2540D	11-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	04-Oct-07	14:26	WLCGSG07GSW04ASH071004	A2540D	11-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	04-Oct-07	08:31	WLCGSG07GSW04BE071004	A2540D	11-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	04-Oct-07	14:35	WLCGSG07GSW04BSH071004	A2540D	11-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	04-Oct-07	08:41	WLCGSG07GSW04CE071004	A2540D	11-Oct-07
WLCGSG07GSW04	GSW-04	6.1	WLCGSG07	04-Oct-07	14:45	WLCGSG07GSW04CSH071004	A2540D	11-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	04-Oct-07	09:17	WLCGSG07GSW05ASL071004	A2540D	11-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	04-Oct-07	09:26	WLCGSG07GSW05BSL071004	A2540D	11-Oct-07

WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	04-Oct-07	09:40	WLCGSG07GSW05CSL071004	A2540D	11-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	05-Oct-07	15:15	WLCGSG07GSW05ASH071005	A2540D	12-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	05-Oct-07	15:20	WLCGSG07GSW05BSH071005	A2540D	12-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	05-Oct-07	15:30	WLCGSG07GSW05CSH071005	A2540D	12-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	08-Oct-07	08:35	WLCGSG07GSW05AE071008	A2540D	13-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	08-Oct-07	08:40	WLCGSG07GSW05BE071008	A2540D	13-Oct-07
WLCGSG07GSW05	GSW-05	6.1	WLCGSG07	08-Oct-07	08:50	WLCGSG07GSW05CE071008	A2540D	13-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	02-Oct-07	10:32	WLCGSG07GSW06ASH071002	A2540D	08-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	02-Oct-07	10:43	WLCGSG07GSW06BSH071002	A2540D	08-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	02-Oct-07	10:53	WLCGSG07GSW06CSH071002	A2540D	08-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	04-Oct-07	09:51	WLCGSG07GSW06ASL071004	A2540D	11-Oct-07

WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	04-Oct-07	10:02	WLCGSG07GSW06BSL071004	A2540D	11-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	04-Oct-07	10:12	WLCGSG07GSW06CSL071004	A2540D	11-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	08-Oct-07	09:00	WLCGSG07GSW06AE071008	A2540D	13-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	08-Oct-07	09:05	WLCGSG07GSW06BE071008	A2540D	13-Oct-07
WLCGSG07GSW06	GSW-06	6.1	WLCGSG07	08-Oct-07	09:12	WLCGSG07GSW06CE071008	A2540D	13-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	01-Oct-07	11:52	WLCGSG07GSW07ASH071001	A2540D	05-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	01-Oct-07	12:04	WLCGSG07GSW07BSH071001	A2540D	05-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	01-Oct-07	12:20	WLCGSG07GSW07CSH071001	A2540D	05-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	03-Oct-07	09:06	WLCGSG07GSW07ASL071003	A2540D	09-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	03-Oct-07	09:15	WLCGSG07GSW07BSL071003	A2540D	09-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	03-Oct-07	09:29	WLCGSG07GSW07CSL071003	A2540D	09-Oct-07

WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	05-Oct-07	08:46	WLCGSG07GSW07AE071005	A2540D	12-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	05-Oct-07	08:53	WLCGSG07GSW07BE071005	A2540D	12-Oct-07
WLCGSG07GSW07	GSW-07	6.1	WLCGSG07	05-Oct-07	09:00	WLCGSG07GSW07CE071005	A2540D	12-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	02-Oct-07	11:15	WLCGSG07GSW08ASH071002	A2540D	08-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	02-Oct-07	11:24	WLCGSG07GSW08BSH071002	A2540D	08-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	02-Oct-07	11:40	WLCGSG07GSW08CSH071002	A2540D	08-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	04-Oct-07	10:35	WLCGSG07GSW08ASL071004	A2540D	11-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	04-Oct-07	10:45	WLCGSG07GSW08BSL071004	A2540D	11-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	04-Oct-07	10:55	WLCGSG07GSW08CSL071004	A2540D	11-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	08-Oct-07	10:00	WLCGSG07GSW08AE071008	A2540D	13-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	08-Oct-07	10:07	WLCGSG07GSW08BE071008	A2540D	13-Oct-07
WLCGSG07GSW08	GSW-08	6.1	WLCGSG07	08-Oct-07	10:15	WLCGSG07GSW08CE071008	A2540D	13-Oct-07

WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	01-Oct-07	13:00	WLCGSG07GSW09AE071001	A2540D	05-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	01-Oct-07	13:05	WLCGSG07GSW09BE071001	A2540D	05-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	01-Oct-07	13:11	WLCGSG07GSW09CE071001	A2540D	05-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	03-Oct-07	11:56	WLCGSG07GSW09ASH071003	A2540D	09-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	03-Oct-07	12:04	WLCGSG07GSW09BSH071003	A2540D	09-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	03-Oct-07	12:13	WLCGSG07GSW09CSH071003	A2540D	09-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	08-Oct-07	13:40	WLCGSG07GSW09ASL071008	A2540D	13-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	08-Oct-07	13:45	WLCGSG07GSW09BSL071008	A2540D	13-Oct-07
WLCGSG07GSW09	GSW-09	6.2	WLCGSG07	08-Oct-07	13:52	WLCGSG07GSW09CSL071008	A2540D	13-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	02-Oct-07	12:15	WLCGSG07GSW10ASH071002	A2540D	08-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	02-Oct-07	12:24	WLCGSG07GSW10BSH071002	A2540D	08-Oct-07

WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	02-Oct-07	12:38	WLCGSG07GSW10CSH071002	A2540D	08-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	05-Oct-07	12:20	WLCGSG07GSW10ASL071005	A2540D	12-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	05-Oct-07	12:27	WLCGSG07GSW10BSL071005	A2540D	12-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	05-Oct-07	12:37	WLCGSG07GSW10CSL071005	A2540D	12-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	08-Oct-07	10:50	WLCGSG07GSW10AE071008	A2540D	13-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	08-Oct-07	10:55	WLCGSG07GSW10BE071008	A2540D	13-Oct-07
WLCGSG07GSW10	GSW-10	6.2	WLCGSG07	08-Oct-07	11:05	WLCGSG07GSW10CE071008	A2540D	13-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	02-Oct-07	14:00	WLCGSG07GSW11AE071002	A2540D	08-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	02-Oct-07	14:09	WLCGSG07GSW11BE071002	A2540D	08-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	02-Oct-07	14:25	WLCGSG07GSW11CE071002	A2540D	08-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	03-Oct-07	13:27	WLCGSG07GSW11ASH071003	A2540D	09-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	03-Oct-07	13:37	WLCGSG07GSW11BSH071003	A2540D	09-Oct-07

WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	03-Oct-07	13:47	WLCGSG07GSW11CSH071003	A2540D	09-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	08-Oct-07	12:40	WLCGSG07GSW11ASL071008	A2540D	13-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	08-Oct-07	12:45	WLCGSG07GSW11BSL071008	A2540D	13-Oct-07
WLCGSG07GSW11	GSW-11	6.2	WLCGSG07	08-Oct-07	12:50	WLCGSG07GSW11CSL071008	A2540D	13-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	01-Oct-07	13:40	WLCGSG07GSW12AE071001	A2540D	05-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	01-Oct-07	14:00	WLCGSG07GSW12BE071001	A2540D	05-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	01-Oct-07	14:19	WLCGSG07GSW12CE071001	A2540D	05-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	03-Oct-07	12:40	WLCGSG07GSW12ASH071003	A2540D	09-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	03-Oct-07	12:50	WLCGSG07GSW12BSH071003	A2540D	09-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	03-Oct-07	13:00	WLCGSG07GSW12CSH071003	A2540D	09-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	05-Oct-07	09:56	WLCGSG07GSW12ASL071005	A2540D	12-Oct-07

WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	05-Oct-07	10:05	WLCGSG07GSW12BSL071005	A2540D	12-Oct-07
WLCGSG07GSW12	GSW-12	6.2	WLCGSG07	05-Oct-07	10:15	WLCGSG07GSW12CSL071005	A2540D	12-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	01-Oct-07	15:30	WLCGSG07GSW13AE071001	A2540D	05-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	01-Oct-07	15:36	WLCGSG07GSW13BE071001	A2540D	05-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	01-Oct-07	15:45	WLCGSG07GSW13CE071001	A2540D	05-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	02-Oct-07	13:14	WLCGSG07GSW13ASH071002	A2540D	08-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	02-Oct-07	13:23	WLCGSG07GSW13BSH071002	A2540D	08-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	02-Oct-07	13:38	WLCGSG07GSW13CSH071002	A2540D	08-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	05-Oct-07	10:35	WLCGSG07GSW13ASL071005	A2540D	12-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	05-Oct-07	10:43	WLCGSG07GSW13BSL071005	A2540D	12-Oct-07
WLCGSG07GSW13	GSW-13	6.3	WLCGSG07	05-Oct-07	10:55	WLCGSG07GSW13CSL071005	A2540D	12-Oct-07

WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	02-Oct-07	09:14	WLCGSG07GSW14ASL071002	A2540D	08-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	02-Oct-07	09:22	WLCGSG07GSW14BSL071002	A2540D	08-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	02-Oct-07	09:34	WLCGSG07GSW14CSL071002	A2540D	08-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	05-Oct-07	14:15	WLCGSG07GSW14ASH071005	A2540D	12-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	05-Oct-07	14:21	WLCGSG07GSW14BSH071005	A2540D	12-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	05-Oct-07	14:30	WLCGSG07GSW14CSH071005	A2540D	12-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	08-Oct-07	11:22	WLCGSG07GSW14AE071008	A2540D	13-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	08-Oct-07	11:30	WLCGSG07GSW14BE071008	A2540D	13-Oct-07
WLCGSG07GSW14	GSW-14	6.3	WLCGSG07	08-Oct-07	11:40	WLCGSG07GSW14CE071008	A2540D	13-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	02-Oct-07	14:54	WLCGSG07GSW15AE071002	A2540D	08-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	02-Oct-07	15:05	WLCGSG07GSW15BE071002	A2540D	08-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	02-Oct-07	15:15	WLCGSG07GSW15CE071002	A2540D	08-Oct-07

WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	04-Oct-07	13:06	WLCGSG07GSW15ASH071004	A2540D	11-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	04-Oct-07	13:14	WLCGSG07GSW15BSH071004	A2540D	11-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	04-Oct-07	13:25	WLCGSG07GSW15CSH071004	A2540D	11-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	08-Oct-07	13:05	WLCGSG07GSW15ASL071008	A2540D	13-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	08-Oct-07	13:12	WLCGSG07GSW15BSL071008	A2540D	13-Oct-07
WLCGSG07GSW15	GSW-15	6.4	WLCGSG07	08-Oct-07	13:21	WLCGSG07GSW15CSL071008	A2540D	13-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	04-Oct-07	13:46	WLCGSG07GSW16ASH071004	A2540D	11-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	04-Oct-07	13:55	WLCGSG07GSW16BSH071004	A2540D	11-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	04-Oct-07	14:10	WLCGSG07GSW16CSH071004	A2540D	11-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	08-Oct-07	09:30	WLCGSG07GSW16AE071008	A2540D	13-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	08-Oct-07	14:10	WLCGSG07GSW16ASL071008	A2540D	13-Oct-07

WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	08-Oct-07	09:35	WLCGSG07GSW16BE071008	A2540D	13-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	08-Oct-07	14:15	WLCGSG07GSW16BSL071008	A2540D	13-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	08-Oct-07	09:43	WLCGSG07GSW16CE071008	A2540D	13-Oct-07
WLCGSG07GSW16	GSW-16	6.4	WLCGSG07	08-Oct-07	14:20	WLCGSG07GSW16CSL071008	A2540D	13-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	03-Oct-07	15:15	WLCGSG07GSW17AE071003	A2540D	09-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	03-Oct-07	10:04	WLCGSG07GSW17ASL071003	A2540D	09-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	03-Oct-07	15:22	WLCGSG07GSW17BE071003	A2540D	09-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	03-Oct-07	10:13	WLCGSG07GSW17BSL071003	A2540D	09-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	03-Oct-07	15:33	WLCGSG07GSW17CE071003	A2540D	09-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	03-Oct-07	10:25	WLCGSG07GSW17CSL071003	A2540D	09-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	09-Oct-07	17:28	WLCGSG07GSW17ASH071009	A2540D	15-Oct-07
WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	09-Oct-07	17:34	WLCGSG07GSW17BSH071009	A2540D	15-Oct-07

WLCGSG07GSW17	GSW-17	6.4	WLCGSG07	09-Oct-07	17:40	WLCGSG07GSW17CSH071009	A2540D	15-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	01-Oct-07	16:17	WLCGSG07GSW18AE071001	A2540D	05-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	01-Oct-07	16:30	WLCGSG07GSW18BE071001	A2540D	05-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	01-Oct-07	16:40	WLCGSG07GSW18CE071001	A2540D	05-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	05-Oct-07	14:45	WLCGSG07GSW18ASH071005	A2540D	12-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	05-Oct-07	14:50	WLCGSG07GSW18BSH071005	A2540D	12-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	05-Oct-07	14:59	WLCGSG07GSW18CSH071005	A2540D	12-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	08-Oct-07	14:40	WLCGSG07GSW18ASL071008	A2540D	13-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	08-Oct-07	14:50	WLCGSG07GSW18BSL071008	A2540D	13-Oct-07
WLCGSG07GSW18	GSW-18	6.5	WLCGSG07	08-Oct-07	15:00	WLCGSG07GSW18CSL071008	A2540D	13-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	05-Oct-07	09:18	WLCGSG07GSW19AE071005	A2540D	12-Oct-07

WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	05-Oct-07	11:19	WLCGSG07GSW19ASL071005	A2540D	12-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	05-Oct-07	09:30	WLCGSG07GSW19BE071005	A2540D	12-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	05-Oct-07	11:26	WLCGSG07GSW19BSL071005	A2540D	12-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	05-Oct-07	09:40	WLCGSG07GSW19CE071005	A2540D	12-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	05-Oct-07	11:36	WLCGSG07GSW19CSL071005	A2540D	12-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	09-Oct-07	16:55	WLCGSG07GSW19ASH071009	A2540D	15-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	09-Oct-07	17:03	WLCGSG07GSW19BSH071009	A2540D	15-Oct-07
WLCGSG07GSW19	GSW-19	6.7	WLCGSG07	09-Oct-07	17:15	WLCGSG07GSW19CSH071009	A2540D	15-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	02-Oct-07	15:45	WLCGSG07GSW20AE071002	A2540D	08-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	02-Oct-07	15:55	WLCGSG07GSW20BE071002	A2540D	08-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	02-Oct-07	16:07	WLCGSG07GSW20CE071002	A2540D	08-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	03-Oct-07	14:22	WLCGSG07GSW20ASH071003	A2540D	09-Oct-07

WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	03-Oct-07	14:33	WLCGSG07GSW20BSH071003	A2540D	09-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	03-Oct-07	14:45	WLCGSG07GSW20CSH071003	A2540D	09-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	04-Oct-07	11:12	WLCGSG07GSW20ASL071004	A2540D	11-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	04-Oct-07	11:20	WLCGSG07GSW20BSL071004	A2540D	11-Oct-07
WLCGSG07GSW20	GSW-20	6.7	WLCGSG07	04-Oct-07	11:35	WLCGSG07GSW20CSL071004	A2540D	11-Oct-07
WLCMBI02SED01	SED01	6.7	WLCMBI02	05-Sep-02		WLCMBI02SED01SED01D	UNK	05-Sep-02
WLCMBI02SED03	SED03	6.8	WLCMBI02	06-Sep-02		WLCMBI02SED03SED03D	UNK	06-Sep-02
WLCMBI02SED04	SED04	6.9	WLCMBI02	06-Sep-02		WLCMBI02SED04SED04D	UNK	06-Sep-02
WLCMBI02SED05	SED05	6.9	WLCMBI02	05-Sep-02		WLCMBI02SED05SED05D	UNK	05-Sep-02
WLCMBI02SED07	SED07	6.9	WLCMBI02	05-Sep-02		WLCMBI02SED07SED07D	UNK	05-Sep-02
WLCMBI02SED08	SED08	7.1	WLCMBI02	05-Sep-02		WLCMBI02SED08SED08D	UNK	05-Sep-02
WLCMBI02SED09	SED09	7	WLCMBI02	06-Sep-02		WLCMBI02SED09SED09D	UNK	06-Sep-02
WLCMBI02SPMD01	SPMD01	7.2	WLCMBI02	12-Sep-02		WLCMBI02SPMD01PMD01D	E160.2	12-Sep-02

WLCMBI02SPMD02	SPMD02	7.2	WLCMBI02	12-Sep-02		WLCMBI02SPMD02PMD02D	E160.2	12-Sep-02
WLCMBI02SPMD05	SPMD05	7.1	WLCMBI02	12-Sep-02		WLCMBI02SPMD05PMD05D	E160.2	12-Sep-02
WLCMBI02SPMD11	SPMD11	6.9	WLCMBI02	12-Sep-02		WLCMBI02SPMD11PMD11D	E160.2	12-Sep-02
WLCMBI02SPMD15	SPMD15	6.8	WLCMBI02	12-Sep-02		WLCMBI02SPMD15PMD15D	E160.2	12-Sep-02
WLCMBI02SPMD20	SPMD20	6.6	WLCMBI02	12-Sep-02		WLCMBI02SPMD20PMD20D	E160.2	12-Sep-02
WLCRIL99HCSW01	HC-SW01	15.5	WLCRIL99	07-Dec-99		WLCRIL99HCSW01CSW100	E160.2	07-Dec-99
WLCRIL99HCSW01	HC-SW01	15.5	WLCRIL99	07-Dec-99		WLCRIL99HCSW01HCSW01	E160.2	07-Dec-99
WLCRIL99HCSW05	HC-SW05	14.6	WLCRIL99	07-Dec-99		WLCRIL99HCSW05HCSW05	E160.2	07-Dec-99

nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis
15:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93	JT	pg/l	NA
05:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	166	JT	pg/l	NA
16:21	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	213	JT	pg/l	NA
17:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	136	JT	pg/l	NA
23:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	481	JT	pg/l	NA
00:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	189	JT	pg/l	NA
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	222	JT	pg/l	NA
14:53	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	210	JT	pg/l	NA
03:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	313	JT	pg/l	NA
05:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	69.9	JT	pg/l	NA

14:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	171	JT	pg/l	NA
04:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	259	JT	pg/l	NA

17:26	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	199	JT	pg/l	NA

03:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	513	JT	pg/l	NA
01:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	245	JT	pg/l	NA

18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	135	JT	pg/l	NA
17:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA

06:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA
07:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72	JT	pg/l	NA

10:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	2620	T	pg/l	NA
14:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	9560	JT	pg/l	NA
03:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	5920	JT	pg/l	NA
11:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1890	T	pg/l	NA
15:33	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1380	JT	pg/l	NA
16:35	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1290	T	pg/l	NA
11:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	285	JT	pg/l	NA
00:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	398	JT	pg/l	NA
11:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	238	JT	pg/l	NA

12:19	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	201	JT	pg/l	NA
01:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	695	JT	pg/l	NA
17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1120	JT	pg/l	NA
02:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	341	JT	pg/l	NA
13:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l	NA
03:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
18:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
16:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l	NA

04:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l	NA
23:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l	NA
12:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l	NA
13:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l	NA
01:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l	NA
16:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l	NA
13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l	NA
05:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l	NA
02:05	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l	NA

14:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA

15:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA

14:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA
15:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA

04:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
18:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA

01:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA
00:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	15.4	JT	pg/l	NA

05:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	336	JT	pg/l	NA
15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.2	JT	pg/l	NA
16:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	17.8	JT	pg/l	NA
21:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
17:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	34.3	JT	pg/l	NA
16:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
17:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	13.5	JT	pg/l	NA
11:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.5	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	40.2	JT	pg/l	NA

14:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	263	JT	pg/l	NA
13:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	239	JT	pg/l	NA

04:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	114	JT	pg/l	NA
05:41	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	96	JT	pg/l	NA

17:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	237	JT	pg/l	NA
18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	248	JT	pg/l	NA

23:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	143	JT	pg/l	NA
22:48	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	130	JT	pg/l	NA

19:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	176	JT	pg/l	NA
20:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	150	JT	pg/l	NA
16:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76.9	JT	pg/l	NA
15:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	457	JT	pg/l	NA

06:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.1	JT	pg/l	NA
12:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	175	JT	pg/l	NA

17:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA
00:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	94.6	JT	pg/l	NA

13:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.4	JT	pg/l	NA

14:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.3	JT	pg/l	NA
10:05	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l	NA
10:05	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l	NA
01:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	162	JT	pg/l	NA
18:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	216	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l	NA
16:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72.9	JT	pg/l	NA
17:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	33.7	JT	pg/l	NA
11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l	NA
11:42	Conventionals	TSS	Total suspended solids	NA	Y	19	J	mg/l	NA
04:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA

03:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	125	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l	NA
11:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	348	JT	pg/l	NA
12:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	89.8	JT	pg/l	NA
07:29	Conventionals	TSS	Total suspended solids	NA	Y	60		mg/l	NA
07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l	NA
02:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	270	JT	pg/l	NA
00:57	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	321	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l	NA
12:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	195	JT	pg/l	NA

13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	121	JT	pg/l	NA
11:18	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l	NA
11:18	Conventionals	TSS	Total suspended solids	NA	Y	14		mg/l	NA
02:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	179	JT	pg/l	NA
05:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	141	JT	pg/l	NA
04:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	157	JT	pg/l	NA
03:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	161	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l	NA
14:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	122	JT	pg/l	NA

15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.6	JT	pg/l	NA
10:56	Conventionals	TSS	Total suspended solids	NA	Y	23		mg/l	NA
10:56	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l	NA
10:56	Conventionals	TSS	Total suspended solids	NA	Y	25		mg/l	NA
10:56	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l	NA
06:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	123	JT	pg/l	NA
05:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l	NA
13:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	102	JT	pg/l	NA
15:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	90.6	JT	pg/l	NA
07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l	NA
07:28	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l	NA

04:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	449	JT	pg/l	NA
03:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	295	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l	NA
16:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	480	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	496	JT	pg/l	NA
07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l	NA
07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l	NA
09:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	156	JT	pg/l	NA
02:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA

18:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	223	JT	pg/l	NA
16:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	165	JT	pg/l	NA
09:34	Conventionals	TSS	Total suspended solids	NA	Y	32		mg/l	NA
09:34	Conventionals	TSS	Total suspended solids	NA	Y	30		mg/l	NA
12:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	172	JT	pg/l	NA
11:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	53.4	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l	NA
17:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	225	JT	pg/l	NA
02:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	186	JT	pg/l	NA
07:28	Conventionals	TSS	Total suspended solids	NA	Y	23		mg/l	NA
07:28	Conventionals	TSS	Total suspended solids	NA	Y	22		mg/l	NA

14:17	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	23.1	JT	pg/l	NA
13:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	87.4	JT	pg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l	NA
03:44	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
04:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.8	JT	pg/l	NA
11:19	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l	NA
11:19	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA

13:35	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA

16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA

18:10	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
18:10	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
18:10	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA

15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA

13:35	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA

13:35	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA

15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA

14:30	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	14		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA

15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA

16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA

15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA

15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA

13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA

14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
18:10	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
18:10	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA

18:10	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:30	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
14:00	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA

15:50	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l	NA
15:50	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
18:10	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
18:10	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
18:10	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
15:12	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA

16:45	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:45	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA
13:35	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	4.4		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	4.42		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	9.68		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	8.4		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	41.6		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	29.4		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	19		mg/l	NA

00:00	Conventionals	TSS	Total suspended solids	NA	Y	87		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	22		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	24		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	53	T	mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	19		mg/l	NA
00:00	Conventionals	TSS	Total suspended solids	NA	Y	23		mg/l	dry
00:00	Conventionals	TSS	Total suspended solids	NA	Y	28		mg/l	dry
00:00	Conventionals	TSS	Total suspended solids	NA	Y	19		mg/l	dry

DVCategory	Notes								
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS1	22-Nov-04	19:40	LW2-W005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	12:50	LW2-W3005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	10:00	LW3-W1005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:24	LW3-W2005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:17	LW3-W2005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:25	LW3-W3005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:15	LW3-W3005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:03	LW3-W4005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:01	LW3-W4005-NS	E160.2

QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS1	17-Nov-04	17:31	LW2-W011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS2	17-Mar-05	14:20	LW2-W2011B	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	11:36	LW2-W3011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:26	LW3-W2011-1NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:13	LW3-W2011-1NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:32	LW3-W4011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:30	LW3-W4011-NS	E160.2

QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS1	08-Nov-04	15:42	LW2-W013-1	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	09:45	LW2-W3013-1	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	12:43	LW2-W013-2	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS1	29-Nov-04	11:48	LW2-W015	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	09:20	LW2-W3015	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS1	30-Nov-04	13:35	LW2-W016-1	E160.2

QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016-1	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	09:03	LW2-W3016-1	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS1	11-Nov-04	00:04	LW2-W018 F	AXYS METHOD MLA-010 Rev 05
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	08:55	LW2-W3018	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS1	15-Nov-04	22:34	LW2-W023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS3	11-Jul-05	14:10	LW2-W3023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	10:00	LW3-W1023-1	E160.2

QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	13:36	LW3-W2023-E	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	18:55	LW3-W3023-E	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	11:00	LW3-W4023-E	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	13:41	LW3-W2023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:00	LW3-W3023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	13:08	LW3-W4023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	13:00	LW3-W4023-M2	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	15:25	LW3-W2023-W	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	16:10	LW3-W3023-W	E160.2

QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	14:00	LW3-W4023-W	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	11:15	LW3-W1024	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:10	LW3-W3024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:04	LW3-W3024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NS	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	17:00	LW3-W2025-E	E160.2

QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	12:59	LW3-W3025-E	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	13:50	LW3-W4025-E	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	13:38	LW3-W2025-M	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:56	LW3-W3025-M	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:25	LW3-W4025-M	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	10:27	LW3-W4025-M2	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	14:30	LW3-W2025-W	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	16:44	LW3-W3025-W	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	10:17	LW3-W4025-W	E160.2

QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:04	LW3-W3026-NB	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:03	LW3-W3026-NS	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:23	LW3-W4026-NB	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:00	LW3-W4026-NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	20:04	LW3-W2027-1NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	19:53	LW3-W2027-1NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NS	E160.2

QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:23	LW3-W4027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:14	LW3-W4027-NS	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:40	LW3-W3028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:30	LW3-W3028-NS	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NS	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	17:09	LW3-W3029-NB	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	16:36	LW3-W3029-NS	E160.2
QA2Cat1									

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27-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l

24-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
24-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l

10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	25	J	mg/l

19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l
19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l

09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	J	mg/l

13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	22	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l

12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
08-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11.5	T	mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l

18-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	UT	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	7	J	mg/l
16-May-05	12:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	277	JT	pg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
22-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	8	T	mg/l
14-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6.5	T	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	17	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	58	T	mg/l

13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	N	1	U	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	N	1	UJ	mg/l

07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20		mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49	J	mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	T	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11	T	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	14	T	mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l

09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	12		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l

13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	12	T	mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l

06-Mar-07	09:35	Conventionals	TSS	Total suspended solids	NA	Y	36		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	29		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l

09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l

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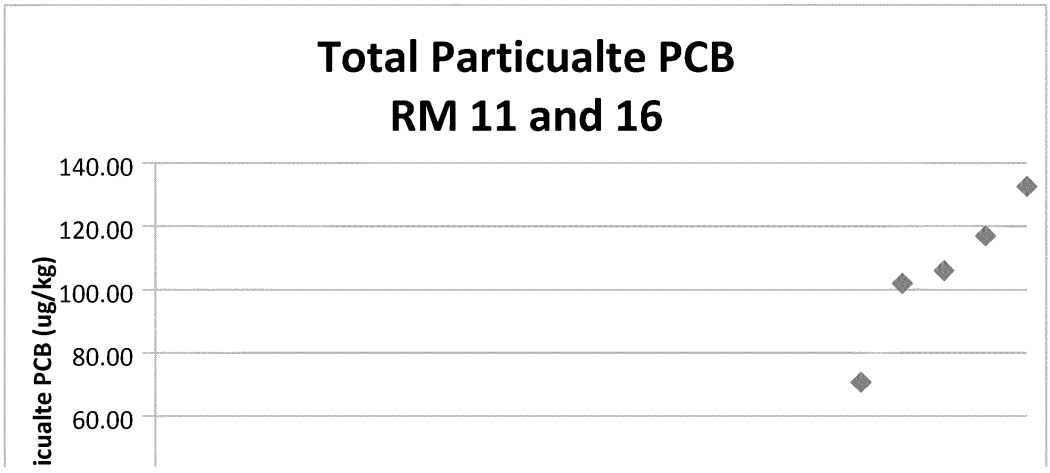
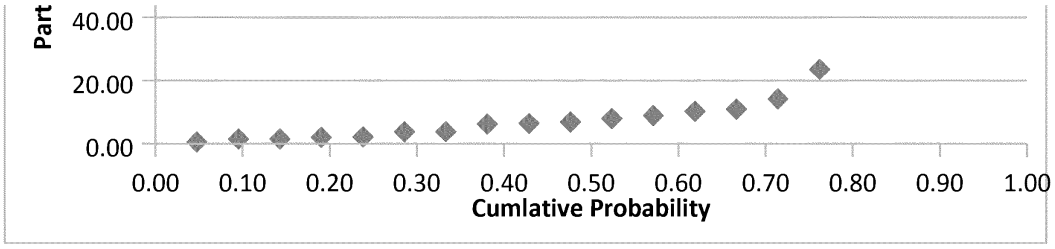
LocationID	LocationName	X	Y	Z	RiverMile	SampleDate	SampleTime
XAD Filter							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:11
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	17:25
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
XAD Column							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:20
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	16:52
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
TSS							
LW2-W023	W023	642505.89	690067.93	-49	11	15-Nov-04	22:34
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	11-Jul-05	14:10
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	10:00
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	11:35

SampleID	Analyte	detect_flag	VALUE	Qualifiers	Units
LW2-W023 F	Pentachlorobiphenyl homologs	Y	56.8	T	pg/l
LW2-W2023 F	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW2-W3023 F	Pentachlorobiphenyl homologs	Y	26.7	JT	pg/l
LW3-W1023 F	Pentachlorobiphenyl homologs	Y	33.4	JT	pg/l
LW3-W2023-M-F	Pentachlorobiphenyl homologs	Y	24.1	JT	pg/l
LW3-W2023-W-F	Pentachlorobiphenyl homologs	Y	16.7	JT	pg/l
LW3-W2023-E-F	Pentachlorobiphenyl homologs	Y	75.8	T	pg/l
LW3-W3023-M-F	Pentachlorobiphenyl homologs	Y	11.4	JT	pg/l
LW3-W3023-E-F	Pentachlorobiphenyl homologs	Y	77.9	JT	pg/l
LW3-W3023-W-F	Pentachlorobiphenyl homologs	Y	34.1	JT	pg/l
LW3-W4023-M-F	Pentachlorobiphenyl homologs	Y	1.97	JT	pg/l
LW3-W4023-M2-F	Pentachlorobiphenyl homologs	Y	17.1	JT	pg/l
LW3-W4023-E-F	Pentachlorobiphenyl homologs	Y	25.3	JT	pg/l
LW3-W4023-W-F	Pentachlorobiphenyl homologs	Y	17.6	JT	pg/l
LW2-W023 C	Pentachlorobiphenyl homologs	Y	8.86	JT	pg/l
LW2-W2023 C	Pentachlorobiphenyl homologs	Y	17.3	JT	pg/l
LW2-W3023 C	Pentachlorobiphenyl homologs	Y	48.5	T	pg/l
LW3-W1023 C	Pentachlorobiphenyl homologs	Y	15.1	JT	pg/l
LW3-W2023-M-C	Pentachlorobiphenyl homologs	Y	34.8	JT	pg/l
LW3-W2023-W-C	Pentachlorobiphenyl homologs	Y	39.5	T	pg/l
LW3-W2023-E-C	Pentachlorobiphenyl homologs	Y	45.2	T	pg/l
LW3-W3023-M-C	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW3-W3023-E-C	Pentachlorobiphenyl homologs	Y	23.3	JT	pg/l
LW3-W3023-W-C	Pentachlorobiphenyl homologs	Y	21.5	JT	pg/l
LW3-W4023-M-C	Pentachlorobiphenyl homologs	Y	6.21	JT	pg/l
LW3-W4023-M2-C	Pentachlorobiphenyl homologs	Y	7.29	JT	pg/l
LW3-W4023-E-C	Pentachlorobiphenyl homologs	Y	12.3	JT	pg/l
LW3-W4023-W-C	Pentachlorobiphenyl homologs	Y	10.7	JT	pg/l
LW2-W023	Total suspended solids	Y	8	T	mg/l
LW2-W2023	Total suspended solids	Y	6.5	T	mg/l
LW2-W3023	Total suspended solids	Y	17	J	mg/l
LW3-W1023-1	Total suspended solids	Y	62	T	mg/l
LW3-W1023-2	Total suspended solids	Y	54		mg/l

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)
17-Nov-04	LW2-W023	11	566	8	70.75
07-Mar-05	LW2-W023	11	67.4	6.5	10.37
12-Jul-05	LW2-W023	11	118	17	6.94
20-Jan-06	LW2-W023	11	127	58	2.19
05-Sep-06	LW3-W023M	10.9	106	1	106.00
06-Sep-06	LW3-W023W	11	64.6	10	6.46
02-Nov-06	LW3-W023M	10.9	43.7	4	10.93
02-Nov-06	LW3-W023W	11	117	1	117.00
15-Jan-07	LW3-W023M	10.9	7.33	13	0.56
02-Mar-07	LW3-W023M	10.9	70.3	18	3.91
04-Mar-07	LW3-W023W	11	76	20	3.80
19-Jan-06	LW3-W024	15.9	77.9	49	1.59
13-Sep-06	LW3-W024	15.9	42.6	3	14.20
13-Sep-06	LW3-W024	15.9	26.7	3	8.90
03-Nov-06	LW3-W024	15.9	118	5	23.60
03-Nov-06	LW3-W024	15.9	39.9	5	7.98
18-Jan-07	LW3-W024	15.9	22.9	11	2.08
18-Jan-07	LW3-W024	15.9	20.9	14	1.49
06-Sep-06	LW3-W023E	11	663	5	132.6
02-Nov-06	LW3-W023E	11	408	4	102
03-Mar-07	LW3-W023E	11	99.7	16	6.23125
Average					
Standard Deviation					
95% UCL					

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Cumlative Probability

Notes

	30.46		
	44.58		
	47.28		
TSS Result is ND	0.56	1	0.05
	1.49	2	0.10
	1.59	3	0.14
TSS Result is ND	2.08	4	0.19
	2.19	5	0.24
	3.80	6	0.29
	3.91	7	0.33
	6.23	8	0.38
	6.46	9	0.43
	6.94	10	0.48
	7.98	11	0.52
	8.90	12	0.57
	10.37	13	0.62
	10.93	14	0.67
RM 11E Location	14.20	15	0.71
	23.60	16	0.76
	70.75	17	0.81
1	102.00	18	0.86
	106.00	19	0.90
	117.00	20	0.95
	132.60	21	1.00
	21		

LocationID	RiverMile	SampleDate	ampleTime	SampleID	Method	AnalysisDate	nalysisTim
LW2-W023	11	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05	13:23
LW2-W023	11	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05	03:38
LW2-W023	11	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05	18:30
LW2-W023	11	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	16:54
LW3-W023M	10.9	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	13:52
LW3-W023W	11	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	05:09
LW3-W023M	10.9	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	01:01
LW3-W023W	11	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	02:05
LW3-W023M	10.9	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07	16:28
LW3-W023M	10.9	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	13:42
LW3-W023W	11	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	14:46
LW3-W023E	11	06-Sep-06	13:36	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06	04:04
LW3-W023E	11	02-Nov-06	18:55	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07	23:56
LW3-W023E	11	03-Mar-07	11:00	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07	12:37

AnalyteGroup	cas_rn	Analyte	al_or_dissol	detect_flag	VALUE	Qualifiers	Units
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l
PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l

SampleDate	ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
15-Nov-04	22:34	LW2-W023	E160.2	22-Nov-04	12:00	Conventionals	TSS
07-Mar-05	13:16	LW2-W2023	E160.2	14-Mar-05	12:00	Conventionals	TSS
11-Jul-05	14:10	LW2-W3023	E160.2	10-Aug-05	00:30	Conventionals	TSS
20-Jan-06	10:00	LW3-W1023-1	E160.2	27-Jan-06	12:00	Conventionals	TSS
05-Sep-06	13:41	LW3-W2023-M	E160.2	07-Sep-06	00:01	Conventionals	TSS
06-Sep-06	15:25	LW3-W2023-W	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	13:00	LW3-W3023-M	E160.2	09-Nov-06	12:00	Conventionals	TSS
02-Nov-06	16:10	LW3-W3023-W	E160.2	09-Nov-06	12:00	Conventionals	TSS
15-Jan-07	13:08	LW3-W4023-M	E160.2	22-Jan-07	12:00	Conventionals	TSS
02-Mar-07	13:00	LW3-W4023-M2	E160.2	07-Mar-07	11:42	Conventionals	TSS
04-Mar-07	14:00	LW3-W4023-W	E160.2	07-Mar-07	11:42	Conventionals	TSS
06-Sep-06	13:36	LW3-W2023-E	E160.2	13-Sep-06	16:40	Conventionals	TSS
02-Nov-06	18:55	LW3-W3023-E	E160.2	09-Nov-06	12:00	Conventionals	TSS
03-Mar-07	11:00	LW3-W4023-E	E160.2	07-Mar-07	11:42	Conventionals	TSS

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
Total suspended solids	NA	Y	8	T	mg/l
Total suspended solids	NA	Y	6.5	T	mg/l
Total suspended solids	NA	Y	17	J	mg/l
Total suspended solids	NA	Y	58	T	mg/l
Total suspended solids	NA	N	1	U	mg/l
Total suspended solids	NA	Y	10		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	N	1	UJ	mg/l
Total suspended solids	NA	Y	13		mg/l
Total suspended solids	NA	Y	18		mg/l
Total suspended solids	NA	Y	20		mg/l
Total suspended solids	NA	Y	5		mg/l
Total suspended solids	NA	Y	4	J	mg/l
Total suspended solids	NA	Y	16		mg/l

LocationID	cationNam	X	Y	Z	RiverMile	Task	SampleDate	SampleTime
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS1	19-Jan-06	16:30
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS2	13-Sep-06	19:10
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:14
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS3	03-Nov-06	17:13
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	12:03
LW3-W024	W024	7646211	665687	7	15.9	B01-01-57B_WS4	18-Jan-07	11:53

SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn
LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06	15:50	PCB_Congeners	1336-36-3
LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06	14:56	PCB_Congeners	1336-36-3
LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06	15:30	PCB_Congeners	1336-36-3
LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07	04:14	PCB_Congeners	1336-36-3
LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07	18:38	PCB_Congeners	1336-36-3
LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	01:34	PCB_Congeners	1336-36-3
LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07	00:30	PCB_Congeners	1336-36-3

Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory	SampleDate
Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA	QA2Cat1	19-Jan-06
Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA	QA2Cat1	13-Sep-06
Total PCB Congeners	NA	Y	118	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA	QA2Cat1	03-Nov-06
Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA	QA2Cat1	15-Jan-07
Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA	QA2Cat1	15-Jan-07

ampleTim	SampleID	Method	AnalysisDate	nalysisTim	AnalyteGroup	cas_rn	Analyte	l_or_disso
11:15	LW3-W1024	E160.2	27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NB	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:10	LW3-W2024-NS	E160.2	19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:10	LW3-W3024-NB	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
17:04	LW3-W3024-NS	E160.2	09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NB	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA
18:40	LW3-W4024-NS	E160.2	22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA

detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory
Y	49	J	mg/l	NA	QA2Cat1
Y	3		mg/l	NA	QA2Cat1
Y	3	T	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	5	J	mg/l	NA	QA2Cat1
Y	11	T	mg/l	NA	QA2Cat1
Y	14	T	mg/l	NA	QA2Cat1

LocationID	cationNam	RiverMile	Task	SampleDate	ampleTim	SampleID	Method	AnalysisDate
LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	20:00	LW3-W2025-E-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	19:27	LW3-W2025-M-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	18:01	LW3-W2025-W-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:38	LW3-W3025-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	17:02	LW3-W3025-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	13:15	LW3-W3025-E-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:38	LW3-W4025-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	17:50	LW3-W4025-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	15:45	LW3-W4025-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	15:53	LW3-W4025-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:09	LW3-W3026-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:11	LW3-W3026-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:30	LW3-W4026-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	14:23	LW3-W4026-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NB-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	21:04	LW3-W2027-1NS-F	AXYS METHOD MLA-010 Rev 08	18-Oct-06
LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:30	LW3-W3027-NS-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	13:26	LW3-W4027-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W027	W027	2.9	B01-01-57B_WS4	28-Feb-07	12:44	LW3-W4027-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:29	LW3-W3028-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07

LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:40	LW3-W4028-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW2-W005	W005	3.9	B01-01-48H_WS1	23-Nov-04	06:27	LW2-W005 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	22:23	LW2-W3005 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	16:40	LW3-W1005 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:16	LW3-W2005-NB-F	AXYS METHOD MLA-010 Rev 08	29-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	21:21	LW3-W2005-NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3005-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:55	LW3-W3005-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:26	LW3-W4005-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W005	W005	3.9	B01-01-57B_WS4	04-Mar-07	11:23	LW3-W4005-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NB-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	15:10	LW3-W3029-NS-F	AXYS METHOD MLA-010 Rev 08	14-Jan-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:50	LW3-W4029-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	15:40	LW3-W4029-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:05	LW3-W3030-NS-F	AXYS METHOD MLA-010 Rev 08	17-Jan-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	12:43	LW3-W4030-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	14:17	LW3-W4030-NS-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	09:15	LW3-W3031-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:38	LW3-W4031-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	12:08	LW3-W4031-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW2-W011	W011	6.3	B01-01-48H_WS1	18-Nov-04	18:23	LW2-W011 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W011	W011	6.3	B01-01-48H_WS2	08-Mar-05	22:05	LW2-W2011 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	21:41	LW2-W3011 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NB-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	00:00	LW3-W2011-1NS-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NB-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:00	LW3-W3011-NS-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07		LW3-W4011-NB-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W011	W011	6.3	B01-01-57B_WS4	02-Mar-07	11:44	LW3-W4011-NS-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07

LW2-W013	W013-1	6.7	B01-01-48H_WS1	09-Nov-04	03:35	LW2-W013-1 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	23:06	LW2-W013-2 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	21:29	LW2-W3013-1 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	10:50	LW3-W3032-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	17:02	LW3-W4032-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW2-W015	W015	6.9	B01-01-48H_WS1	30-Nov-04	00:05	LW2-W015 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05

LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	23:27	LW2-W3015 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	17:30	LW3-W3033-2-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NB-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:40	LW3-W3033-NS-F	AXYS METHOD MLA-010 Rev 08	10-Jan-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:43	LW3-W4033-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	16:27	LW3-W4033-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW2-W016	W016-1	7.2	B01-01-48H_WS1	01-Dec-04	01:15	LW2-W016 F	AXYS METHOD MLA-010 Rev 05	03-Jun-05
LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	22:54	LW2-W3016 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:50	LW3-W3034-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:49	LW3-W3034-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	16:35	LW3-W4034-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW2-W018	W018	8.3	B01-01-48H_WS1	10-Nov-04	11:15	LW2-W018	E160.2	12-Nov-04
LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	21:52	LW2-W3018 F	AXYS METHOD MLA-010 Rev 05	23-Aug-05
LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	11:41	LW3-W3035-NB-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS3	04-Nov-06	10:56	LW3-W3035-NS-F	AXYS METHOD MLA-010 Rev 08	12-Jan-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	16:05	LW3-W4035-NB-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	15:35	LW3-W4035-NS-F	AXYS METHOD MLA-010 Rev 08	04-May-07
LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:26	LW3-W3036-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07

LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:28	LW3-W3036-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:08	LW3-W4036-NB-F	AXYS METHOD MLA-010 Rev 08	25-May-07
LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	13:14	LW3-W4036-NS-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:54	LW3-W3037-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:32	LW3-W4037-NB-F	AXYS METHOD MLA-010 Rev 08	22-May-07
LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	12:30	LW3-W4037-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:57	LW3-W3038-NB-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS-F	AXYS METHOD MLA-010 Rev 08	18-Jan-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:48	LW3-W4038-NB-F	AXYS METHOD MLA-010 Rev 08	23-May-07
LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	16:50	LW3-W4038-NS-F	AXYS METHOD MLA-010 Rev 08	23-May-07

LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	17:28	LW3-W2023-M-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:18	LW3-W3023-M-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	16:49	LW3-W4023-M-F	AXYS METHOD MLA-010 Rev 08	19-Mar-07
LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	17:00	LW3-W4023-M2-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW2-W023	W023	11	B01-01-48H_WS1	17-Nov-04	00:03	LW2-W023 F	AXYS METHOD MLA-010 Rev 05	16-May-05
LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023 F	AXYS METHOD MLA-010 Rev 05	19-Jun-05
LW2-W023	W023	11	B01-01-48H_WS3	12-Jul-05	00:30	LW2-W3023 F	AXYS METHOD MLA-010 Rev 05	22-Aug-05
LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	17:24	LW3-W1023 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	17:21	LW3-W2023-E-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	18:11	LW3-W2023-W-F	AXYS METHOD MLA-010 Rev 08	30-Sep-06
LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	19:49	LW3-W3023-E-F	AXYS METHOD MLA-010 Rev 08	08-Jan-07

LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	17:25	LW3-W3023-W-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	15:30	LW3-W4023-E-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	17:00	LW3-W4023-W-F	AXYS METHOD MLA-010 Rev 08	25-Apr-07
LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	16:30	LW3-W1024 F	AXYS METHOD MLA-010 Rev 07	29-Mar-06
LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NB-F	AXYS METHOD MLA-010 Rev 08	02-Oct-06
LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	19:10	LW3-W2024-NS-F	AXYS METHOD MLA-010 Rev 08	17-Oct-06
LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:14	LW3-W3024-NB-F	AXYS METHOD MLA-010 Rev 08	09-Jan-07
LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:13	LW3-W3024-NS-F	AXYS METHOD MLA-010 Rev 08	13-Jan-07
LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	12:03	LW3-W4024-NB-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07
LW3-W024	W024	15.9	B01-01-57B_WS4	18-Jan-07	11:53	LW3-W4024-NS-F	AXYS METHOD MLA-010 Rev 08	20-Mar-07

nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	15.4	JT	pg/l	NA
16:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	17.8	JT	pg/l	NA
17:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	13.5	JT	pg/l	NA
21:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
11:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.5	JT	pg/l	NA
05:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	336	JT	pg/l	NA
17:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	34.3	JT	pg/l	NA
15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.2	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	40.2	JT	pg/l	NA
16:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
14:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	263	JT	pg/l	NA

13:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	239	JT	pg/l	NA
04:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	114	JT	pg/l	NA
05:41	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	96	JT	pg/l	NA
17:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	237	JT	pg/l	NA
18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	248	JT	pg/l	NA
23:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	143	JT	pg/l	NA
22:48	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	130	JT	pg/l	NA
19:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	176	JT	pg/l	NA
20:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	150	JT	pg/l	NA
16:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76.9	JT	pg/l	NA
15:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	457	JT	pg/l	NA

06:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.1	JT	pg/l	NA
12:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	175	JT	pg/l	NA
15:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93	JT	pg/l	NA
05:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	166	JT	pg/l	NA
16:21	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	213	JT	pg/l	NA
17:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	136	JT	pg/l	NA
23:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	481	JT	pg/l	NA
00:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	189	JT	pg/l	NA
15:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	222	JT	pg/l	NA
14:53	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	210	JT	pg/l	NA
03:55	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	313	JT	pg/l	NA

05:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	69.9	JT	pg/l	NA
17:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA
00:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	94.6	JT	pg/l	NA
13:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.4	JT	pg/l	NA
14:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	88.3	JT	pg/l	NA
01:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	162	JT	pg/l	NA
18:31	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	216	JT	pg/l	NA
16:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72.9	JT	pg/l	NA
17:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	33.7	JT	pg/l	NA
04:32	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA
03:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	125	JT	pg/l	NA

11:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	348	JT	pg/l	NA
12:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	89.8	JT	pg/l	NA
14:27	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	171	JT	pg/l	NA
04:43	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	259	JT	pg/l	NA
17:26	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	199	JT	pg/l	NA
03:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	513	JT	pg/l	NA
01:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	245	JT	pg/l	NA
18:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	135	JT	pg/l	NA
17:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	85	JT	pg/l	NA
06:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA
07:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	72	JT	pg/l	NA

10:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	2620	T	pg/l	NA
11:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1890	T	pg/l	NA
14:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	9560	JT	pg/l	NA
15:33	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1380	JT	pg/l	NA
03:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	5920	JT	pg/l	NA
02:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	270	JT	pg/l	NA
00:57	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	321	JT	pg/l	NA
12:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	195	JT	pg/l	NA
13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	121	JT	pg/l	NA
16:35	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1290	T	pg/l	NA
11:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	285	JT	pg/l	NA

00:02	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	398	JT	pg/l	NA
02:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	179	JT	pg/l	NA
05:15	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	141	JT	pg/l	NA
04:10	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	157	JT	pg/l	NA
03:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	161	JT	pg/l	NA
14:47	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	122	JT	pg/l	NA
15:51	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	93.6	JT	pg/l	NA
11:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	238	JT	pg/l	NA
12:19	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	201	JT	pg/l	NA
01:06	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	695	JT	pg/l	NA
06:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	123	JT	pg/l	NA

05:36	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	110	JT	pg/l	NA
13:58	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	102	JT	pg/l	NA
15:03	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	90.6	JT	pg/l	NA
17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l	NA
16:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	1120	JT	pg/l	NA
02:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	341	JT	pg/l	NA
04:45	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	449	JT	pg/l	NA
03:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	295	JT	pg/l	NA
16:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	480	JT	pg/l	NA
18:00	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	496	JT	pg/l	NA
09:59	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	156	JT	pg/l	NA

02:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
18:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	223	JT	pg/l	NA
16:07	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	165	JT	pg/l	NA
12:08	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	172	JT	pg/l	NA
11:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	53.4	JT	pg/l	NA
17:11	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	225	JT	pg/l	NA
02:40	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	186	JT	pg/l	NA
14:17	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	23.1	JT	pg/l	NA
13:12	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	87.4	JT	pg/l	NA
03:44	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	103	JT	pg/l	NA
04:49	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	54.8	JT	pg/l	NA

13:52	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	106	JT	pg/l	NA
01:01	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	43.7	JT	pg/l	NA
16:28	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	7.33	JT	pg/l	NA
13:42	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	70.3	JT	pg/l	NA
13:23	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	566	JT	pg/l	NA
03:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	67.4	JT	pg/l	NA
18:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
16:54	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	127	JT	pg/l	NA
04:04	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	663	JT	pg/l	NA
05:09	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	64.6	JT	pg/l	NA
23:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	408	JT	pg/l	NA

02:05	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	117	JT	pg/l	NA
12:37	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	99.7	JT	pg/l	NA
14:46	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	76	JT	pg/l	NA
15:50	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	77.9	JT	pg/l	NA
14:56	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	42.6	JT	pg/l	NA
15:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	26.7	JT	pg/l	NA
04:14	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	118	JT	pg/l	NA
18:38	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	39.9	JT	pg/l	NA
01:34	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	22.9	JT	pg/l	NA
00:30	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	20.9	JT	pg/l	NA

DVCategory		LocationID	ocationNam	RiverMile	Task	SampleDate	ampleTim	SampleID	Method
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS2	04-Sep-06	17:00	LW3-W2025-E	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS2	04-Sep-06	13:38	LW3-W2025-M	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS2	05-Sep-06	14:30	LW3-W2025-W	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS3	02-Nov-06	12:56	LW3-W3025-M	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS3	02-Nov-06	16:44	LW3-W3025-W	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS3	03-Nov-06	12:59	LW3-W3025-E	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	15-Jan-07	13:25	LW3-W4025-M	E160.2
QA2Cat1		LW3-W025E	W025E	2.0	B01-01-57B_WS4	08-Mar-07	13:50	LW3-W4025-E	E160.2
QA2Cat1		LW3-W025W	W025W	2.0	B01-01-57B_WS4	09-Mar-07	10:17	LW3-W4025-W	E160.2
QA2Cat1		LW3-W025M	W025M	2.0	B01-01-57B_WS4	10-Mar-07	10:27	LW3-W4025-M2	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:04	LW3-W3026-NB	E160.2

QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS3	04-Nov-06	17:03	LW3-W3026-NS	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:23	LW3-W4026-NB	E160.2
QA2Cat1		LW3-W026	W026	2.1	B01-01-57B_WS4	26-Feb-07	13:00	LW3-W4026-NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	20:04	LW3-W2027-1NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS2	07-Sep-06	19:53	LW3-W2027-1NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS3	04-Nov-06	14:45	LW3-W3027-NS	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:23	LW3-W4027-NB	E160.2
QA2Cat1		LW3-W027	W027	2.9	B01-01-57B_WS4	27-Feb-07	14:14	LW3-W4027-NS	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:40	LW3-W3028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS3	04-Nov-06	09:30	LW3-W3028-NS	E160.2

QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NB	E160.2
QA2Cat1		LW3-W028	W028	3.6	B01-01-57B_WS4	01-Mar-07	17:00	LW3-W4028-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS1	22-Nov-04	19:40	LW2-W005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS2	10-Mar-05	12:41	LW2-W2005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-48H_WS3	13-Jul-05	12:50	LW2-W3005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS1	21-Jan-06	10:00	LW3-W1005	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:24	LW3-W2005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS2	08-Sep-06	20:17	LW3-W2005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:25	LW3-W3005-NB	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS3	04-Nov-06	14:15	LW3-W3005-NS	E160.2
QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:03	LW3-W4005-NB	E160.2

QA2Cat1		LW2-W005	W005	3.9	B01-01-57B_WS4	03-Mar-07	15:01	LW3-W4005-NS	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	17:09	LW3-W3029-NB	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS3	03-Nov-06	16:36	LW3-W3029-NS	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:45	LW3-W4029-NB	E160.2
QA2Cat1		LW3-W029	W029	4.4	B01-01-57B_WS4	05-Mar-07	10:10	LW3-W4029-NS	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:45	LW3-W3030-NB	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS3	04-Nov-06	17:15	LW3-W3030-NS	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:00	LW3-W4030-NB	E160.2
QA2Cat1		LW3-W030	W030	5.5	B01-01-57B_WS4	01-Mar-07	13:30	LW3-W4030-NS	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:58	LW3-W3031-NB	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS3	05-Nov-06	08:54	LW3-W3031-NS	E160.2

QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	10:45	LW3-W4031-NB	E160.2
QA2Cat1		LW3-W031	W031	6.1	B01-01-57B_WS4	24-Feb-07	09:40	LW3-W4031-NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS1	17-Nov-04	17:31	LW2-W011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS2	17-Mar-05	14:20	LW2-W2011B	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-48H_WS3	12-Jul-05	11:36	LW2-W3011	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:26	LW3-W2011-1NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS2	12-Sep-06	20:13	LW3-W2011-1NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS3	03-Nov-06	10:30	LW3-W3011-NS	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:32	LW3-W4011-NB	E160.2
QA2Cat1		LW2-W011	W011	6.3	B01-01-57B_WS4	01-Mar-07	17:30	LW3-W4011-NS	E160.2

QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS1	08-Nov-04	15:42	LW2-W013-1	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS1	09-Nov-04	12:43	LW2-W013-2	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS2	01-Mar-05	11:04	LW2-W2013-1	E160.2
QA2Cat1		LW2-W013-2	W013-2	6.7	B01-01-48H_WS2	02-Mar-05	10:00	LW2-W2013-2	E160.2
QA2Cat1		LW2-W013	W013-1	6.7	B01-01-48H_WS3	06-Jul-05	09:45	LW2-W3013-1	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NB	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS3	05-Nov-06	09:45	LW3-W3032-NS	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:53	LW3-W4032-NB	E160.2
QA2Cat1		LW3-W032	W032	6.7	B01-01-57B_WS4	21-Feb-07	11:30	LW3-W4032-NS	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS1	29-Nov-04	11:48	LW2-W015	E160.2
QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS2	14-Mar-05	09:10	LW2-W2015	E160.2

QA2Cat1		LW2-W015	W015	6.9	B01-01-48H_WS3	19-Jul-05	09:20	LW2-W3015	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	16:40	LW3-W3033-2-NS	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS3	03-Nov-06	14:20	LW3-W3033-NS	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	12:22	LW3-W4033-2-NB	E160.2
QA2Cat1		LW3-W033	W033	7.0	B01-01-57B_WS4	26-Feb-07	11:56	LW3-W4033-2-NS	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS1	30-Nov-04	13:35	LW2-W016-1	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS2	15-Mar-05	09:23	LW2-W2016-1	E160.2
QA2Cat1		LW2-W016	W016-1	7.2	B01-01-48H_WS3	18-Jul-05	09:03	LW2-W3016-1	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:28	LW3-W3034-NB	E160.2

QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS3	04-Nov-06	13:27	LW3-W3034-NS	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:10	LW3-W4034-NB	E160.2
QA2Cat1		LW3-W034	W034	7.5	B01-01-57B_WS4	24-Feb-07	15:00	LW3-W4034-NS	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS1	11-Nov-04	00:04	LW2-W018 F	AXYS METHOD MLA-010 Rev 05
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS2	03-Mar-05	08:56	LW2-W2018	E160.2
QA2Cat1		LW2-W018	W018	8.3	B01-01-48H_WS3	14-Jul-05	08:55	LW2-W3018	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:40	LW3-W3035-NB	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS3	05-Nov-06	10:30	LW3-W3035-NS	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:25	LW3-W4035-NB	E160.2
QA2Cat1		LW3-W035	W035	8.5	B01-01-57B_WS4	25-Feb-07	10:15	LW3-W4035-NS	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:40	LW3-W3036-NB	E160.2

QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS3	04-Nov-06	17:30	LW3-W3036-NS	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:34	LW3-W4036-NB	E160.2
QA2Cat1		LW3-W036	W036	8.6	B01-01-57B_WS4	27-Feb-07	11:15	LW3-W4036-NS	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	11:57	LW3-W3037-NB	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS3	05-Nov-06	12:11	LW3-W3037-NS	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:28	LW3-W4037-NB	E160.2
QA2Cat1		LW3-W037	W037	9.6	B01-01-57B_WS4	23-Feb-07	10:26	LW3-W4037-NS	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:47	LW3-W3038-NB	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS3	05-Nov-06	13:45	LW3-W3038-NS	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:36	LW3-W4038-NB	E160.2
QA2Cat1		LW3-W038	W038	9.9	B01-01-57B_WS4	22-Feb-07	10:43	LW3-W4038-NS	E160.2

QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS2	05-Sep-06	13:41	LW3-W2023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS3	02-Nov-06	13:00	LW3-W3023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	15-Jan-07	13:08	LW3-W4023-M	E160.2
QA2Cat1		LW3-W023M	W023M	10.9	B01-01-57B_WS4	02-Mar-07	13:00	LW3-W4023-M2	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS1	15-Nov-04	22:34	LW2-W023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS2	07-Mar-05	13:16	LW2-W2023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-48H_WS3	11-Jul-05	14:10	LW2-W3023	E160.2
QA2Cat1		LW2-W023	W023	11	B01-01-57B_WS1	20-Jan-06	10:00	LW3-W1023-1	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS2	06-Sep-06	13:36	LW3-W2023-E	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS2	06-Sep-06	15:25	LW3-W2023-W	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS3	02-Nov-06	18:55	LW3-W3023-E	E160.2

QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS3	02-Nov-06	16:10	LW3-W3023-W	E160.2
QA2Cat1		LW3-W023E	W023E	11	B01-01-57B_WS4	03-Mar-07	11:00	LW3-W4023-E	E160.2
QA2Cat1		LW3-W023W	W023W	11	B01-01-57B_WS4	04-Mar-07	14:00	LW3-W4023-W	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS1	19-Jan-06	11:15	LW3-W1024	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS2	13-Sep-06	18:10	LW3-W2024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:10	LW3-W3024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS3	03-Nov-06	17:04	LW3-W3024-NS	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NB	E160.2
QA2Cat1		LW3-W024	W024	15.9	B01-01-57B_WS4	15-Jan-07	18:40	LW3-W4024-NS	E160.2

nalysisDat	nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	12		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l
13-Mar-07	17:54	Conventionals	TSS	Total suspended solids	NA	Y	9		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	12	T	mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
06-Mar-07	09:35	Conventionals	TSS	Total suspended solids	NA	Y	36		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	29		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l
27-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	8		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l

07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
08-Mar-07	10:05	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
08-Mar-07	10:05	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	19	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	2		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	60		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
24-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
24-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	25	J	mg/l
19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	15		mg/l
19-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	Y	6		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	22	J	mg/l
13-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18	J	mg/l

12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
12-Nov-04	17:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
08-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11.5	T	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	8	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
28-Feb-07	11:18	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
28-Feb-07	11:18	Conventionals	TSS	Total suspended solids	NA	Y	14		mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
15-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	7		mg/l

10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6	J	mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	24		mg/l
05-Mar-07	10:56	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
03-Dec-04	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
18-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	UT	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	7	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
16-May-05	12:18	PCB_Congeners	1336-36-3	Total PCB Congeners	NA	Y	277	JT	pg/l
09-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	N	5	U	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
02-Mar-07	07:29	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l

10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	32		mg/l
06-Mar-07	09:34	Conventionals	TSS	Total suspended solids	NA	Y	30		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	23		mg/l
02-Mar-07	07:28	Conventionals	TSS	Total suspended solids	NA	Y	22		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
10-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4		mg/l
28-Feb-07	11:19	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
28-Feb-07	11:19	Conventionals	TSS	Total suspended solids	NA	Y	17		mg/l

07-Sep-06	00:01	Conventionals	TSS	Total suspended solids	NA	N	1	U	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l
22-Nov-04	12:00	Conventionals	TSS	Total suspended solids	NA	Y	8	T	mg/l
14-Mar-05	12:00	Conventionals	TSS	Total suspended solids	NA	Y	6.5	T	mg/l
10-Aug-05	00:30	Conventionals	TSS	Total suspended solids	NA	Y	17	J	mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	58	T	mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l
13-Sep-06	16:40	Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l

09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	N	1	UJ	mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l
07-Mar-07	11:42	Conventionals	TSS	Total suspended solids	NA	Y	20		mg/l
27-Jan-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	49	J	mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3		mg/l
19-Sep-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	3	T	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
09-Nov-06	12:00	Conventionals	TSS	Total suspended solids	NA	Y	5	J	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	11	T	mg/l
22-Jan-07	12:00	Conventionals	TSS	Total suspended solids	NA	Y	14	T	mg/l

Basis	DVCategory
NA	QA2Cat1
NA	QA2Cat1
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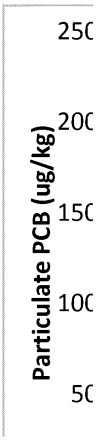
NA	QA2Cat1
NA	QA2Cat1

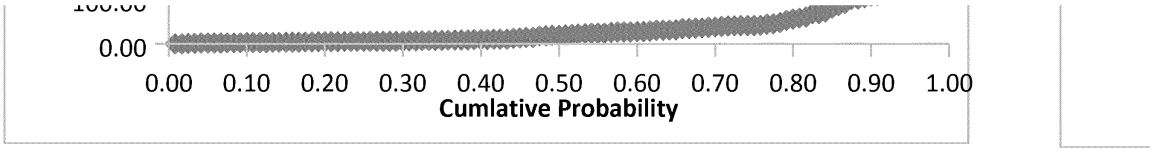
NA QA2Cat1

Sample Date	Sample Location	River Mile	Total Particaulate PCB Congeners (pg/L)	TSS (mg/L)	Suspended Particle PCB (ug/kg)
04-Sep-06	W025E	2	15.4	8	1.93
04-Sep-06	W025M	2	17.8	6	2.97
05-Sep-06	W025W	2	13.5	4	3.38
02-Nov-06	W025M	2	103	5	20.60
02-Nov-06	W025W	2	64.5	5	12.90
03-Nov-06	W025E	2	336	5	67.20
15-Jan-07	W025M	2	34.3	12	2.86
08-Mar-07	W025E	2	88.2	9	9.80
09-Mar-07	W025W	2	40.2	10	4.02
10-Mar-07	W025M	2	67.4	9	7.49
04-Nov-06	W026	2.1	263	7	37.57
04-Nov-06	W026	2.1	239	4	59.75
26-Feb-07	W026	2.1	114	13	8.77
26-Feb-07	W026	2.1	96	13	7.38
07-Sep-06	W027	2.9	237	12	19.75
07-Sep-06	W027	2.9	248	6	41.33
04-Nov-06	W027	2.9	143	4	35.75
04-Nov-06	W027	2.9	130	3	43.33
28-Feb-07	W027	2.9	176	36	4.89
28-Feb-07	W027	2.9	150	29	5.17
04-Nov-06	W028	3.6	76.9	4	19.23
04-Nov-06	W028	3.6	457	4	114.25
01-Mar-07	W028	3.6	54.1	20	2.71
01-Mar-07	W028	3.6	175	18	9.72
23-Nov-04	W005	3.9	93	7	13.29
10-Mar-05	W005	3.9	166	6	27.67
13-Jul-05	W005	3.9	213	8	26.63
21-Jan-06	W005	3.9	136	49	2.78
08-Sep-06	W005	3.9	481	16	30.06
08-Sep-06	W005	3.9	189	8	23.63
04-Nov-06	W005	3.9	222	6	37.00
04-Nov-06	W005	3.9	210	6	35.00
04-Mar-07	W005	3.9	313	17	18.41
04-Mar-07	W005	3.9	69.9	15	4.66
03-Nov-06	W029	4.4	85	6	14.17
03-Nov-06	W029	4.4	94.6	5	18.92
05-Mar-07	W029	4.4	93.4	17	5.49
05-Mar-07	W029	4.4	88.3	16	5.52
04-Nov-06	W030	5.5	162	4	40.50
04-Nov-06	W030	5.5	216	2	108.00
01-Mar-07	W030	5.5	72.9	20	3.65
01-Mar-07	W030	5.5	33.7	19	1.77

05-Nov-06	W031	6.1	110	2	55.00
05-Nov-06	W031	6.1	125	4	31.25
24-Feb-07	W031	6.1	348	60	5.80
24-Feb-07	W031	6.1	89.8	17	5.28
18-Nov-04	W011	6.3	171	5	34.20
08-Mar-05	W011	6.3	259	5	51.80
12-Jul-05	W011	6.3	199	25	7.96
12-Sep-06	W011	6.3	513	15	34.20
12-Sep-06	W011	6.3	245	6	40.83
03-Nov-06	W011	6.3	135	5	27.00
03-Nov-06	W011	6.3	85	3	28.33
02-Mar-07	W011	6.3	76	22	3.45
02-Mar-07	W011	6.3	72	18	4.00
09-Nov-04	W013-1	6.7	2620	5	524.00
09-Nov-04	W013-2	6.7	1890	5	378.00
01-Mar-05	W013-1	6.7	9560	5	1912.00
02-Mar-05	W013-2	6.7	1380	11.5	120.00
06-Jul-05	W013-1	6.7	5920	8	740.00
05-Nov-06	W032	6.7	270	4	67.50
05-Nov-06	W032	6.7	321	3	107.00
21-Feb-07	W032	6.7	195	18	10.83
21-Feb-07	W032	6.7	121	14	8.64
30-Nov-04	W015	6.9	1290	5	258.00
14-Mar-05	W015	6.9	285	7	40.71
19-Jul-05	W015	6.9	398	5	79.60
03-Nov-06	W033	7	179	4	44.75
03-Nov-06	W033	7	141	6	23.50
03-Nov-06	W033	7	157	6	26.17
03-Nov-06	W033	7	161	6	26.83
26-Feb-07	W033	7	122	24	5.08
26-Feb-07	W033	7	93.6	17	5.51
01-Dec-04	W016-1	7.2	238	5	47.60
15-Mar-05	W016-1	7.2	201	5	40.20
18-Jul-05	W016-1	7.2	695	7	99.29
04-Nov-06	W034	7.5	123	3	41.00
04-Nov-06	W034	7.5	110	4	27.50
24-Feb-07	W034	7.5	102	17	6.00
24-Feb-07	W034	7.5	90.6	16	5.66
10-Nov-04	W018	8.3	5	277	0.02
03-Mar-05	W018	8.3	1120	5	224.00
14-Jul-05	W018	8.3	341	4	85.25
04-Nov-06	W035	8.5	449	5	89.80
04-Nov-06	W035	8.5	295	3	98.33
25-Feb-07	W035	8.5	480	16	30.00
25-Feb-07	W035	8.5	496	16	31.00

04-Nov-06	W036	8.6	156	4	39.00
04-Nov-06	W036	8.6	118	5	23.60
27-Feb-07	W036	8.6	223	32	6.97
27-Feb-07	W036	8.6	165	30	5.50
05-Nov-06	W037	9.6	172	3	57.33
05-Nov-06	W037	9.6	53.4	3	17.80
23-Feb-07	W037	9.6	225	23	9.78
23-Feb-07	W037	9.6	186	22	8.45
05-Nov-06	W038	9.9	23.1	5	4.62
05-Nov-06	W038	9.9	87.4	4	21.85
22-Feb-07	W038	9.9	103	18	5.72
22-Feb-07	W038	9.9	54.8	17	3.22
05-Sep-06	W023M	10.9	106	1	106.00
02-Nov-06	W023M	10.9	43.7	4	10.93
15-Jan-07	W023M	10.9	7.33	13	0.56
02-Mar-07	W023M	10.9	70.3	18	3.91
17-Nov-04	W023	11	566	8	70.75
07-Mar-05	W023	11	67.4	6.5	10.37
12-Jul-05	W023	11	118	17	6.94
20-Jan-06	W023	11	127	58	2.19
06-Sep-06	W023E	11	663	5	132.60
06-Sep-06	W023W	11	64.6	10	6.46
02-Nov-06	W023E	11	408	4	102.00
02-Nov-06	W023W	11	117	1	117.00
03-Mar-07	W023E	11	99.7	16	6.23
04-Mar-07	W023W	11	76	20	3.80
19-Jan-06	W024	15.9	77.9	49	1.59
13-Sep-06	W024	15.9	42.6	3	14.20
13-Sep-06	W024	15.9	26.7	3	8.90
03-Nov-06	W024	15.9	118	5	23.60
03-Nov-06	W024	15.9	39.9	5	7.98
18-Jan-07	W024	15.9	22.9	11	2.08
18-Jan-07	W024	15.9	20.9	14	1.49

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0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
Cumlative Probability

Notes	Suspended Particle PCB (ug/kg)	Rank	Cumlative Probability
	0.02	1	0.01
	0.56	2	0.02
	1.49	3	0.03
	1.59	4	0.03
	1.77	5	0.04
	1.93	6	0.05
	2.08	7	0.06
	2.19	8	0.07
	2.71	9	0.08
	2.78	10	0.08
	2.86	11	0.09
	2.97	12	0.10
	3.22	13	0.11
	3.38	14	0.12
	3.45	15	0.13
	3.65	16	0.13
	3.80	17	0.14
	3.91	18	0.15
	4.00	19	0.16
	4.02	20	0.17
	4.62	21	0.18
	4.66	22	0.18
	4.89	23	0.19
	5.08	24	0.20
	5.17	25	0.21
	5.28	26	0.22
	5.49	27	0.23
	5.50	28	0.23
	5.51	29	0.24
	5.52	30	0.25
	5.66	31	0.26
	5.72	32	0.27
	5.80	33	0.28
	6.00	34	0.28
	6.23	35	0.29
	6.46	36	0.30
	6.94	37	0.31
	6.97	38	0.32
	7.38	39	0.33
	7.49	40	0.33
	7.96	41	0.34
	7.98	42	0.35

8.45	43	0.36
8.64	44	0.37
8.77	45	0.38
8.90	46	0.38
9.72	47	0.39
9.78	48	0.40
9.80	49	0.41
10.37	50	0.42
10.83	51	0.43
10.93	52	0.43
12.90	53	0.44
13.29	54	0.45
14.17	55	0.46
14.20	56	0.47
17.80	57	0.48
18.41	58	0.48
18.92	59	0.49
19.23	60	0.50
19.75	61	0.51
20.60	62	0.52
21.85	63	0.53
23.50	64	0.53
23.60	65	0.54
23.60	66	0.55
23.63	67	0.56
26.17	68	0.57
26.63	69	0.58
26.83	70	0.58
27.00	71	0.59
27.50	72	0.60
27.67	73	0.61
28.33	74	0.62
30.00	75	0.63
30.06	76	0.63
31.00	77	0.64
31.25	78	0.65
34.20	79	0.66
34.20	80	0.67
35.00	81	0.68
35.75	82	0.68
37.00	83	0.69
37.57	84	0.70
39.00	85	0.71
40.20	86	0.72
40.50	87	0.73

40.71	88	0.73
40.83	89	0.74
41.00	90	0.75
41.33	91	0.76
43.33	92	0.77
44.75	93	0.78
47.60	94	0.78
51.80	95	0.79
55.00	96	0.80
57.33	97	0.81
59.75	98	0.82
67.20	99	0.83
67.50	100	0.83
70.75	101	0.84
79.60	102	0.85
85.25	103	0.86
89.80	104	0.87
98.33	105	0.88
99.29	106	0.88
102.00	107	0.89
106.00	108	0.90
107.00	109	0.91
108.00	110	0.92
114.25	111	0.93
117.00	112	0.93
120.00	113	0.94
132.60	114	0.95
224.00	115	0.96
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378.00	117	0.98
524.00	118	0.98
740.00	119	0.99
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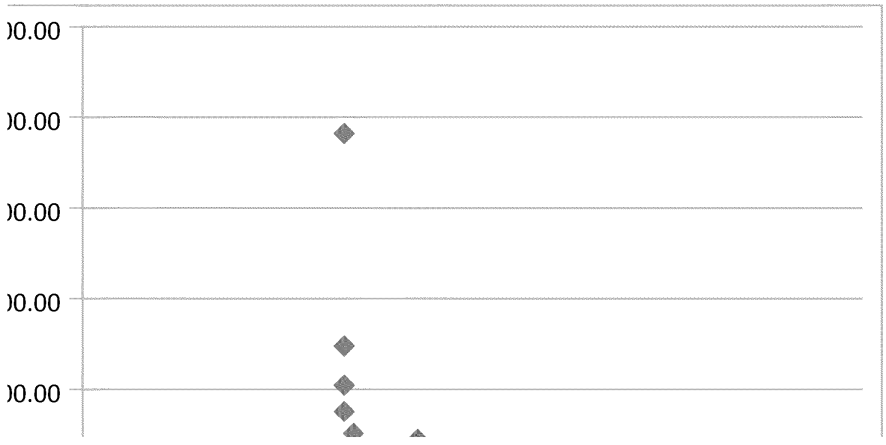

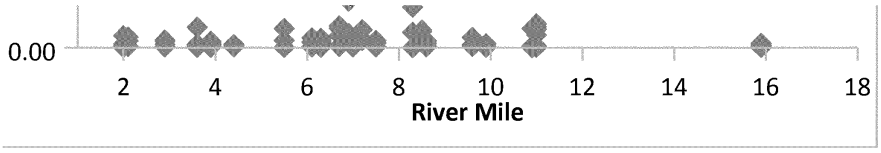
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River Mile

LWG
Lower Willamette Group

MEMORANDUM

To: Chip Humphrey and Kristine Koch, U.S. Environmental Protection Agency, Region 10

From: Lower Willamette Group

Date: January 15, 2014

Re: Proposed Process for Incorporation of EPA's Dredge Production and Dredge Residual Recommendations for the Portland Harbor Feasibility Study

In a November 20, 2013 email, the U.S. Environmental Protection Agency (EPA) requested that the Lower Willamette Group (LWG) "propose a process that incorporates the dredge production and residual recommendations in the Corps memos that EPA sent to LWG on September 10, 2013." This memorandum proposes such a process for revision of the Portland Harbor Feasibility Study (FS). The memoranda in question were dated May 24, 2013, and May 27, 2013, for the dredge releases/residuals and dredging production rate, respectively. The memoranda were prepared by Paul Schroeder and Karl Gustavson of the U.S. Army Engineer Research and Development Center (ERDC). The LWG-proposed, revised FS process for each memorandum is addressed in the following sections.

DREDGING PRODUCTION RATES

As reviewed in the May 27, 2013 ERDC dredging production rate memorandum, the draft FS assumes a production rate of 700 cubic yards (cy) per day per dredge plant, which is 2,100 cy per day total, given that simultaneous operation of three dredge plants is assumed in the draft FS. The ERDC memorandum recommends, instead, a higher production rate of 1,867 cy per day per dredge plant, which is 5,601 cy per day, given the same assumption of three dredge plants operating simultaneously. The ERDC memorandum also suggests that further refinements to this rate could be conducted. The LWG has significant concerns about the optimistic nature of the ERDC production rate, including the following:

- The ERDC production rate is significantly higher than those implemented in similar projects in the Pacific Northwest, including T4 Early Action, Gasco Early Action, and Alcoa Vancouver (each in the 500 to 900 cy per day range); Zidell (less than 400 cy per day); Port of Olympia 2009 Interim Action (400 cy per day); East Waterway Duwamish Phase 1 Removal Action (up to 1800 cy per day); Boeing Plant 2 Duwamish, Season 1 (700 to 1000 cy per day); and the Head of Hylebos Waterway (722 to 1150 cy per day). (Citations are in the draft FS or can be supplied upon request).
- The ERDC memorandum cites non-Northwest projects where the highest production rates involve disposal directly into Confined Disposal Facilities, which may only apply to some Portland Harbor alternatives and, at best, a minority of the Portland Harbor sediments.
- The ERDC memorandum cites the Hudson Phase 2 project with a rate of 900 cy per dredge per day (or 2,700 cy per day for three dredge plants), which is only slightly higher than the total production rate used in the draft FS (2,100 cy per day).

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- The ERDC memorandum discusses consideration of, but largely ignores, specific local issues, such as available infrastructure as well as water transport, offloading, upland transportation, and disposal bottlenecks, which have been demonstrated constraints on other Pacific Northwest remedial dredging projects.
- The ERDC memorandum discusses the impacts of release/residual best management practices and performance standards on production rates but does not propose specific methods and standards that will allow the assumed higher production rates.
- The ERDC memorandum does not address in any detail the contracting, EPA oversight, and other implementation logistics for this complex site, which has a range of SMA-specific conditions and many responsible parties and contractors as discussed the draft FS. The Portland Harbor situation differs significantly from the situations that the ERDC cited at Hudson River, Buffalo River, and Indiana Harbor sites, all of which involve one responsible party and one contractor.

Range Evaluation Proposal

Despite these concerns, it is recognized that both the LWG and ERDC production rate estimates are attempts to predict a future condition that is unknown, including issues of the exact dredging methods, cut depths, and equipment to be used; the residuals and water quality controls and performance standards to be imposed; dewatering treatment requirements; the number of dredge plants that can be reasonably mobilized to the site for any given season; the exact offloading and transportation infrastructure to be used; the disposal destinations; contracting and performing parties logistics; and the period of day during which dredging will be allowed due to noise, light, traffic, and other community concerns. Given these uncertainties, the LWG proposes that the revised FS evaluate a range of potential dredge production rates and the impact of those ranges on remedial decisions.

If EPA is agreeable to a range evaluation approach for production rates, the LWG would want to discuss further with EPA the appropriate production rate ranges for such an evaluation. As noted in the draft FS, we believe the draft FS production rates are not the slowest possible production rates for real world environmental dredging in Portland Harbor. And as noted above, it also appears that the ERDC memorandum proposed rates are very optimistic for real world environmental dredging here. Although the LWG is amenable to discussing higher production rates than those in the draft FS as part of a revised FS range evaluation, the LWG believes the high range production rates should be considerably lower than the ERDC estimates for reasons stated above.

Regardless of the range of production rates used in a revised FS evaluation, the methods for such an evaluation would be the same for a variety of potential production rate ranges. Therefore, the methods for incorporating this type of range evaluation into the revised FS are discussed in the following subsection.

Range Evaluation Methods

Production rates are used in the FS to determine the implementation speed for removal, transport, and disposal required under each alternative. The production rate is an important, but not the

sole, factor in determining the duration of each alternative. Duration can, in turn, impact the sequence of Sediment Management Areas (SMAs) addressed and directly impacts some of the unit cost calculations for each alternative (e.g., dredging unit cost). Duration and sequence can then impact the evaluation of each alternative's effectiveness and feasibility. Some components of the effectiveness evaluation, particularly the fate and transport modeling, specifically rely on the duration and sequence to estimate the impacts of each alternative. Therefore, if the production rates are varied, all of these other FS evaluation components would need to be revised as well.

For reasons discussed above, the LWG continues to believe that the draft FS production rates are reasonable estimates of real world Portland Harbor-specific conditions that already factor in a considerable amount of optimism (i.e., favoring higher production rates). Consequently, it appears appropriate to continue to use these production rates as the "base case" assumption that is used to develop the related FS evaluation components discussed above. In addition, for FS report schedule, cost, and logistical reasons, both EPA and the LWG have discussed the value in using the existing evaluations in the draft FS to continue to support the revised FS, where possible. Consequently, the LWG proposes that the range of dredge production rates only be used to calculate new durations for each alternative. The sequencing, costs, effectiveness (e.g., QEA Fate modeling), and feasibility calculations for each alternative in the revised FS would continue to use the "base case" from the draft FS production rates, sequences, and durations.

As determined through further EPA/LWG discussions, higher production rate-based durations would be presented and used in the alternatives evaluation sections of the revised FS (i.e., the detailed and comparative evaluations represented by the current draft FS Sections 8 and 9). Alternative evaluations that rely on or discuss durations of the alternatives would present the full range of durations as calculated in the range evaluation. This would include any detailed or comparative alternative evaluation tables or graphs that use duration as a metric. For tables, ranges of values would be presented. For graphs, any duration estimates would include error bars or similar indicators of shorter durations that could be attained using the higher production rates.

Finally, as discussed in Section 10 of the draft FS (see Section 10.3.5, 10.3.6, and Appendix U Table 7.1-1 for details), duration is a related metric to short-term effectiveness and implementability. (This should not be inferred to mean that duration is synonymous with or a replacement for the full evaluation of short-term effectiveness and implementability conducted in Sections 8 and 9.) As a result, duration is used to calculate the short-term effectiveness and implementability component scores within the overall summary scoring of alternatives in Section 10. To the extent that EPA desires to use such a scoring system for summarizing the evaluation of alternatives in the revised FS, the effect of the duration ranges proposed in this memorandum could be incorporated into the overall summary score ranges.

DREDGE RESIDUALS

The May 24, 2013 ERDC dredge residuals memorandum recommends a different method for the calculation of residuals than that used in the fate and transport modeling evaluations in the draft FS. The details of the ERDC-proposed method are provided in the recommendations

section of that memorandum and do not need to be repeated here. Again, the LWG has some specific concerns about the information supporting the ERDC-recommended residual calculation method, including the following:

- All but the Port of Olympia and possibly the West Branch Calumet projects from the post-dredge "cover" mixing citations provided by ERDC actually refer to capping projects, where installation methods are specifically targeted to minimize mixing, which is usually not the case for post-dredge cover project methods. For post dredge covers the material is usually placed under the assumption that mixing will take place during construction and in the future due to natural forces. Using capping methods for post dredge cover placement would greatly increase the time, implementability issues, and expense of completing dredging in each sediment management area.
- The Boeing Plant 2 project, referred to as demonstrating "improved dredging and residuals management," collected insufficient data to assess residuals or the potential release rates associated with them, as this was not the intent of the post-dredge sampling program. For example, dredging was conducted to native clean sand, where 1-foot-long cores were collected of the post-dredge surface, and the entire 1-foot interval was analyzed as a composite. A composite sample of this length would be expected to dilute any potential for an accurate measure of the residuals layer actually present, particularly at low contaminant of concern concentrations.

The draft FS residuals modeling assumptions are based on empirical data on residuals management strategies at other sites, and thus, the LWG believes residuals modeling assumptions are appropriate for an FS-level evaluation. Nonetheless, the LWG agrees that the fate and transport modeling residual calculation was intended to be an estimate of post-dredging residuals to allow easier parameterization of a detailed and spatially varied set of model conditions, not a design level calculation. For this reason, there is a separate Appendix Ib, which presents a more detailed evaluation of dredge residuals production and concentration impacts that would have been difficult to incorporate fully into the fate and transport model. We agree that there are uncertainties in this estimate that are difficult to quantify given that construction methods are unknown at this time, including exact dredge equipment, dredge cut specifications, and EPA's eventual requirements for residuals cleanup passes and cover placement. Note that the draft FS assumes one cleanup pass followed by post dredge cover placement, and the LWG proposes to retain these assumptions for the revised FS.

The LWG proposes a range evaluation that uses the ERDC-specified residuals calculation methods, while continuing to use the draft FS assumptions of one cleanup pass followed by post dredge cover placement. As with the production rates, we continue to believe that the methods used to parameterize residuals effects in the FS fate and transport model are sufficiently accurate for the draft FS evaluations. In addition, propagating changes to the residuals calculations through the entire FS, including fate and transport model parameterization and model runs, would be time and resource intensive. Instead, we propose that for each alternative a static surface be calculated that represents the entire site after all SMAs are remediated.

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Currently, the model calculates the post-dredge surfaces by SMA, and then the model fate and transport processes are allowed to function while other SMAs are being actively remediated in a specified sequence. For the residuals range evaluation for each alternative, the post-dredge surfaces will be calculated for all the SMAs at once, using both the current draft FS methods and the ERDC-recommended methods. These overall surface sediment concentrations can then be compared between the two methods to determine how much difference is created in Surface-area Weighted Average Concentrations (SWACs). The SWACs will be calculated on a model grid spatial scale such that SWACs over a wide range of spatial scales can be understood (e.g., site-wide, river segment, and river mile). Color-coded maps showing the magnitude of SWAC differences in each model grid cell can be developed to highlight areas of greater and lesser variation between the two methods.

This range evaluation information would provide additional details to support a discussion in the revised FS on a representative range of impacts of dredge residuals on remediation effectiveness as currently discussed and modeled in the draft FS. By comparing existing draft FS model run SWACs over time to the potential variation in starting SWACs after construction, specific conclusions can be reached about the potential for varying residuals levels to change the outcome of each alternative. For example, if the static SWACs for the two residual calculation methods vary by 5 parts per billion (ppb) in and around a particular SMA, and the draft FS model runs project a change of 70 ppb in that same area over 30 or 45 years, it is unlikely that the variations in residual calculations would change the conclusion substantially for that area for that alternative.

CONCLUSION

Both the dredge production and dredge residuals proposals in this memorandum provide a specific method to incorporate detailed information regarding EPA's concerns in the revised FS that will support conclusions about remedial effectiveness (and other Superfund FS criteria) through a quantitative range evaluation. This has the added benefit of not requiring wholesale revision of every existing alternative in the draft FS. If EPA is amenable to these proposals, more detailed methods for the calculations for each range evaluation or example evaluation outputs can be provided by the LWG, as necessary.

MEMORANDUM

To: Chip Humphrey and Kristine Koch, U.S. Environmental Protection Agency, Region 10

From: Lower Willamette Group

Date: January 15, 2014

Re: Draft Decision Step Process Outline for incorporation of EPA's Remedial Action Levels into the revised Portland Harbor Feasibility Study

In a November 20, 2013 email, the U.S. Environmental Protection Agency (EPA) requested that the Lower Willamette Group (LWG) "Propose a process that incorporates EPA's July 2011 RALs (also presented at the 'all hands' meeting with the LWG last week) in the analysis of alternatives B, C, and D." The request was discussed with EPA on December 16, 2013, and it was agreed that many options exist for incorporating the Remedial Action Levels (RALs) into the revised Feasibility Study (FS). EPA requested that the LWG provide a decision step process outline for exploring the options for RAL incorporation, and this memorandum provides a draft recommendation for such a process. The expectation is that this outline will be further discussed to assist EPA decisions about incorporating the EPA RALs into the revised FS.

1.0 INFORMATION PRESENTED

EPA requested that the outline present the following:

- The likely decision steps for RAL incorporation
- Key questions that would need to be asked at each step
- An estimate of the level of effort to complete each step

These items are discussed in the following sections. The level of effort is expressed in terms of time to complete the work with time ranges provided that relate to the potential range of decisions EPA could make at each step. The time estimates include time to prepare materials to assist EPA. The time estimates do not include time for EPA review or text revisions to the FS. In addition, for each decision step, the additional decisions or information that would be needed for that step to allow efficient redevelopment of the alternatives is outlined below.

Note that EPA's original request relates to reanalysis of Alternative B, C, and D. Because of the change from individual DDD, DDE, and DDT RALs to a combined DDx RAL and EPA's application of the BaPEq RAL to the navigation channel, all draft FS alternatives (B through G) are impacted by the EPA RALs. Thus, the decision step outline below considers potential changes to all the alternatives.

Also note that the decision steps described below relate to the potential redevelopment of the alternatives, as requested by EPA. However, revision of the RALs would also require reanalysis and revision to the process described in draft FS Section 4. Section 4 of the FS presents a possible range of RALs and assesses the magnitude of risk reduction provided by that range of RALs. Specifically, estimates are made of the Surface-area Weighted Average Concentrations

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(SWACs) that would be achieved by the range of RALs at different time increments (i.e., immediately, 10 years, and 30 years after construction) at appropriate risk-based spatial scales (e.g., site-wide, river mile, shoreline half river mile). These comparisons are often referred to as "RAL curves." The estimated SWACs are then compared to risk-based cleanup values (i.e., PRGs) to determine points in the RAL curves that span the zone of maximum incremental risk reduction and include at least one RAL at or beyond the point of minimal change in risk reduction.

Before any of the steps below are undertaken, this Section 4 analysis should be revised to ensure that any RAL changes are consistent with the framework of the FS including the precepts of RAL development described in draft FS. It may be found that some of the proposed new RALs may need to be further refined or that some RAL changes are not necessary to achieve the overall goals of the FS. It is possible that EPA has already conducted this analysis or something similar to it, in which case, the LWG would like an opportunity to review EPA's analysis before any of the decisions steps outlined below are undertaken.

2.0 RAL DECISION STEP OUTLINE

A preliminary step in the process would be a decision from EPA regarding whether or not to include Alternative G in some or all of the steps that follow. Inclusion of Alternative G would involve additional work, impacting time range estimates at every step, because this alternative was only developed at a screening level of detail in the draft FS per EPA direction on the draft FS. The process that follows assumes that Alternative G will not be incorporated and evaluated at any step in the revised FS.

After the above preliminary step, the major steps discussed in the next sections would need to be addressed in some fashion by EPA and LWG.

2.1 Step 1—Areas and Volumes Calculation

The areas and volumes created by the new RALs would be the first step in any alternative development process. These calculations are generally assumed to follow the methods already described in the draft FS. The overall goal of this step is to answer the question: Are the changes in areas and volumes limited enough to be considered within the acceptable ranges of FS-level alternatives evaluations, or is the next step needed?

2.1.1 Additional Decisions or Information Needed for Step 1

1. EPA decision on benthic risk areas (to include in the RAL overlay)
2. EPA to provide RAL mapping layers or an explanation on how to create such layers (e.g., specify data density refinements)

2.1.2 Key Questions at the End of Step 1

1. Compare areas and volumes by Sediment Management Area (SMA) between the two sets of RALs/benthic areas.
2. How much do areas and volumes change?

a. How do RALs/benthic areas affect each alternative? Which alternatives are substantially affected?

b. Are there substantial changes in area and volume to every SMA or just a few?

c. What is the impact of the new RALs on the Depth of Impact calculations?

d. Are the changes in areas and volumes limited enough to be considered within the acceptable ranges of FS-level alternatives evaluations, or is the next step (Step 2) needed?

2.1.3 Level of Effort to Complete Step 1

1. Estimated time to complete: **4 weeks** (from the time that additional information noted in Section 2.1.1 is provided by EPA)

   a. This time estimate assumes that Alternatives B through F would be re-evaluated.

2.2 Step 2—SubSMA Development and Technology Assignments

The subSMAs created by the new RALs would be developed in this step and then the technology application criteria would be used to define technologies for each subSMA. All SMAs and subSMAs would be included in this evaluation so that the sum total of all changes to each alternative could be understood. However, only the new areas created by RAL changes would require development of new subSMAs, and new technologies assignments would only be needed for those new subSMAs. Existing subSMAs would be used for all the unchanged areas, to the extent feasible given the overall changes in the SMA boundaries. This process is assumed to generally follow the methods already described in the draft FS.

2.2.1 Additional Decisions and Information Needed for Step 2

1. EPA's technology application criteria (if revised from the draft FS) and/or EPA's technology assignments for each subSMA
2. EPA's Principle Threat Material and Oregon Hot Spot decisions (if revised from the draft FS). These concepts potentially impact technology assignments for some subSMAs (e.g., preferences for removal or treatment).
3. Other SMA decision factors, (e.g., Transition Zone Water [TZW] areas, if revised from the draft FS). Any changes to SMAs for other reasons would also need to be incorporated into the process.

2.2.2 Key Questions at the End of Step 2

1. How do subSMA development and technology assignments change the alternatives?

   a. Do different technology assignments affect each alternative or a subset of alternatives?

   b. Compare amount of area and number of subSMAs with new or different technologies.

c. Are the changes limited enough to be considered within the acceptable ranges of FS-level alternatives evaluations, or is the next step (Step 3) needed?

2.2.3 Level of Effort to Complete Step 2

1. Estimated time to complete: **4 to 6 weeks.** This estimate assumes the following:
   a. EPA's technology assignment criteria are not very complicated and do not require new analyses to determine whether the criteria are met (e.g., additional erosion modeling to determine where enhanced monitored natural recovery [EMNR] is appropriate).
   b. The low range estimate assumes that few additional changes are made to subSMAs due to additional issues like hot spots or TZW areas and five or fewer alternatives are revised.
   c. The high range estimate assumes that a few other small changes to subSMAs are needed due to additional issues and five or more alternatives are revised.

2.3 Step 3—Develop Full Description of Each Alternative

This step provides a full description of the alternatives, including all the characteristics needed for an FS-level evaluation of the alternatives. Key characteristics would include sequence of remediation, duration, and cost estimates. This step is described in Section 7 of the draft FS, and the description below assumes that the process in Section 7 would generally be followed.

2.3.1 Additional Decisions and Information Needed for Step 3

1. EPA's disposal site option selections for each alternative.
2. EPA's input on alternative options to be presented in the revised FS (e.g., final list of integrated and removal focused options).
3. EPA's choices of representative technology process options for each technology type, including the following:
   a. Type of dredging to represent removal in general (e.g., mechanical or hydraulic)
   b. Transloading and transport assumptions
   c. In situ treatment methods
   d. Capping standard cross sections
   e. Dock removal requirements
   f. Rigid barrier requirements during removal.
4. Any changes to long term monitoring or operations and maintenance assumptions.
5. EPA's sequencing assumptions (e.g., how to decide which SMAs go first/last).
6. EPA decision on production rates and residuals and release assumptions.

7. Any changes to cost calculation methods coming from the ongoing EPA cost estimate reviews.

2.3.2 Key Questions at the End of Step 3

1. Compare durations and costs (at least as a first screening) between the alternatives with the two sets of RALs.
2. How much do these descriptions change the alternatives?
   a. Do the details above affect each alternative or a subset of the alternatives?
   b. Are there large scale changes in the volume of removal or duration?
   c. Are there large scale changes in the costs of the alternatives?
   d. Are the changes limited enough to be incorporated into the FS as part of an uncertainly analysis or is the next step needed?

2.3.3 Level of Effort to Complete Step 3

1. Estimated time to complete: **4 to 8 weeks**. This estimate assumes the following:
   a. EPA's additional information, per the items above, are relatively straightforward, are all available before this timeline starts, and do not require new analyses to determine any of the alternative characteristics. It also assumes that the cost estimating methods do not change substantially.
   b. The low range estimate assumes that few additional changes are made to the existing alternative options and representative technology assumptions as currently presented in the draft FS and five or fewer alternatives are revised.
   c. The high range estimate assumes that some other small changes to the alternative options and representative technology assumptions are needed and five or more alternatives are revised.

2.4 Step 4—Conduct Full Evaluation of Each Alternative

This step would use the fully described alternatives from Step 3 and conduct necessary evaluations of those alternatives to support Sections 8, 9, and 10 of the revised FS, which evaluate the alternatives against the nine Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) criteria and reach conclusions about the best performing alternatives. (Again, this work would not include rewriting the text of these sections based on the new evaluations.)

2.4.1 Additional Decisions and Information Needed for Step 4

1. This step would require EPA decisions regarding which of the alternatives evaluations would be re-conducted. A very large array of possible combinations exists. For example, evaluations used in Sections 8, 9, and 10 of the draft FS include the following:
   a. Monitored natural recovery (MNR) lines of evidence evaluation (Section 6.2.2)

b. RAL development figures and tables (Appendix Db)

c. Remediation Goal and Sediment Management Area Sensitivity Analysis (Appendix E)

d. Contents of the Site-wide Area of Potential Concern and Buried Contamination Analysis (Appendix Fa)

e. Fate and Transport Modeling (Appendix Ha)

f. Bioaccumulation Modeling (Appendix Hb)

g. Capping Effectiveness and Stability Modeling (Appendix Hc and Sections 6.2.5 and 6.2.6)

h. Dredging Water Quality Evaluation (Appendix Ia)

i. Evaluation of Dredge Residuals Management (Appendix Ib)

j. Air Pollutant and Greenhouse Gas Emissions Inventory (Appendix Ic)

k. Selection and Evaluation of Disposal Options (Appendix Ja/Jb and subsections of Section 8 and 9)

l. Sediment Transport Modeling (Appendix La)

m. HEC-RAS Hydrodynamic (Flood) Modeling (Appendix Lb)

n. Preliminary Draft Clean Water Act Section 404(B)(1) Evaluation (Appendix M)

o. Green Remediation evaluation (Appendix N)

p. Treatment Technology Screening Evaluation (Appendix S)

q. Long term Monitoring and Contingency Program Outline (Appendix T)

r. Additional Analyses to Support Comparative Evaluation of Alternatives (Appendix U), including the following:

   i. Alternatives screening evaluation

   ii. Compliance with applicable or relevant and appropriate requirements (ARARs) evaluation

   iii. Long-term effectiveness and performance evaluations

   iv. Short-term effectiveness evaluations

   v. Additional evaluations supporting MNR evaluation

   vi. Disposal site effectiveness and implementability evaluations

   vii. Analyses and Graphics supporting Section 10 conclusions

2.4.2 Key Questions at the End of Step 4

1. No further decision comparisons are necessary. At this point, EPA would simply use the evaluations selected above to re-evaluate the new alternatives following the CERCLA process.

2.4.3 Level of Effort to Complete Step 4

1. Estimated time to complete: **6 to 12 weeks**. This time estimate includes the following assumptions:
   a. Both the low and high range estimates assume that the primary re-evaluation would be the fate and transport modeling. The low time estimate assumes that one alternative is re-modeled, and the high time estimate assumes that ten alternatives are re-modeled.
   b. A further assumption is that while the fate and transport modeling is being conducted, some additional evaluations could also be accomplished from the list above. Those additional evaluations would need to be independent of and not interfere with the fate and transport modeling in order to not add any time to the overall time estimate. Also, those additional evaluations would need to be fairly limited in scope. For example, only a limited number of evaluations noted above could not be accomplished within this same overlapping time range.
   c. This also assumes that EPA does not have other specific changes to the evaluations noted above. That is, the only variable that changes in the re-evaluation is the new alternative itself.

MEMORANDUM

To: Chip Humphrey and Kristine Koch, U.S. Environmental Protection Agency, Region 10
Karl Gustavson and Earl Hayter, U.S. Army Corps of Engineers ERDC

From: Kirk Ziegler, Li Zheng, and Fanghui Chen, Anchor QEA, LLC

Date: January 15, 2014

Re: Sediment Transport Modeling Analysis: Item 2 of EPA's Portland Harbor Feasibility Study Supplemental Information Requests

The U.S. Environmental Protection Agency (EPA) requested in a November 20, 2013 email a supplemental modeling analysis be conducted using the Portland Harbor sediment transport model developed for the draft Feasibility Study (FS), designated as Item 2 in the request. This memorandum provides the requested information. The specific Item 2 request from EPA was:

> Modeling Analysis - Please run the sediment transport model for the following events:
>
> - Two-year event: Start the modeling on Jan 1, 2003. After 5 days of spin-up, start the sediment transport model and run it until February 28, 2003. Please provide hourly output of bed shear stress and critical shear stress values in each grid cell, and the values of bed shear stress and critical shear stress at time of peak flow on February 26th.
> - Twenty-five year event: Please conduct a similar analysis on a period of the LWR hydrograph that encompasses a 25-year flood event, and provide similar output.
>
> The overall objective for this request is to assess the potential for erodibility under various stage floods.

The purpose of this memorandum is to describe the flood events and the relevant model output being provided to EPA. After reviewing U.S. Geological Survey (USGS) flow rate data for the Lower Willamette River (LWR) during January and February 2003, it was determined that the peak flow rate of the 2-year flood discussed by EPA occurred on February 1, 2003, not on February 26, consequently the information provided straddles the February 1 peak flow (Figure 1). In addition, a review of USGS flow rate data indicated that a 25-year flood occurred during January 1997. Both of these floods had been previously simulated using the LWR hydrodynamic and sediment transport models for a 30-year period that included 1997 and 2003. Thus, new model simulations did not need to be set up and conducted to provide the information requested by EPA. During a discussion with Karl Gustavson and Earl Hayter, it was determined that providing hourly output of model results during a 3-day period for each flood event (i.e., 1 day before peak flow, 1 day during peak flow, and 1 day after peak flow) would be useful for their needs.

During a phone conversion on December 13, 2013, Karl Gustavson and Earl Hayter indicated that EPA is planning to use the model results to conduct some type of bed stability analysis based on comparisons of predicted bed shear stress and critical shear stress during these two floods. This type of analysis can provide preliminary insights about locations in the LWR where

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erosion may occur during 2-year and 25-year floods. However, results of this type of simplified analysis cannot be used to reliably determine estimates of scour depth or quantify the potential for remobilization of buried contaminants. A more reliable and accurate method for evaluating bed stability is to use the LWR hydrodynamic and sediment transport models to simulate the 2-year and 25-year floods. These simulations have already been conducted by Anchor QEA and the model inputs and setup were provided to EPA through emails on September 14, 2011.

2-YEAR AND 25-YEAR FLOODS IN THE LOWER WILLAMETTE RIVER

A summary of the estimated flow rates for high-flow events in the Lower Willamette River is presented in Table 1 (Portland Harbor RI/FS, Appendix L). The flow rates for the 2-year and 25-year high-flow events are 156,000 and 297,000 cubic feet per second (cfs), respectively.

Table 1. Estimated Lower Willamette River Flow Rates for High-flow Events

Flood Return Period (years)	Flow Rate (cubic feet per second)
2	156,000
10	252,000
25	297,000
50	329,000
100	360,000
500	428,000

According to the flow rate data observed by the USGS gauging station (14211720) at the Willamette River at Portland, Oregon, the peak flow rates on February 1, 2003, and January 2, 1997, correspond to the 2-year and 25-year flood events, respectively (Figure 1). Predicted bed shear stresses at hourly intervals during a 3-day period of the floods (i.e., 1 day before and after peak flow rate) were extracted from a long-term sediment transport simulation that were transferred to EPA on September 14, 2011.

PREDICTED BED SHEAR STRESSES DURING THE 2-YEAR AND 25-YEAR FLOODS

The following files contain the predicted bed shear stresses at hourly intervals during the 3-day period of flood, as well as the critical bed shear stress:

LWR_Sedtran_longterm_1008-02_2-yr_flood_Tau.xlsx

This file contains predicted bed shear stresses at hourly intervals during a 3-day period of the 2-year flood (i.e., January 31 to February 2, 2003). This file contains the following data fields:

- Time: month-day-year, hour : minute
- EFDC grid cell index I
- EFDC grid cell index J
- BEDMAP: bed property index ("0" represents cohesive bed, and "1" represents non-cohesive bed)
- Predicted bed shear stress in Pascal (Pa)

- Note that hard-bottom grid cells, where no erosion and deposition occur, are excluded from this file

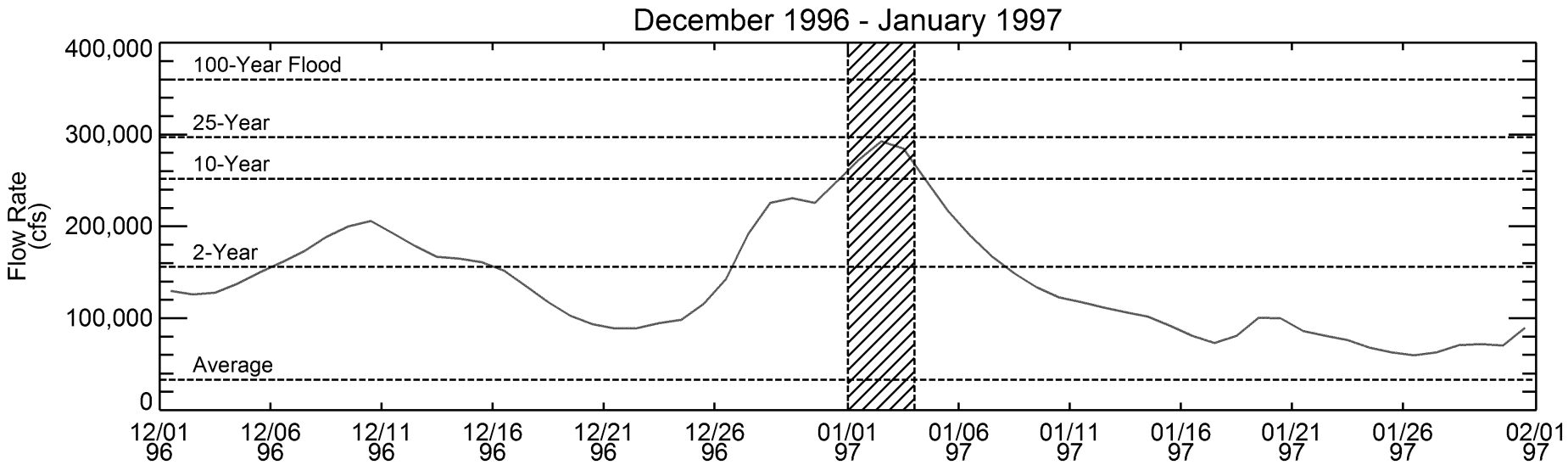
LWR_Sedtran_longterm_1008-02_25-yr_flood_Tau.xlsx

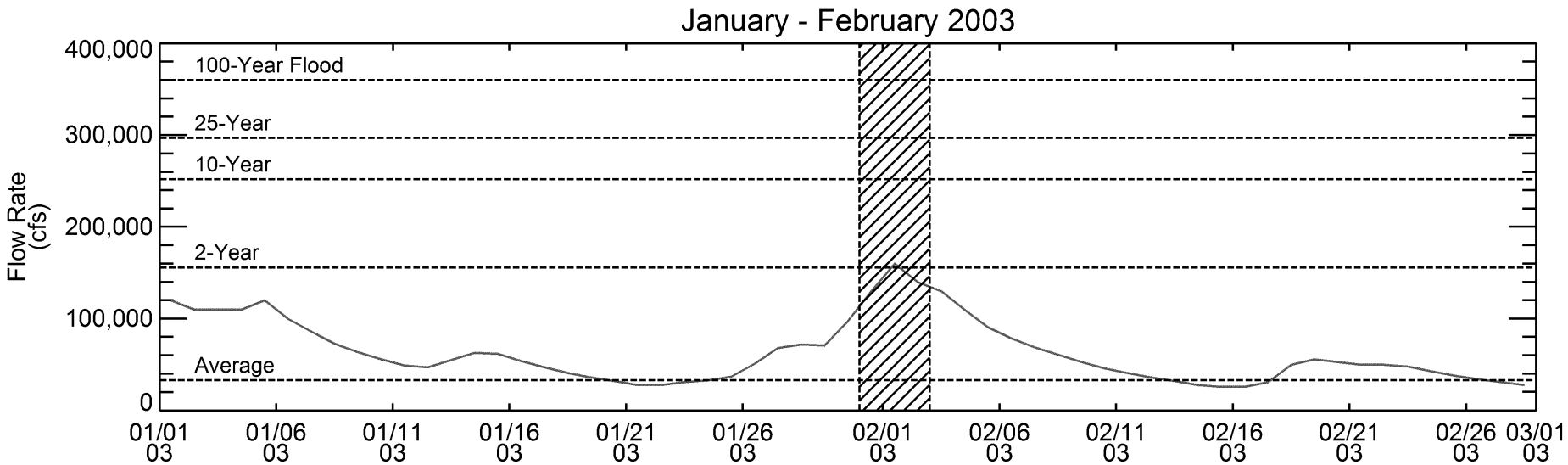
- This file contains predicted bed shear stresses at hourly intervals during a 3-day period of the 25-year flood (i.e., January 1 to January 3, 1997). The data structure in this file is similar to that in the 2-year flood file.

LWR_BED_TAU_CR.xlsx

This file contains critical bed shear stresses (Pa).

- In the cohesive bed area (i.e., bedmap = 0), critical shear stress is 0.28 Pa, corresponding to the spatial average of Sedflume data at the 0 to 5 cm layer bed.
- In the non-cohesive bed area (i.e., bedmap = 1), critical bed shear stress is referred to the one for the initiation of bed load transport, which is a function of median sediment size class d50.





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ANCHOR QEA

Figure 1

Daily Average Flow Rates in Lower Willamette River for 2-year (2003) and 25-year (1997) Floods

Lower Willamette River: Model Output Transfer to EPA

Portland Harbor RI/FS

fc - \\aries\Montvale\Users\fchen\F_DRIVE\JOBS\LWG\Analysis\Model_inputs\flow\plot_lwg_temporal_flow_longterm_model_input_wateryr_97_03.pro
Mon Jan 06 14:35:05 2014

To: Gustavson, Karl[Gustavson.Karl@epa.gov]; King, Todd W.[KingTW@cdmsmith.com]
From: Blischke, Eric
Sent: Tue 12/24/2013 7:12:32 PM
Subject: RE: Penta PCB Water Column Data
Time_Series_Penta_PCB_Water_Data.pdf
PH_SW_Summary.pdf
Penta_PCB_Water_Column.xlsx

Looking at the SW summary in the RI, the time series plots are off by one year (see PH SW Summary attachment). The high flow event took place in January 2006, not January 2007. The first surface water sampling event took place in November 2004, not November 2005. The last event took place in March 2007 not March 2008.

Now that I figured the dates, I have been able to confirm the concentrations in the time series plots. They are the whole water and particulate phase concentrations from the XAD data.

The next question is whether the data presented in Figure 3.2-4C of Appendix Ha matches. Based on this figure, the modeled penta PCB whole water concentrations range between 30 and 60 pg/L. This is in the ballpark of the measure Penta PCB levels which range between 30.0 and 78.7 pg/L. The flows presented in Figure 3.2-4C also appear to match with the high flow event shown as taking place in January 2006.

We still have a problem with the particulate solid concentrations however. Using data from the first four sampling events where we have TSS and the suspended solid concentration data from the XAD filters, suspended particulate Penta PCB concentrations range between 0.6 and 7 ug/kg (particulate Penta PCB/TSS). This is well below the values reported on Figure 3.2-4C which range between 0.2 and 2 ng/kg. We are off by about a factor of 3000.

I am attaching the relevant figures from Appendix Ha. Water and particulate data are in the spreadsheet and the relevant calculations are pasted below.

Date	Total Penta PCB (pg/L)	Disssolved Penta PCB (pg/L)	Particualte Penta PCB (pg/L)	TSS (mg/L)	Suspended Particle Penta PCB (ug/kg)
15-Nov-04	65.66	8.86	56.8	8	7.10

07-Mar-05	32.60	17.3	15.3	6.5	2.35
11-Jul-05	75.20	48.5	26.7	17	1.57
20-Jan-06	48.50	15.1	33.4	58	0.58

Eric

From: Gustavson, Karl [mailto:Gustavson.Karl@epa.gov]
Sent: Tuesday, December 24, 2013 5:10 AM
To: Blischke, Eric; King, Todd W.
Subject: RE: Penta PCB Water Column Data

You know these data better than anyone, so I don't have a clue. Kristine's been working on the RI for some time now. Would she know?

From: Blischke, Eric [mailto:blischkee@cdmsmith.com]
Sent: Monday, December 23, 2013 4:27 PM
To: Gustavson, Karl; King, Todd W.
Subject: Penta PCB Water Column Data

Attached are two time series plots from Appendix Ha showing water column and particulate phase concentrations for penta PCB homologs. The spreadsheet presents the Penta PCB homolog data extracted from the PH data base. I have also include TSS results for four of the events where we have this data.

These results are all from the XAD sampling events. These events took place between November 2004 and March 2007. The sampling events that took place between 9/06 and 3/07 included samples from the east, navigation channel and west sides of the river with the exception of the January 2007 event which was a high flow event (170,000 cfs) that only included a single mid-channel sample.

I am unable to match up the data with the figures. The concentrations are in the ballpark but do

not match up exactly. The sampling date does not match up at all. As a result, it is impossible to reproduce either the water column result let alone the particulate phase concentration.

Am I missing something here?

Eric

Eric Blischke

CDM Smith

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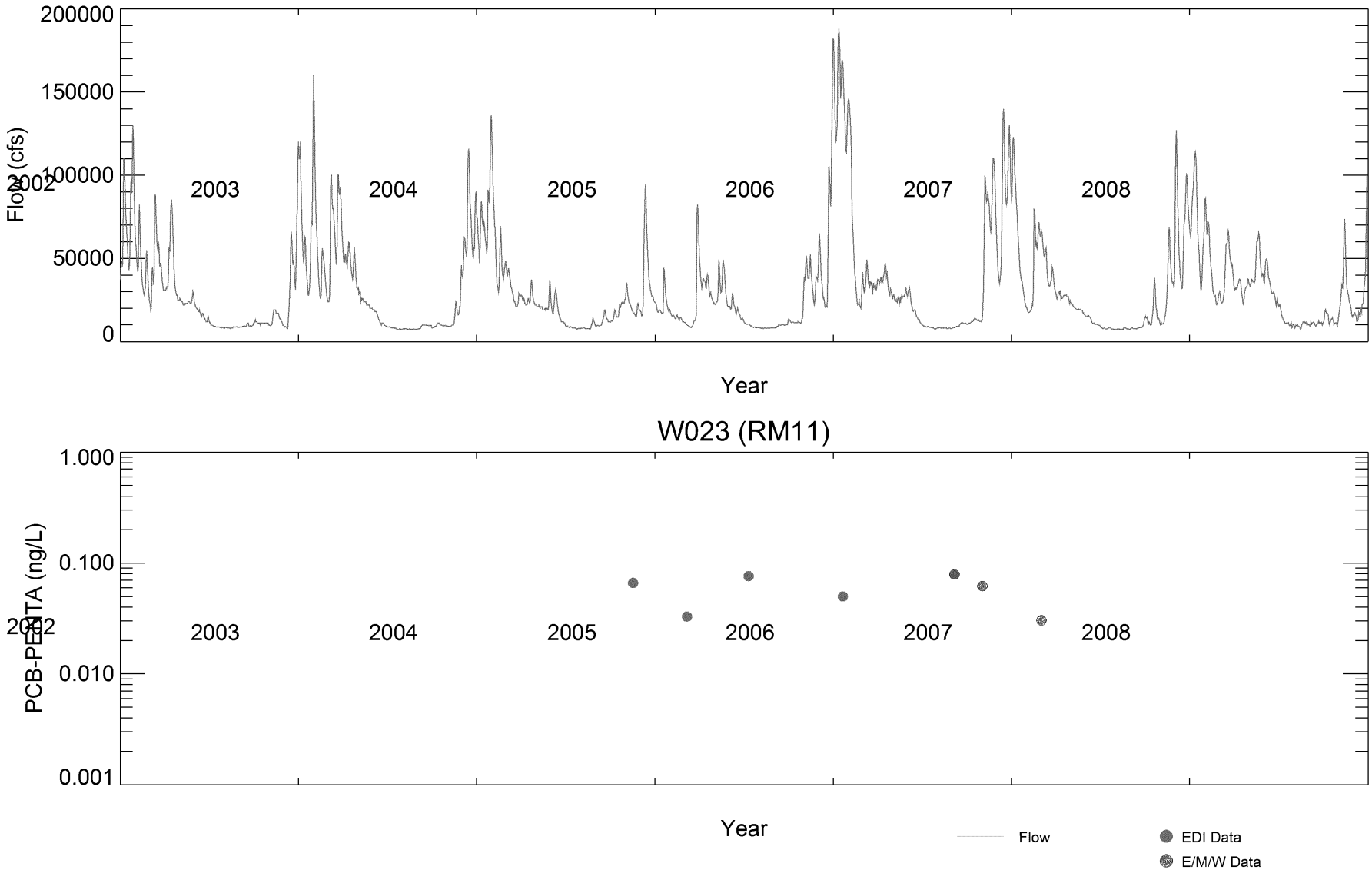

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Figure 3.3-1a
Portland Harbor RI/FS
Draft Feasibility Study
Time Series of Water Column PCB-PENTA Concentrations from 2002-2008
Open symbols indicate non-detect values at the detection limit.

MCS - H:\010142-01_LWG-Willamette\model\EFDC\Post_process\Water_Column\plot\batch\calibration\FS\LWG_WC_Temp_bat_FS.pro Thu Mar 15 16:56:44 2012

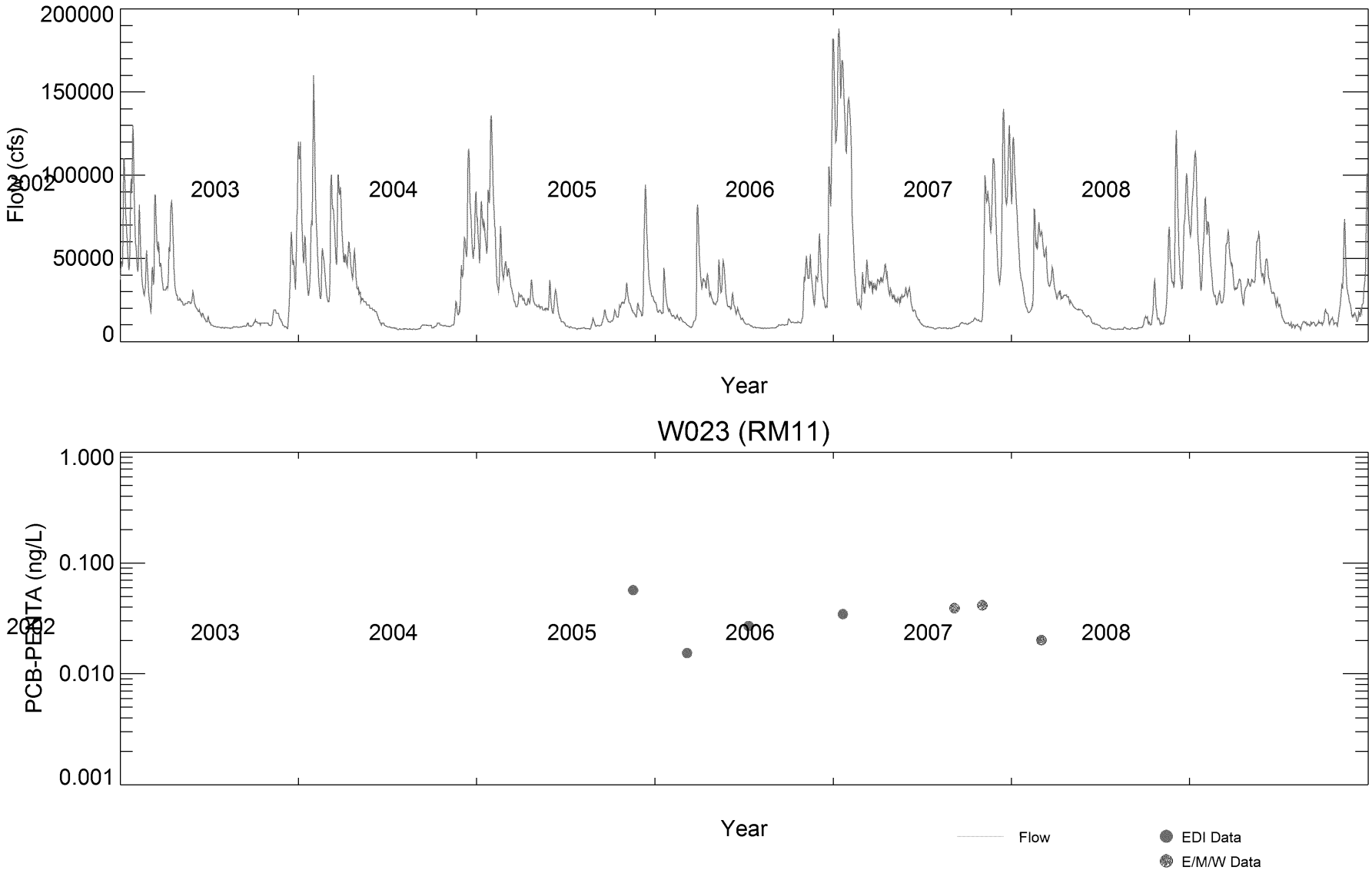

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Figure 3.3-2a

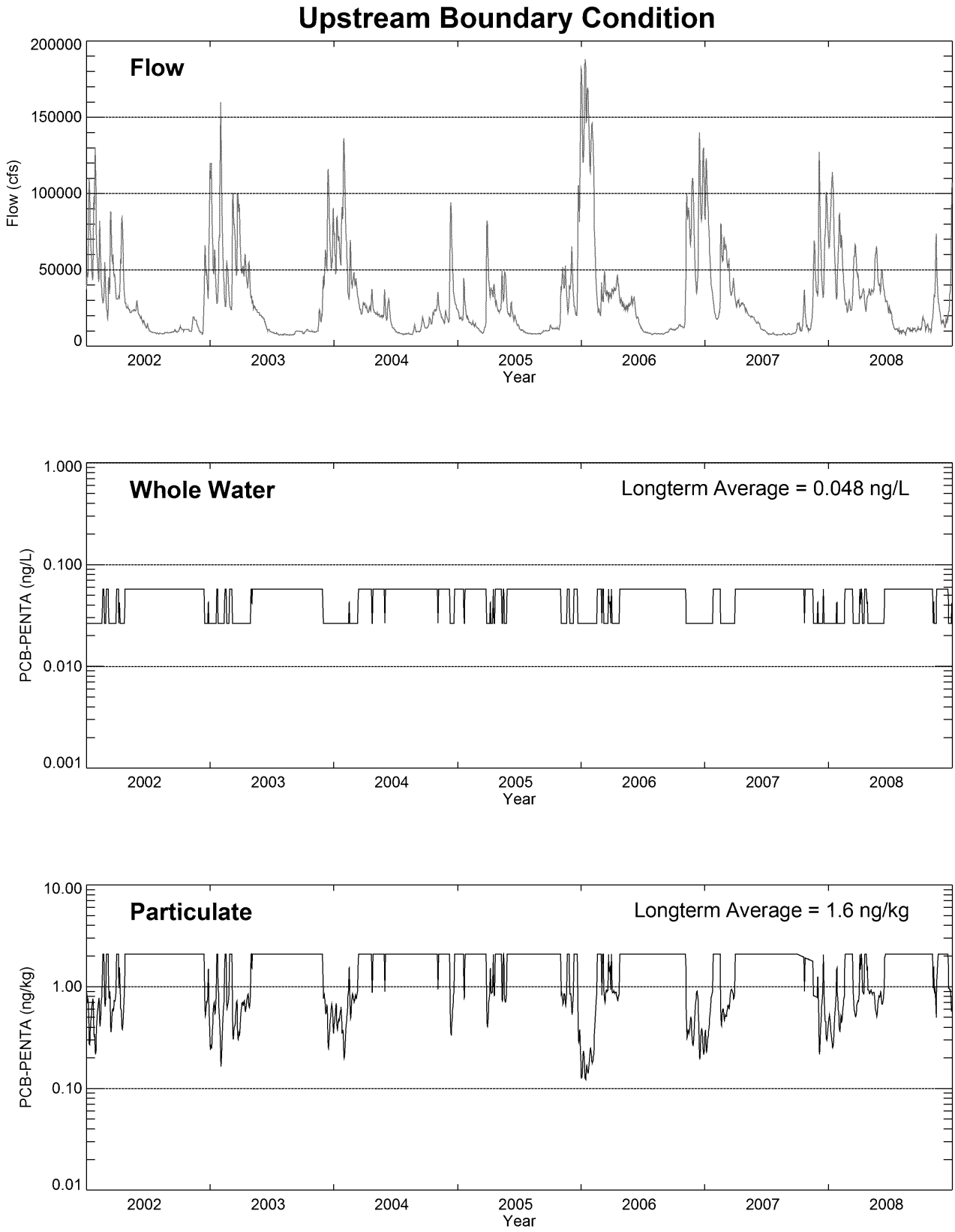
Portland Harbor RI/FS

Draft Feasibility Study

Time Series of Water Column PCB-PENTA Particulate Phase Concentrations from 2002-2008

Open symbols indicate non-detect values at the detection limit.

MCS - H:\010142-01_LWG-Willamette\model\EFDC\Post_process\Water_Column\plot\batch\calibration\FS\LWG_WC_Part_Temp_bat_FS.pro Thu Mar 15 17:07:33 2012



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LWG
LOWER WILLAMETTE GROUP

Figure 3.2-4c
Portland Harbor RI/FS
Draft Feasibility Study
Time Series of Water Column Upstream Boundary Condition Concentrations (PCB-PENTA)

RRM - H:\010142-01_LWG-Willamette\model\EFDC\Post_process\Water_Column\plot\batch\calibration\FS\LWG_WC_BC_Temp_bat_proj_45_FS.pro Thu Mar 15 15:48:54 2012

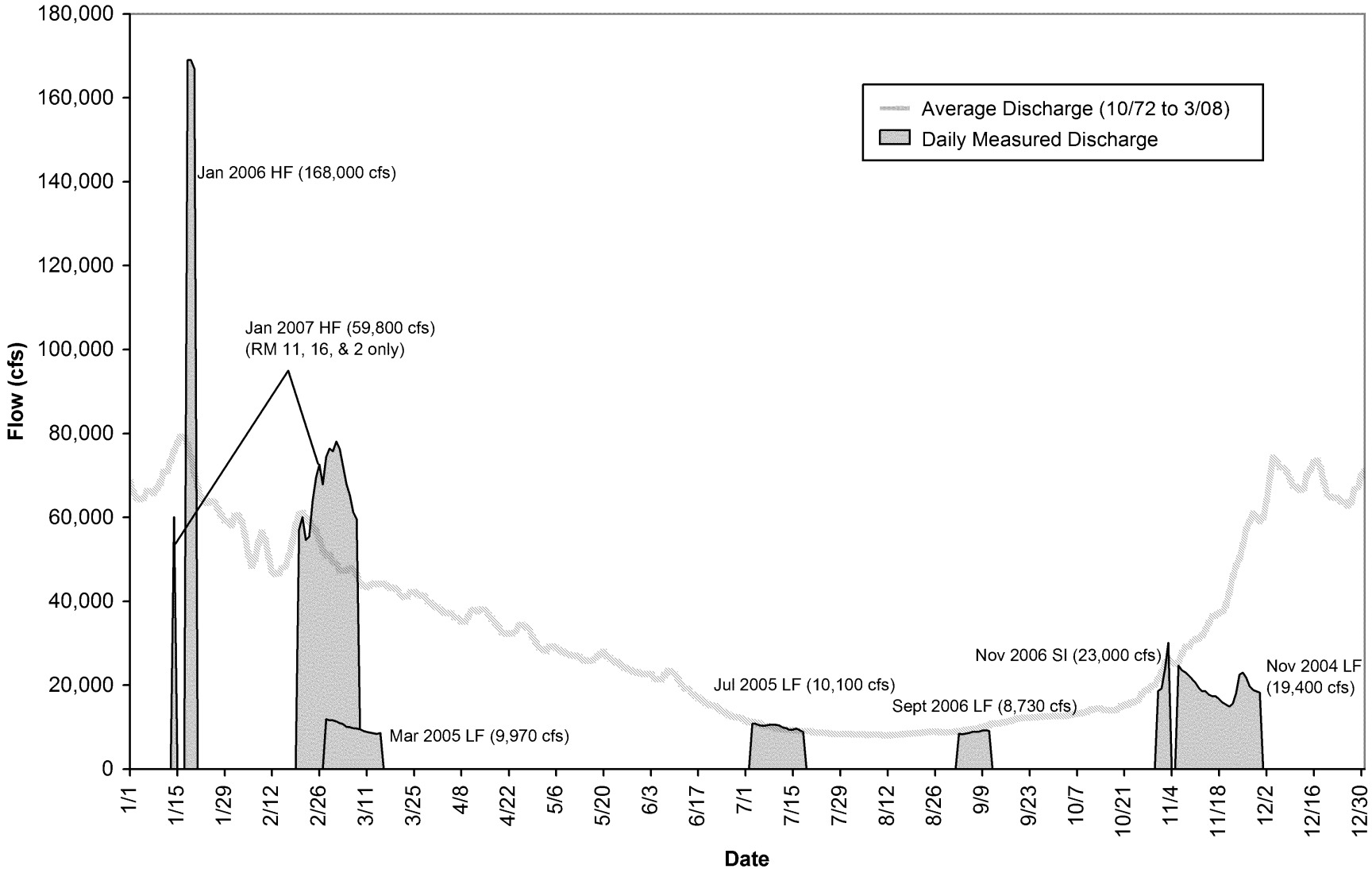

Figure 5.3-1
Portland Harbor RI/FS
Draft Remedial Investigation Report
Hydrograph of Surface Water Sampling Events
and Average Year, RM 2-16

integral consulting inc. LWG LOWER WILLAMETTE GROUP

DRAFT
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Table 5.3-1. Surface Water Sampling Event Flow Conditions Summary.

Sample Event Round	Event	Flow Conditions	Sampling Event Period	Number of Days Sampled	Start Date Flow[a] (cfs)	End Date Flow[a] (cfs)	Average Flow[a,b] During Sample Event (cfs)	Maximum Flow[a] During Sample Event (cfs)	Minimum Flow[a] During Sample Event (cfs)
2A	Nov 2004	Low Flow	11/8 - 12/2	15	24,700	18,300	19,400	24,700	14,900
2A	Mar 2005	Low Flow	3/1 - 3/17	13	11,900	8,640	9,970	11,900	8,390
2A	Jul 2005	Low Flow	7/5 - 7/20	12	10,800	8,910	10,100	10,800	8,910
3A	Jan 2006	High Flow	1/19 - 1/21	3	169,000	167,000	168,000	169,000	167,000
3A	Sep 2006	Low Flow	9/4 - 9/13	7	8,450	9,080	8,810	9,240	8,320
3A	Nov 2006	Stormwater-Influenced	11/2 - 11/5	4	18,700	30,100	23,000	30,100	18,700
3A	Jan 2007[c]	High Flow	1/15 - 1/18, 2/21 - 3/10	18	60,100	49,900	59,800	72,600	46,400

Notes:

[a] This velocity-discharge rating is considered unknown at discharges below 20,000 cfs.

[b] Average of daily flows reported for USGS gauging station Willamette River at Morrison Bridge (station ID 14211720).

[c] The January 2007 high flow event was cancelled after two days of sampling due to an unexpected change in flow conditions. Sampling resumed on February 21, 2007.

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LocationID	LocationName	X	Y	Z	RiverMile	SampleDate	SampleTime
XAD Filter							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:11
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	17:25
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
XAD Column							
LW2-W023	W023	642505.89	690067.93	-49	11	17-Nov-04	00:03
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	12-Jul-05	00:30
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	17:24
LW3-W023M	W023M	7642502	690082	-49	10.9	05-Sep-06	17:28
LW3-W023W	W023W	7642186	689770	-31	11	06-Sep-06	18:20
LW3-W023E	W023E	7642849	690351	-26	11	06-Sep-06	17:21
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Nov-06	13:18
LW3-W023E	W023E	7642849	690351	-26	11	02-Nov-06	19:49
LW3-W023W	W023W	7642186	689770	-31	11	02-Nov-06	16:52
LW3-W023M	W023M	7642502	690082	-49	10.9	15-Jan-07	16:49
LW3-W023M	W023M	7642502	690082	-49	10.9	02-Mar-07	17:00
LW3-W023E	W023E	7642849	690351	-26	11	03-Mar-07	15:30
LW3-W023W	W023W	7642186	689770	-31	11	04-Mar-07	17:00
TSS							
LW2-W023	W023	642505.89	690067.93	-49	11	15-Nov-04	22:34
LW2-W023	W023	642505.89	690067.93	-49	11	07-Mar-05	13:16
LW2-W023	W023	642505.89	690067.93	-49	11	11-Jul-05	14:10
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	10:00
LW2-W023	W023	642505.89	690067.93	-49	11	20-Jan-06	11:35

SampleID	Analyte	detect_flag	VALUE	Qualifiers	Units
LW2-W023 F	Pentachlorobiphenyl homologs	Y	56.8	T	pg/l
LW2-W2023 F	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW2-W3023 F	Pentachlorobiphenyl homologs	Y	26.7	JT	pg/l
LW3-W1023 F	Pentachlorobiphenyl homologs	Y	33.4	JT	pg/l
LW3-W2023-M-F	Pentachlorobiphenyl homologs	Y	24.1	JT	pg/l
LW3-W2023-W-F	Pentachlorobiphenyl homologs	Y	16.7	JT	pg/l
LW3-W2023-E-F	Pentachlorobiphenyl homologs	Y	75.8	T	pg/l
LW3-W3023-M-F	Pentachlorobiphenyl homologs	Y	11.4	JT	pg/l
LW3-W3023-E-F	Pentachlorobiphenyl homologs	Y	77.9	JT	pg/l
LW3-W3023-W-F	Pentachlorobiphenyl homologs	Y	34.1	JT	pg/l
LW3-W4023-M-F	Pentachlorobiphenyl homologs	Y	1.97	JT	pg/l
LW3-W4023-M2-F	Pentachlorobiphenyl homologs	Y	17.1	JT	pg/l
LW3-W4023-E-F	Pentachlorobiphenyl homologs	Y	25.3	JT	pg/l
LW3-W4023-W-F	Pentachlorobiphenyl homologs	Y	17.6	JT	pg/l
LW2-W023 C	Pentachlorobiphenyl homologs	Y	8.86	JT	pg/l
LW2-W2023 C	Pentachlorobiphenyl homologs	Y	17.3	JT	pg/l
LW2-W3023 C	Pentachlorobiphenyl homologs	Y	48.5	T	pg/l
LW3-W1023 C	Pentachlorobiphenyl homologs	Y	15.1	JT	pg/l
LW3-W2023-M-C	Pentachlorobiphenyl homologs	Y	34.8	JT	pg/l
LW3-W2023-W-C	Pentachlorobiphenyl homologs	Y	39.5	T	pg/l
LW3-W2023-E-C	Pentachlorobiphenyl homologs	Y	45.2	T	pg/l
LW3-W3023-M-C	Pentachlorobiphenyl homologs	Y	15.3	JT	pg/l
LW3-W3023-E-C	Pentachlorobiphenyl homologs	Y	23.3	JT	pg/l
LW3-W3023-W-C	Pentachlorobiphenyl homologs	Y	21.5	JT	pg/l
LW3-W4023-M-C	Pentachlorobiphenyl homologs	Y	6.21	JT	pg/l
LW3-W4023-M2-C	Pentachlorobiphenyl homologs	Y	7.29	JT	pg/l
LW3-W4023-E-C	Pentachlorobiphenyl homologs	Y	12.3	JT	pg/l
LW3-W4023-W-C	Pentachlorobiphenyl homologs	Y	10.7	JT	pg/l
LW2-W023	Total suspended solids	Y	8	T	mg/l
LW2-W2023	Total suspended solids	Y	6.5	T	mg/l
LW2-W3023	Total suspended solids	Y	17	J	mg/l
LW3-W1023-1	Total suspended solids	Y	62	T	mg/l
LW3-W1023-2	Total suspended solids	Y	54		mg/l

Date	Total Penta PCB (pg/L)	Disssolved Penta PCB (pg/L)	Particualte Penta PCB (pg/L)	TSS (mg/L)	Suspended Particle Penta PCB (ug/kg)
15-Nov-04	65.66	8.86	56.8	8	7.10
07-Mar-05	32.60	17.3	15.3	6.5	2.35
11-Jul-05	75.20	48.5	26.7	17	1.57
20-Jan-06	48.50	15.1	33.4	58	0.58

To: King, Todd W.[KingTW@cdmsmith.com]; Gustavson, Karl[Gustavson.Karl@epa.gov]
From: Blischke, Eric
Sent: Sat 12/21/2013 1:17:06 AM
Subject: Incoming Sediment Particle Concentrations
Particulate_PCB.pptx
Appx_Ha_Partitioning.pdf

Gentlemen, I have reviewed section 2.2.2.3 – Partitioning – of appendix Ha of the draft FS to understand how the LWG may have estimated incoming sediment particle concentrations in the model. I have attached the relevant pages. It appears that a partitioning and non-partitioning approach was used in the model.

In the non-partitioning case, equation 4 was utilized to "express the particulate-phase concentration on a mass of contaminant per mass of dry solids basis" – r = Cp/Ms where r is the concentration of contaminant sorbed to particulate matter on a mass/mass basis, cp is the concentration of contaminant sorbed to particulate matter on volumetric basis and Ms is the suspended solids concentration in the water column.

Using average particulate PCB data from the XAD filter samples collected between RM 10.9 and RM 11 and average TSS data from the same location, Cp is measured as 1.84 x 10-4 ug/L and TSS is measured at 16 mg/L. Dividing Cp by Ms gives an average incoming total PCB concentration of 11.5 ug/L. This is clearly within the range of the incoming sediment particle concentrations we are considering.

In the partitioning case, r = Kd x Cd where Cd is the freely dissolved phase concentration of the contaminant and the partition coefficient, Kd where Kd = Foc x Koc. In this case, r may be calculated based on a homolog basis using the dissolved phase homolog concentration, the homolog specific Koc and an assumed Foc of 2%. The calculated results are presented below for the low flow and high flow condition based on information presented in the Appendix Ha.

Low Flow Condition

Chem	Koc	TOC	Kd (L/M)	Diss LF (ng/L)	r(ug/kg)
Tri PCB	398107.2	0.02	7962.143	28.8	0.2
Tetra PCB	794328.2	0.02	15886.56	49.9	0.8
Penta	1584893	0.02	31697.86	57.5	1.8

PCB					
Hexa PCB	7943282	0.02	158865.6	79.1	12.6
Hepta PCB	5011872	0.02	100237.4	53.4	5.4
Total PCB (Low Flow)				268.7	20.8

High Flow Condition

Chemical	Kd	TOC	Kd (L/M)	Diss LF (ng/L)	r (ug/kg)
Tri PCB	398107.2	0.02	7962.143	15.3	0.1
Tetra PCB	794328.2	0.02	15886.56	26.8	0.4
Penta PCB	1584893	0.02	31697.86	26.5	0.8
Hexa PCB	7943282	0.02	158865.6	23.1	3.7
Hepta PCB	5011872	0.02	100237.4	10.6	1.1
Total PCB (High Flow)				102.3	6.1

Based on this method, incoming particle concentrations are between 6.1 and 20.8 ug/L – againg within the range of what we would expect based on the estimates of upstream particualte concentrations.

Regarding the question of how the LWG developed the concentration estimates presented in Figure 3.2-4, the footnote reads: "Particulate-phase concentrations shown on Figure 3.2-4 are calculated by the model as a function of the input whole water contaminant concentration and the total suspended solids concentration at the upstream boundary and partition coefficients." However, neither of the approaches rely on both partitioning and TSS. We can estimated the particualte concentration either based on the solid phase data and TSS or the dissolved phase concentration and a partitioning equation.

As to the question of what value of the incoming sediment concentration to use, I have estimated the particualte phase concentration for all XAD samples collected in Portland Harbor. I have used an average TSS value of 16 mg/L rather a sample specific TSS value because that would require me to link the conventional sampling TSS results with the XAD results which would require additional data base manipulation. I have pasted the results into the attached power point file. The two pages are the same data set, I only adjusted the scale. Using this approach the mean particulate PCB concentraion based on all site data (including upstream) is 24.2 ug/L, the 95% UCL is 34.6 ug/L and the 95% UPL is 136 ug/L.

Eric

Eric Blischke

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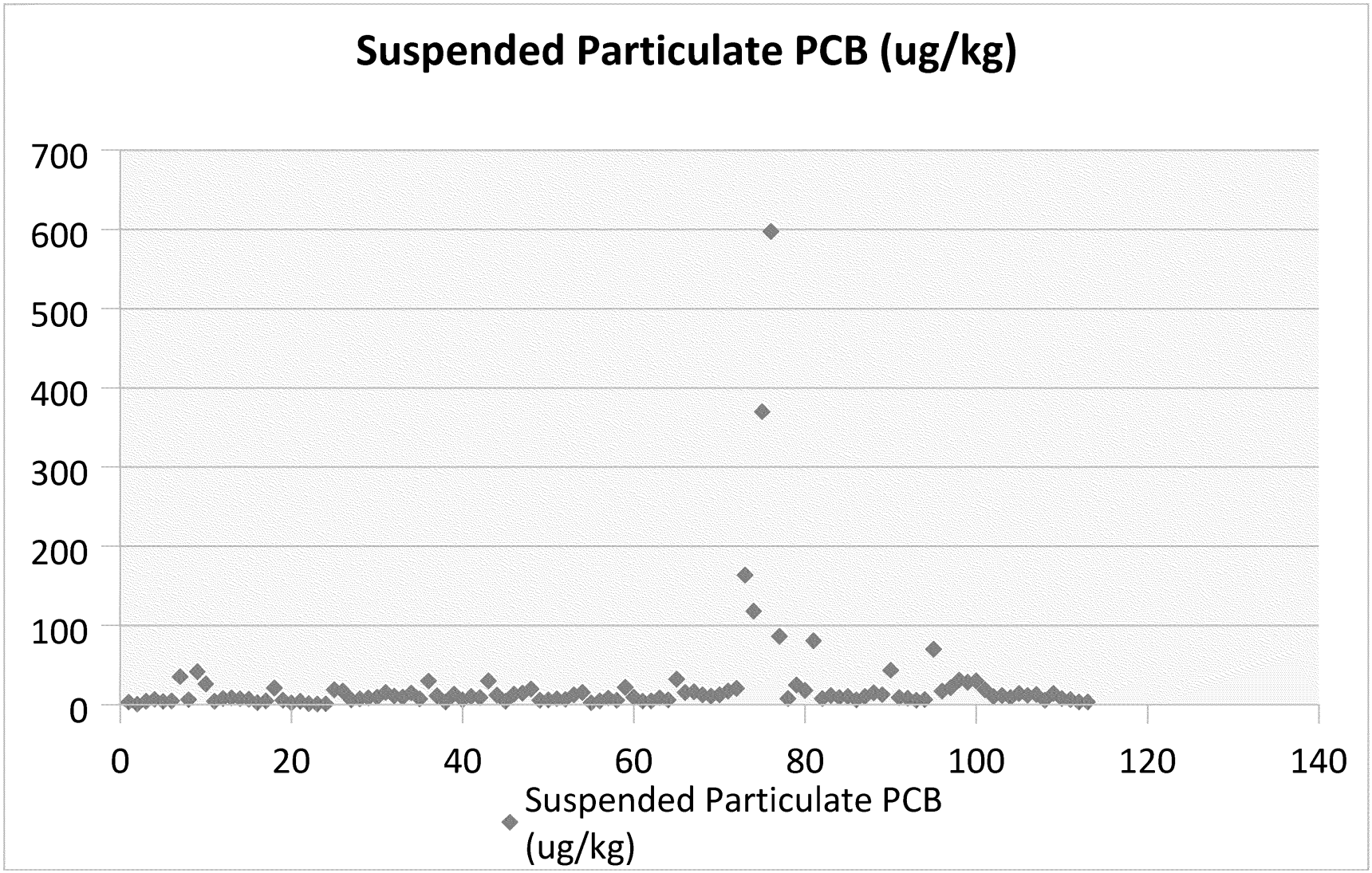
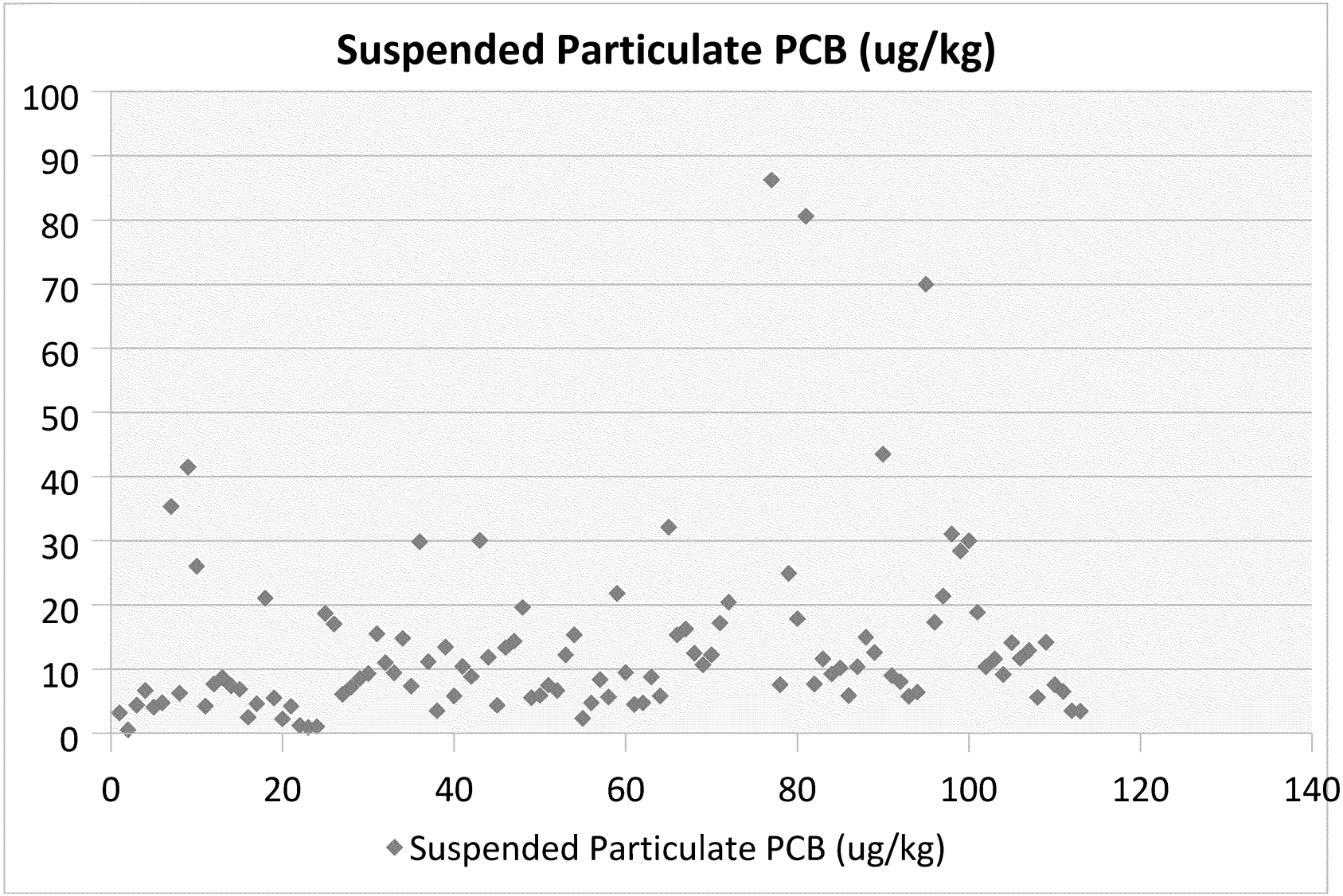

Suspended Particulate PCB (ug/kg)
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120
140
Suspended Particulate PCB (ug/kg)


Suspended Particulate PCB (ug/kg)
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
Suspended Particulate PCB (ug/kg)

Low Flow Condition

Chemical	Koc	TOC	Kd (L/M)	Diss LF (ng/L)	Cs (ug/kg)
Tri PCB	107.17055		0.02962.14341	28.8	0.2
Tetra PCB	328.23472		0.02886.56469	49.9	0.8
Penta PCB	893.19246		0.02697.86385	57.5	1.8
Hexa PCB	282.34724		0.02865.64694	79.1	12.6
Hepta PCB	872.33627		0.02237.44673	53.4	5.4
Total PCB (Low Flow)				268.7	20.8

High Flow Condition

Chemical	Koc	TOC	Kd (L/M)	Diss LF (ng/L)	Cs (ug/kg)
Tri PCB	107.17055		0.02962.14341	15.3	0.1
Tetra PCB	328.23472		0.02886.56469	26.8	0.4
Penta PCB	893.19246		0.02697.86385	26.5	0.8
Hexa PCB	282.34724		0.02865.64694	23.1	3.7
Hepta PCB	872.33627		0.02237.44673	10.6	1.1
Total PCB (High Flow)				102.3	6.1

Chemical	Kdoc	TOC	Kd (L/M)	Diss LF (ng/L)	Cs (ug/kg)
Tri PCB	810.71706		0.02796.21434	28.8	0.0
Tetra PCB	432.82347		0.02588.65647	49.9	0.1
Penta PCB	489.31925		0.02169.78638	57.5	0.2
Hexa PCB	328.23472		0.02886.56469	79.1	1.3
Hepta PCB	187.23363		0.02023.74467	53.4	0.5
Total PCB (Low Flow)				268.7	2.1

Chemical	Koc	TOC	Kd (L/M)	Diss LF (ng/L)	Cs (ug/kg)
Tri PCB	810.71706		0.02796.21434	15.3	0.0
Tetra PCB	432.82347		0.02588.65647	26.8	0.0
Penta PCB	489.31925		0.02169.78638	26.5	0.1
Hexa PCB	328.23472		0.02886.56469	23.1	0.4
Hepta PCB	187.23363		0.02023.74467	10.6	0.1
Total PCB (High Flow)				102.3	0.6

Average TSS (mg/L)	15.96667
Average Particaluate PCB (ug/L)	1.84E-04

Average Suspended Solid	11.52

Maximum PCB

Average TSS (mg/L)	15.96667
Average Particaluate PCB (ug/L)	0.00956
Average Suspended Solid	598.74739

Average Site-Wide PCB

Average TSS (mg/L)	16
Average Particaluate PCB (ug/L)	0.00039
Average Suspended Solid	24.15389

UPL

Average TSS (mg/L)	16
Average Particaluate PCB (ug/L)	0.00217
Average Suspended Solid	135.68766

UCL

Average TSS (mg/L)	16
Average Particaluate PCB (ug/L)	0.00055
Average Suspended Solid	34.64625

LocationID	cationNam	X	Y	Z	RiverMile	Task	JpperDeptl	lowerDeptl	DepthUnit
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS4			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS3			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS2			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS4			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS3			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-57B_WS1			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-57B_WS1			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS3			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS2			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS3			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS2			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS4			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS4			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS1			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS2			

SampleDate	SampleTime	Species	Tissue	SampleID	ParentSamp	SampleType	Method	AnalysisDat	AnalysisTim
02-Mar-07	13:00			LW3-W4023-M2		N	E160.2	07-Mar-07	11:42
02-Nov-06	13:00			LW3-W3023-M		N	E160.2	09-Nov-06	12:00
05-Sep-06	13:41			LW3-W2023-M		N	E160.2	07-Sep-06	00:01
15-Jan-07	13:08			LW3-W4023-M		N	E160.2	22-Jan-07	12:00
02-Nov-06	16:10			LW3-W3023-W		N	E160.2	09-Nov-06	12:00
20-Jan-06	11:35			LW3-W1023-2	LW3-W1023-1	FR	E160.2	27-Jan-06	12:00
20-Jan-06	10:00			LW3-W1023-1		N	E160.2	27-Jan-06	12:00
11-Jul-05	14:10			LW2-W3023		N	E160.2	10-Aug-05	00:30
06-Sep-06	13:36			LW3-W2023-E		N	E160.2	13-Sep-06	16:40
02-Nov-06	18:55			LW3-W3023-E		N	E160.2	09-Nov-06	12:00
06-Sep-06	15:25			LW3-W2023-W		N	E160.2	13-Sep-06	16:40
04-Mar-07	14:00			LW3-W4023-W		N	E160.2	07-Mar-07	11:42
03-Mar-07	11:00			LW3-W4023-E		N	E160.2	07-Mar-07	11:42
15-Nov-04	22:34			LW2-W023		N	E160.2	22-Nov-04	12:00
07-Mar-05	13:16			LW2-W2023		N	E160.2	14-Mar-05	12:00

nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory
Conventionals	TSS	Total suspended solids	NA	Y	18		mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	N	1	U	mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	13		mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	N	1	UJ	mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	54		mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	62	T	mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	17	J	mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	5		mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	4	J	mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	10		mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	20		mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	16		mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	8	T	mg/l	NA	QA2Cat1
Conventionals	TSS	Total suspended solids	NA	Y	6.5	T	mg/l	NA	QA2Cat1

15.96667 1

Notes

LocationID	cationNam	X	Y	Z	RiverMile	Task	JpperDeptl	owerDeptl	DepthUnit
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS3			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS4			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS4			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS2			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS2			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS4			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS1			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS4			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS2			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS3			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS2			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS3			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-57B_WS1			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS3			
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS3			
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS4			
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS3			
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS3			
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS4			
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS4			
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS4			
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS2			

LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS2	
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS2	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS3	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS3	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS4	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS4	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS3	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS3	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS2	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS4	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS4	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS2	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS3	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS3	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS4	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS4	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-48H_WS3	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-48H_WS1	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-48H_WS2	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS1	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS2	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS2	

LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS4	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS3	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS3	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS4	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS4	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS4	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS3	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS3	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS3	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS3	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS4	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS4	
LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS3	
LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS4	
LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS4	
LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS4	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS4	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS2	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS2	

LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-48H_WS2	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-48H_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-48H_WS1	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS4	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS3	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS3	
LW2-W013	W013-1	627111.88	705760.03	-1	6.7	B01-01-48H_WS1	
LW2-W013-2	W013-2	627115.05	705761.09	-1	6.7	B01-01-48H_WS1	
LW2-W013	W013-1	627111.88	705760.03	-1	6.7	B01-01-48H_WS3	
LW2-W013	W013-1	627111.88	705760.03	-1	6.7	B01-01-48H_WS2	
LW2-W013-2	W013-2	627115.05	705761.09	-1	6.7	B01-01-48H_WS2	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS4	
LW2-W015	W015	626447.04	703929.23	2	6.9	B01-01-48H_WS3	
LW2-W015	W015	626447.04	703929.23	2	6.9	B01-01-48H_WS2	
LW2-W015	W015	626447.04	703929.23	2	6.9	B01-01-48H_WS1	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS4	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS4	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	

LW2-W016	W016-1	7627821.5	702551.16	-2	7.2	B01-01-48H_WS1	
LW2-W016	W016-1	7627821.5	702551.16	-2	7.2	B01-01-48H_WS2	
LW2-W016	W016-1	7627821.5	702551.16	-2	7.2	B01-01-48H_WS3	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS3	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS3	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS4	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS4	
LW2-W018	W018	633797.55	700824.33	5	8.3	B01-01-48H_WS2	
LW2-W018	W018	633797.55	700824.33	5	8.3	B01-01-48H_WS1	
LW2-W018	W018	633797.55	700824.33	5	8.3	B01-01-48H_WS3	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS4	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS3	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS4	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS3	
LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS4	
LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS3	
LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS3	
LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS4	
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS4	
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS3	
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS3	
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS4	

LW3-W038	W038	7639448	695056	-39.9		B01-01-57B_WS3	
LW3-W038	W038	7639448	695056	-39.9		B01-01-57B_WS4	
LW3-W038	W038	7639448	695056	-39.9		B01-01-57B_WS3	
LW3-W038	W038	7639448	695056	-39.9		B01-01-57B_WS4	

SampleDate	SampleTime	Species	Tissue	SampleID	ParentSamp	SampleType	Method	AnalysisDat
02-Nov-06	13:18			LW3-W3023-M-F		N	BERA Sum	
15-Jan-07	16:49			LW3-W4023-M-F		N	BERA Sum	
02-Mar-07	17:00			LW3-W4023-M2-F		N	BERA Sum	
05-Sep-06	17:28			LW3-W2023-M-F		N	BERA Sum	
06-Sep-06	18:11			LW3-W2023-W-F		N	BERA Sum	
04-Mar-07	17:00			LW3-W4023-W-F		N	BERA Sum	
17-Nov-04	00:03			LW2-W023 F		N	BERA Sum	
03-Mar-07	15:30			LW3-W4023-E-F		N	BERA Sum	
06-Sep-06	17:21			LW3-W2023-E-F		N	BERA Sum	
02-Nov-06	19:49			LW3-W3023-E-F		N	BERA Sum	
07-Mar-05	13:16			LW2-W2023 F		N	BERA Sum	
02-Nov-06	17:25			LW3-W3023-W-F		N	BERA Sum	
20-Jan-06	17:24			LW3-W1023 F		N	BERA Sum	
12-Jul-05	00:30			LW2-W3023 F		N	BERA Sum	
02-Nov-06	12:38			LW3-W3025-M-F		N	BERA Sum	
09-Mar-07	15:45			LW3-W4025-W-F		N	BERA Sum	
02-Nov-06	17:02			LW3-W3025-W-F		N	BERA Sum	
03-Nov-06	13:15			LW3-W3025-E-F		N	BERA Sum	
08-Mar-07	17:50			LW3-W4025-E-F		N	BERA Sum	
15-Jan-07	13:38			LW3-W4025-M-F		N	BERA Sum	
10-Mar-07	15:53			LW3-W4025-M2-F		N	BERA Sum	
04-Sep-06	19:27			LW3-W2025-M-F		N	BERA Sum	

05-Sep-06	18:01			LW3-W2025-W-F		N	BERA Sum
04-Sep-06	20:00			LW3-W2025-E-F		N	BERA Sum
04-Nov-06	17:09			LW3-W3026-NB-F		N	BERA Sum
04-Nov-06	17:11			LW3-W3026-NS-F		N	BERA Sum
26-Feb-07	14:23			LW3-W4026-NS-F		N	BERA Sum
26-Feb-07	14:30			LW3-W4026-NB-F		N	BERA Sum
04-Nov-06	14:30			LW3-W3027-NS-F		N	BERA Sum
04-Nov-06	14:30			LW3-W3027-NB-F		N	BERA Sum
07-Sep-06	21:04			LW3-W2027-1NS-F		N	BERA Sum
28-Feb-07	13:26			LW3-W4027-NB-F		N	BERA Sum
28-Feb-07	12:44			LW3-W4027-NS-F		N	BERA Sum
07-Sep-06	21:04			LW3-W2027-1NB-F		N	BERA Sum
04-Nov-06	09:29			LW3-W3028-NB-F		N	BERA Sum
04-Nov-06	09:29			LW3-W3028-NS-F		N	BERA Sum
01-Mar-07	17:40			LW3-W4028-NS-F		N	BERA Sum
01-Mar-07	17:40			LW3-W4028-NB-F		N	BERA Sum
13-Jul-05	22:23			LW2-W3005 F		N	BERA Sum
23-Nov-04	06:27			LW2-W005 F		N	BERA Sum
10-Mar-05	12:41			LW2-W2005 F		N	BERA Sum
21-Jan-06	16:40			LW3-W1005 F		N	BERA Sum
08-Sep-06	21:16			LW3-W2005-NB-F		N	BERA Sum
08-Sep-06	21:21			LW3-W2005-NS-F		N	BERA Sum

04-Mar-07	11:23			LW3-W4005-NS-F		N	BERA Sum
04-Nov-06	14:55			LW3-W3005-NS-F		N	BERA Sum
04-Nov-06	14:45			LW3-W3005-NB-F		N	BERA Sum
04-Mar-07	11:26			LW3-W4005-NB-F		N	BERA Sum
05-Mar-07	15:40			LW3-W4029-NS-F		N	BERA Sum
05-Mar-07	15:50			LW3-W4029-NB-F		N	BERA Sum
03-Nov-06	15:10			LW3-W3029-NB-F		N	BERA Sum
03-Nov-06	15:10			LW3-W3029-NS-F		N	BERA Sum
04-Nov-06	17:05			LW3-W3030-NB-F		N	BERA Sum
04-Nov-06	17:05			LW3-W3030-NS-F		N	BERA Sum
01-Mar-07	14:17			LW3-W4030-NS-F		N	BERA Sum
01-Mar-07	12:43			LW3-W4030-NB-F		N	BERA Sum
05-Nov-06	09:15			LW3-W3031-NB-F		N	BERA Sum
24-Feb-07	12:08			LW3-W4031-NS-F		N	BERA Sum
24-Feb-07	12:38			LW3-W4031-NB-F		N	BERA Sum
05-Nov-06	09:15			LW3-W3031-NS-F		N	BERA Sum
02-Mar-07	11:44			LW3-W4011-NS-F		N	BERA Sum
02-Mar-07				LW3-W4011-NB-F		N	BERA Sum
03-Nov-06	10:00			LW3-W3011-NB-F		N	BERA Sum
03-Nov-06	10:00			LW3-W3011-NS-F		N	BERA Sum
12-Sep-06	00:00			LW3-W2011-1NB-F		N	BERA Sum
12-Sep-06	00:00			LW3-W2011-1NS-F		N	BERA Sum

08-Mar-05	22:05			LW2-W2011 F		N	BERA Sum
12-Jul-05	21:41			LW2-W3011 F		N	BERA Sum
18-Nov-04	18:23			LW2-W011 F		N	BERA Sum
21-Feb-07	17:02			LW3-W4032-NB-F		N	BERA Sum
05-Nov-06	10:50			LW3-W3032-NB-F		N	BERA Sum
05-Nov-06	10:50			LW3-W3032-NS-F		N	BERA Sum
09-Nov-04	03:35			LW2-W013-1 F		N	BERA Sum
09-Nov-04	23:06			LW2-W013-2 F	LW2-W013-1 F	FR	BERA Sum
06-Jul-05	21:29			LW2-W3013-1 F		N	BERA Sum
01-Mar-05	11:04			LW2-W2013-1 F		N	BERA Sum
02-Mar-05	10:00			LW2-W2013-2 F	LW2-W2013-1 F	FR	BERA Sum
21-Feb-07	17:02			LW3-W4032-NS-F		N	BERA Sum
19-Jul-05	23:27			LW2-W3015 F		N	BERA Sum
14-Mar-05	09:10			LW2-W2015 F		N	BERA Sum
30-Nov-04	00:05			LW2-W015 F		N	BERA Sum
26-Feb-07	16:43			LW3-W4033-NB-F		N	BERA Sum
03-Nov-06	17:30			LW3-W3033-2-NB-F	LW3-W3033-NB-F	FR	BERA Sum
03-Nov-06	17:30			LW3-W3033-2-NS-F	LW3-W3033-NS-F	FR	BERA Sum
03-Nov-06	14:40			LW3-W3033-NB-F		N	BERA Sum
26-Feb-07	16:27			LW3-W4033-NS-F		N	BERA Sum
03-Nov-06	14:40			LW3-W3033-NS-F		N	BERA Sum

01-Dec-04	01:15			LW2-W016 F		N	BERA Sum
15-Mar-05	09:23			LW2-W2016 F		N	BERA Sum
18-Jul-05	22:54			LW2-W3016 F		N	BERA Sum
04-Nov-06	13:50			LW3-W3034-NB-F		N	BERA Sum
04-Nov-06	13:49			LW3-W3034-NS-F		N	BERA Sum
24-Feb-07	16:35			LW3-W4034-NS-F		N	BERA Sum
24-Feb-07	16:35			LW3-W4034-NB-F		N	BERA Sum
03-Mar-05	08:56			LW2-W2018 F		N	BERA Sum
11-Nov-04	00:04			LW2-W018 F		N	BERA Sum
14-Jul-05	21:52			LW2-W3018 F		N	BERA Sum
25-Feb-07	15:35			LW3-W4035-NS-F		N	BERA Sum
04-Nov-06	11:41			LW3-W3035-NB-F		N	BERA Sum
25-Feb-07	16:05			LW3-W4035-NB-F		N	BERA Sum
04-Nov-06	10:56			LW3-W3035-NS-F		N	BERA Sum
27-Feb-07	13:14			LW3-W4036-NS-F		N	BERA Sum
04-Nov-06	17:26			LW3-W3036-NB-F		N	BERA Sum
04-Nov-06	17:28			LW3-W3036-NS-F		N	BERA Sum
27-Feb-07	13:08			LW3-W4036-NB-F		N	BERA Sum
23-Feb-07	12:30			LW3-W4037-NS-F		N	BERA Sum
05-Nov-06	11:54			LW3-W3037-NB-F		N	BERA Sum
05-Nov-06	11:54			LW3-W3037-NS-F		N	BERA Sum
23-Feb-07	12:32			LW3-W4037-NB-F		N	BERA Sum

05-Nov-06	13:45			LW3-W3038-NS-F		N	BERA Sum
22-Feb-07	16:48			LW3-W4038-NB-F		N	BERA Sum
05-Nov-06	13:57			LW3-W3038-NB-F		N	BERA Sum
22-Feb-07	16:50			LW3-W4038-NS-F		N	BERA Sum

LocationID	cationNam	X	Y	Z	RiverMile	Task	JpperDeptl
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS3	
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS4	
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS3	
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS3	
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS4	
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS4	
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS4	
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS2	
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS2	
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS2	

LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS3
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS3
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS4
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS4

nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00005	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.000009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00011	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00008	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00057	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.0001	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00066	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00042	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00011	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00034	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00002	JT	ug/l

	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00001	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00002	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00030	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00027	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00010	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00025	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00018	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00024	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00048	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00018	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00006	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00022	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00048	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l

	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00021	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00023	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00031	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00011	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00020	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00025	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00008	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00013	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00035	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00008	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00051	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00025	JT	ug/l

	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00026	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.0002	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00020	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00028	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00033	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00262	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00189	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00592	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00956	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00138	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00040	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00029	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00129	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00016	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l

	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00024	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00020	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00070	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00013	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00010	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00112	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00028	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00034	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00050	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00046	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00048	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00030	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00023	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00021	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00023	JT	ug/l

	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00010	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00006	JT	ug/l
	Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00006	JT	ug/l
						1.84E-04		ug/l
						9.56E-03		ug/l
						8.83E-06		ug/l

owerDeptl	DepthUnit	SampleDate	SampleTime	Species	Tissue	SampleID	arentSamp	ampleTyp
		02-Nov-06	12:38			LW3-W3025-M-F		N
		09-Mar-07	15:45			LW3-W4025-W-F		N
		02-Nov-06	17:02			LW3-W3025-W-F		N
		03-Nov-06	13:15			LW3-W3025-E-F		N
		08-Mar-07	17:50			LW3-W4025-E-F		N
		15-Jan-07	13:38			LW3-W4025-M-F		N
		10-Mar-07	15:53			LW3-W4025-M2-F		N
		04-Sep-06	19:27			LW3-W2025-M-F		N
		05-Sep-06	18:01			LW3-W2025-W-F		N
		04-Sep-06	20:00			LW3-W2025-E-F		N

	04-Nov-06	17:09			LW3-W3026-NB-F		N
	04-Nov-06	17:11			LW3-W3026-NS-F		N
	26-Feb-07	14:23			LW3-W4026-NS-F		N
	26-Feb-07	14:30			LW3-W4026-NB-F		N

Basis	DVCategory	Notes
NA	QA2Cat1	
NA	QA2Cat1	
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Method	nalysisDat	nalysisTim	nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00011	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00034	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00002	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00001	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00002	JT

BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00030	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00027	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00010	JT
BERA Sum			Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT
								0.00011	

Units	Basis	QVCategory	Notes
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	

ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	
ug/l	NA	QA2Cat1	

1

LocationID	cationNam	X	Y	Z	RiverMile	Task	JpperDeptl	owerDeptl	DepthUnit
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS3			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS4			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS4			
LW3-W023M	W023M	7642502	690082	-49	10.9	B01-01-57B_WS2			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS2			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS4			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS1			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS4			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS2			
LW3-W023E	W023E	7642849	690351	-26	11	B01-01-57B_WS3			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS2			
LW3-W023W	W023W	7642186	689770	-31	11	B01-01-57B_WS3			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-57B_WS1			
LW2-W023	W023	642505.89	690067.93	-49	11	B01-01-48H_WS3			

LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS3	
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS4	
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS3	
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS3	
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS4	
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS4	
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS4	
LW3-W025M	W025M	7616825	725477	-41	2	B01-01-57B_WS2	
LW3-W025W	W025W	7616252	725869	-15	2	B01-01-57B_WS2	
LW3-W025E	W025E	7617480	725058	-45	2	B01-01-57B_WS2	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS3	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS3	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS4	
LW3-W026	W026	7617306	724354	-32	2.1	B01-01-57B_WS4	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS3	

LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS3	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS2	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS4	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS4	
LW3-W027	W027	7613907	720197	6	2.9	B01-01-57B_WS2	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS3	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS3	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS4	
LW3-W028	W028	7617549	717541	-29	3.6	B01-01-57B_WS4	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-48H_WS3	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-48H_WS1	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-48H_WS2	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS1	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS2	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS2	

LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS4	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS3	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS3	
LW2-W005	W005	617639.07	715650.05	-50	3.9	B01-01-57B_WS4	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS4	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS4	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS3	
LW3-W029	W029	7617938	713075	-11	4.4	B01-01-57B_WS3	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS3	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS3	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS4	
LW3-W030	W030	7621758	709031	-20	5.5	B01-01-57B_WS4	
LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS3	
LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS4	
LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS4	

LW3-W031	W031	7623291	706118	-20	6.1	B01-01-57B_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS4	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS4	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS2	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-57B_WS2	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-48H_WS2	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-48H_WS3	
LW2-W011	W011	624381.08	706235.85	-44	6.3	B01-01-48H_WS1	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS4	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS3	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS3	
LW2-W013	W013-1	627111.88	705760.03	-1	6.7	B01-01-48H_WS1	
LW2-W013-2	W013-2	627115.05	705761.09	-1	6.7	B01-01-48H_WS1	

LW2-W013	W013-1	627111.88	705760.03	-1	6.7	B01-01-48H_WS3	
LW2-W013	W013-1	627111.88	705760.03	-1	6.7	B01-01-48H_WS2	
LW2-W013-2	W013-2	627115.05	705761.09	-1	6.7	B01-01-48H_WS2	
LW3-W032	W032	7627040	705489	-23	6.7	B01-01-57B_WS4	
LW2-W015	W015	626447.04	703929.23	2	6.9	B01-01-48H_WS3	
LW2-W015	W015	626447.04	703929.23	2	6.9	B01-01-48H_WS2	
LW2-W015	W015	626447.04	703929.23	2	6.9	B01-01-48H_WS1	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS4	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS4	
LW3-W033	W033	7627079	703373	-8	7.0	B01-01-57B_WS3	
LW2-W016	W016-1	7627821.5	702551.16	-2	7.2	B01-01-48H_WS1	
LW2-W016	W016-1	7627821.5	702551.16	-2	7.2	B01-01-48H_WS2	

LW2-W016	W016-1	7627821.5	702551.16	-2	7.2	B01-01-48H_WS3	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS3	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS3	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS4	
LW3-W034	W034	7628583	701770	-19	7.5	B01-01-57B_WS4	
LW2-W018	W018	633797.55	700824.33	5	8.3	B01-01-48H_WS2	
LW2-W018	W018	633797.55	700824.33	5	8.3	B01-01-48H_WS1	
LW2-W018	W018	633797.55	700824.33	5	8.3	B01-01-48H_WS3	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS4	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS3	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS4	
LW3-W035	W035	7634935	700291	-26	8.5	B01-01-57B_WS3	
LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS4	
LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS3	
LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS3	

LW3-W036	W036	7632756	697294	-14	8.6	B01-01-57B_WS4		
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS4		
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS3		
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS3		
LW3-W037	W037	7637164	694714	-13	9.6	B01-01-57B_WS4		
LW3-W038	W038	7639448	695056	-3	9.9	B01-01-57B_WS3		
LW3-W038	W038	7639448	695056	-3	9.9	B01-01-57B_WS4		
LW3-W038	W038	7639448	695056	-3	9.9	B01-01-57B_WS3		
LW3-W038	W038	7639448	695056	-3	9.9	B01-01-57B_WS4		

ampleDate	ampleTime	Species	Tissue	SampleID	arentSamp	ampleType	Method	nalysisDat	nalysisTim
02-Nov-06	13:18			LW3-W3023-M-F		N	BERA Sum		
15-Jan-07	16:49			LW3-W4023-M-F		N	BERA Sum		
02-Mar-07	17:00			LW3-W4023-M2-F		N	BERA Sum		
05-Sep-06	17:28			LW3-W2023-M-F		N	BERA Sum		
06-Sep-06	18:11			LW3-W2023-W-F		N	BERA Sum		
04-Mar-07	17:00			LW3-W4023-W-F		N	BERA Sum		
17-Nov-04	00:03			LW2-W023 F		N	BERA Sum		
03-Mar-07	15:30			LW3-W4023-E-F		N	BERA Sum		
06-Sep-06	17:21			LW3-W2023-E-F		N	BERA Sum		
02-Nov-06	19:49			LW3-W3023-E-F		N	BERA Sum		
07-Mar-05	13:16			LW2-W2023 F		N	BERA Sum		
02-Nov-06	17:25			LW3-W3023-W-F		N	BERA Sum		
20-Jan-06	17:24			LW3-W1023 F		N	BERA Sum		
12-Jul-05	00:30			LW2-W3023 F		N	BERA Sum		

02-Nov-06	12:38			LW3-W3025-M-F		N	BERA Sum	
09-Mar-07	15:45			LW3-W4025-W-F		N	BERA Sum	
02-Nov-06	17:02			LW3-W3025-W-F		N	BERA Sum	
03-Nov-06	13:15			LW3-W3025-E-F		N	BERA Sum	
08-Mar-07	17:50			LW3-W4025-E-F		N	BERA Sum	
15-Jan-07	13:38			LW3-W4025-M-F		N	BERA Sum	
10-Mar-07	15:53			LW3-W4025-M2-F		N	BERA Sum	
04-Sep-06	19:27			LW3-W2025-M-F		N	BERA Sum	
05-Sep-06	18:01			LW3-W2025-W-F		N	BERA Sum	
04-Sep-06	20:00			LW3-W2025-E-F		N	BERA Sum	
04-Nov-06	17:09			LW3-W3026-NB-F		N	BERA Sum	
04-Nov-06	17:11			LW3-W3026-NS-F		N	BERA Sum	
26-Feb-07	14:23			LW3-W4026-NS-F		N	BERA Sum	
26-Feb-07	14:30			LW3-W4026-NB-F		N	BERA Sum	
04-Nov-06	14:30			LW3-W3027-NS-F		N	BERA Sum	

04-Nov-06	14:30			LW3-W3027-NB-F		N	BERA Sum	
07-Sep-06	21:04			LW3-W2027-1NS-F		N	BERA Sum	
28-Feb-07	13:26			LW3-W4027-NB-F		N	BERA Sum	
28-Feb-07	12:44			LW3-W4027-NS-F		N	BERA Sum	
07-Sep-06	21:04			LW3-W2027-1NB-F		N	BERA Sum	
04-Nov-06	09:29			LW3-W3028-NB-F		N	BERA Sum	
04-Nov-06	09:29			LW3-W3028-NS-F		N	BERA Sum	
01-Mar-07	17:40			LW3-W4028-NS-F		N	BERA Sum	
01-Mar-07	17:40			LW3-W4028-NB-F		N	BERA Sum	
13-Jul-05	22:23			LW2-W3005 F		N	BERA Sum	
23-Nov-04	06:27			LW2-W005 F		N	BERA Sum	
10-Mar-05	12:41			LW2-W2005 F		N	BERA Sum	
21-Jan-06	16:40			LW3-W1005 F		N	BERA Sum	
08-Sep-06	21:16			LW3-W2005-NB-F		N	BERA Sum	
08-Sep-06	21:21			LW3-W2005-NS-F		N	BERA Sum	

04-Mar-07	11:23			LW3-W4005-NS-F		N	BERA Sum	
04-Nov-06	14:55			LW3-W3005-NS-F		N	BERA Sum	
04-Nov-06	14:45			LW3-W3005-NB-F		N	BERA Sum	
04-Mar-07	11:26			LW3-W4005-NB-F		N	BERA Sum	
05-Mar-07	15:40			LW3-W4029-NS-F		N	BERA Sum	
05-Mar-07	15:50			LW3-W4029-NB-F		N	BERA Sum	
03-Nov-06	15:10			LW3-W3029-NB-F		N	BERA Sum	
03-Nov-06	15:10			LW3-W3029-NS-F		N	BERA Sum	
04-Nov-06	17:05			LW3-W3030-NB-F		N	BERA Sum	
04-Nov-06	17:05			LW3-W3030-NS-F		N	BERA Sum	
01-Mar-07	14:17			LW3-W4030-NS-F		N	BERA Sum	
01-Mar-07	12:43			LW3-W4030-NB-F		N	BERA Sum	
05-Nov-06	09:15			LW3-W3031-NB-F		N	BERA Sum	
24-Feb-07	12:08			LW3-W4031-NS-F		N	BERA Sum	
24-Feb-07	12:38			LW3-W4031-NB-F		N	BERA Sum	

05-Nov-06	09:15			LW3-W3031-NS-F		N	BERA Sum	
02-Mar-07	11:44			LW3-W4011-NS-F		N	BERA Sum	
02-Mar-07				LW3-W4011-NB-F		N	BERA Sum	
03-Nov-06	10:00			LW3-W3011-NB-F		N	BERA Sum	
03-Nov-06	10:00			LW3-W3011-NS-F		N	BERA Sum	
12-Sep-06	00:00			LW3-W2011-1NB-F		N	BERA Sum	
12-Sep-06	00:00			LW3-W2011-1NS-F		N	BERA Sum	
08-Mar-05	22:05			LW2-W2011 F		N	BERA Sum	
12-Jul-05	21:41			LW2-W3011 F		N	BERA Sum	
18-Nov-04	18:23			LW2-W011 F		N	BERA Sum	
21-Feb-07	17:02			LW3-W4032-NB-F		N	BERA Sum	
05-Nov-06	10:50			LW3-W3032-NB-F		N	BERA Sum	
05-Nov-06	10:50			LW3-W3032-NS-F		N	BERA Sum	
09-Nov-04	03:35			LW2-W013-1 F		N	BERA Sum	
09-Nov-04	23:06			LW2-W013-2 F	LW2-W013-1 F	FR	BERA Sum	

06-Jul-05	21:29			LW2-W3013-1 F		N	BERA Sum		
01-Mar-05	11:04			LW2-W2013-1 F		N	BERA Sum		
02-Mar-05	10:00			LW2-W2013-2 F	LW2-W2013-1 F	FR	BERA Sum		
21-Feb-07	17:02			LW3-W4032-NS-F		N	BERA Sum		
19-Jul-05	23:27			LW2-W3015 F		N	BERA Sum		
14-Mar-05	09:10			LW2-W2015 F		N	BERA Sum		
30-Nov-04	00:05			LW2-W015 F		N	BERA Sum		
26-Feb-07	16:43			LW3-W4033-NB-F		N	BERA Sum		
03-Nov-06	17:30			LW3-W3033-2-NB-F	LW3-W3033-NB-F	FR	BERA Sum		
03-Nov-06	17:30			LW3-W3033-2-NS-F	LW3-W3033-NS-F	FR	BERA Sum		
03-Nov-06	14:40			LW3-W3033-NB-F		N	BERA Sum		
26-Feb-07	16:27			LW3-W4033-NS-F		N	BERA Sum		
03-Nov-06	14:40			LW3-W3033-NS-F		N	BERA Sum		
01-Dec-04	01:15			LW2-W016 F		N	BERA Sum		
15-Mar-05	09:23			LW2-W2016 F		N	BERA Sum		

18-Jul-05	22:54			LW2-W3016 F		N	BERA Sum	
04-Nov-06	13:50			LW3-W3034-NB-F		N	BERA Sum	
04-Nov-06	13:49			LW3-W3034-NS-F		N	BERA Sum	
24-Feb-07	16:35			LW3-W4034-NS-F		N	BERA Sum	
24-Feb-07	16:35			LW3-W4034-NB-F		N	BERA Sum	
03-Mar-05	08:56			LW2-W2018 F		N	BERA Sum	
11-Nov-04	00:04			LW2-W018 F		N	BERA Sum	
14-Jul-05	21:52			LW2-W3018 F		N	BERA Sum	
25-Feb-07	15:35			LW3-W4035-NS-F		N	BERA Sum	
04-Nov-06	11:41			LW3-W3035-NB-F		N	BERA Sum	
25-Feb-07	16:05			LW3-W4035-NB-F		N	BERA Sum	
04-Nov-06	10:56			LW3-W3035-NS-F		N	BERA Sum	
27-Feb-07	13:14			LW3-W4036-NS-F		N	BERA Sum	
04-Nov-06	17:26			LW3-W3036-NB-F		N	BERA Sum	
04-Nov-06	17:28			LW3-W3036-NS-F		N	BERA Sum	

27-Feb-07	13:08			LW3-W4036-NB-F		N	BERA Sum		
23-Feb-07	12:30			LW3-W4037-NS-F		N	BERA Sum		
05-Nov-06	11:54			LW3-W3037-NB-F		N	BERA Sum		
05-Nov-06	11:54			LW3-W3037-NS-F		N	BERA Sum		
23-Feb-07	12:32			LW3-W4037-NB-F		N	BERA Sum		
05-Nov-06	13:45			LW3-W3038-NS-F		N	BERA Sum		
22-Feb-07	16:48			LW3-W4038-NB-F		N	BERA Sum		
05-Nov-06	13:57			LW3-W3038-NB-F		N	BERA Sum		
22-Feb-07	16:50			LW3-W4038-NS-F		N	BERA Sum		

nalyteGrou	cas_rn	Analyte	l_or_disso	detect_flag	VALUE	Qualifiers	Units	Basis	DVCategory
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00005	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.000009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00011	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00008	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00057	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.0001	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00066	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00042	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1

Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00011	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00034	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00002	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00001	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00002	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00030	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00027	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00010	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l	NA	QA2Cat1

Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00025	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00018	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00024	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00048	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00018	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00006	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00022	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00048	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l	NA	QA2Cat1

Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00021	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00023	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00031	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00011	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00020	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00025	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00004	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00008	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00013	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00035	JT	ug/l	NA	QA2Cat1

Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00007	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00008	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00051	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00025	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00026	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.0002	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00020	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00028	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00033	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00262	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00189	JT	ug/l	NA	QA2Cat1

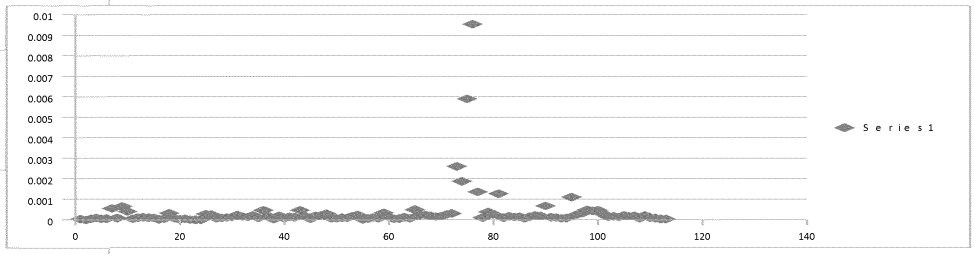
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00592	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00956	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00138	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00040	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00029	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00129	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00016	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00024	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00020	JT	ug/l	NA	QA2Cat1

Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00070	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00014	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00013	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00010	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00112	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00028	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00034	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00050	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00046	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00048	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00030	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00017	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00015	JT	ug/l	NA	QA2Cat1

Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00023	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00019	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00021	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00009	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00023	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00012	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00010	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00006	JT	ug/l	NA	QA2Cat1
Aroclors	Total PCBs (calc'd)	Total PCBs (calc'd)	NA	Y	0.00006	JT	ug/l	NA	QA2Cat1

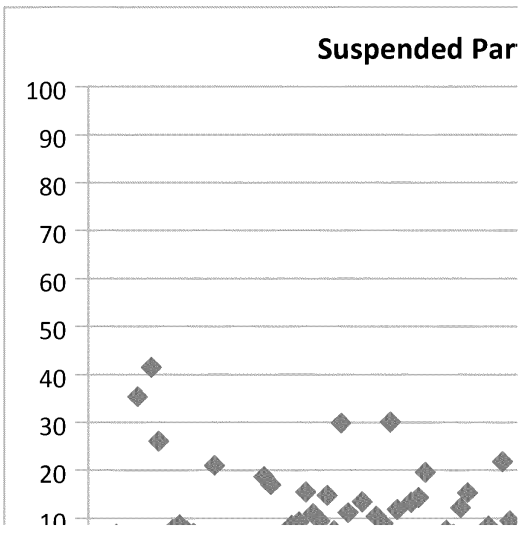
Mean	0.00039	1
Max	0.00956	
Std Dev	0.00108	
UPL	0.00217	
UCL	0.00055	

Notes

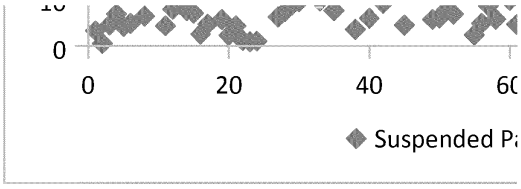

0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0
20
40
60
80
100
120
140
Series1

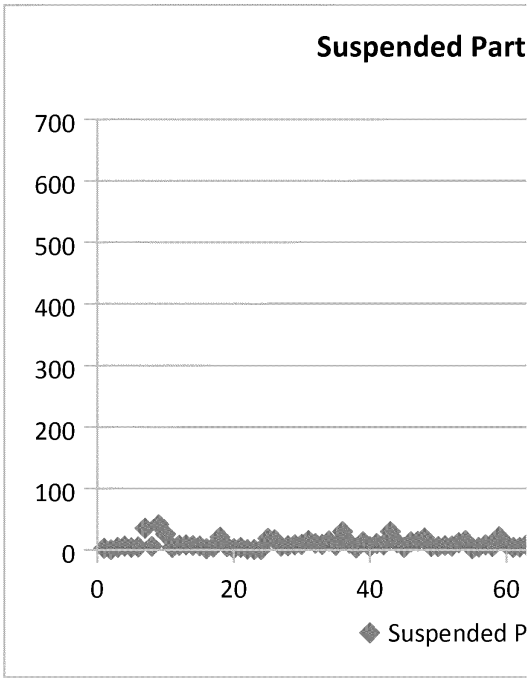
PCB Particulate (ug/L)	TSS (mg/L)	Suspended Particulate PCB (ug/kg)
0.00005	16	3.18125
0.000009	16	0.55188
0.00007	16	4.4
0.00011	16	6.6875
0.00007	16	4.075
0.00008	16	4.76875
0.00057	16	35.375
0.0001	16	6.25
0.00066	16	41.5
0.00042	16	26.0625
0.00007	16	4.25
0.00012	16	7.6875
0.00014	16	8.6875
0.00012	16	7.4375
0.00011	16	6.875
0.00004	16	2.525
0.00007	16	4.60625
0.00034	16	21.0625
0.00009	16	5.525
0.00004	16	2.25
0.00007	16	4.225
0.00002	16	1.21875
0.00001	16	0.925
0.00002	16	1.04375
0.00030	16	18.6875
0.00027	16	17.0625
0.00010	16	6.10625
0.00012	16	7.1875
0.00014	16	8.5625
0.00015	16	9.3125
0.00025	16	15.5
0.00018	16	11
0.00015	16	9.4375
0.00024	16	14.8125
0.00012	16	7.375
0.00048	16	29.875
0.00018	16	11.1875
0.00006	16	3.53125
0.00022	16	13.4375
0.00009	16	5.825
0.00017	16	10.4375
0.00014	16	8.875
0.00048	16	30.0625
0.00019	16	11.875

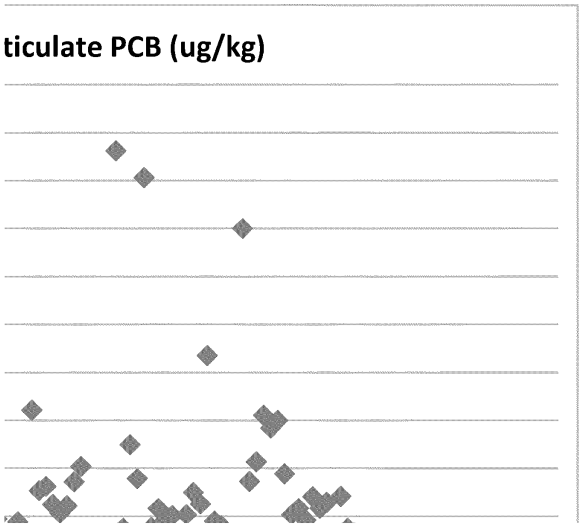
0.00007	16	4.38125
0.00021	16	13.375
0.00023	16	14.375
0.00031	16	19.625
0.00009	16	5.56875
0.00009	16	5.90625
0.00012	16	7.5
0.00011	16	6.6875
0.00020	16	12.25
0.00025	16	15.375
0.00004	16	2.34375
0.00008	16	4.7625
0.00013	16	8.375
0.00009	16	5.66875
0.00035	16	21.8125
0.00015	16	9.5
0.00007	16	4.50625
0.00008	16	4.7625
0.00014	16	8.8125
0.00009	16	5.83125
0.00051	16	32.125
0.00025	16	15.375
0.00026	16	16.25
0.0002	16	12.5
0.00017	16	10.6875
0.00020	16	12.25
0.00028	16	17.1875
0.00033	16	20.4375
0.00262	16	163.75
0.00189	16	118.125
0.00592	16	370
0.00956	16	597.5
0.00138	16	86.25
0.00012	16	7.5625
0.00040	16	24.9375
0.00029	16	17.875
0.00129	16	80.625
0.00012	16	7.6875
0.00019	16	11.625
0.00015	16	9.25
0.00016	16	10.1875
0.00009	16	5.875
0.00017	16	10.375
0.00024	16	15
0.00020	16	12.625



0.00070	16	43.5
0.00014	16	9
0.00013	16	8.0625
0.00009	16	5.7625
0.00010	16	6.4375
0.00112	16	70
0.00028	16	17.3125
0.00034	16	21.375
0.00050	16	31.0625
0.00046	16	28.4375
0.00048	16	30
0.00030	16	18.875
0.00017	16	10.375
0.00019	16	11.625
0.00015	16	9.1875
0.00023	16	14.125
0.00019	16	11.6875
0.00021	16	12.9375
0.00009	16	5.6
0.00023	16	14.1875
0.00012	16	7.5625
0.00010	16	6.5
0.00006	16	3.525
0.00006	16	3.45



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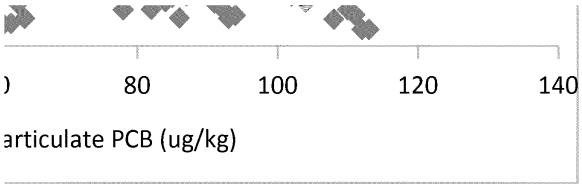
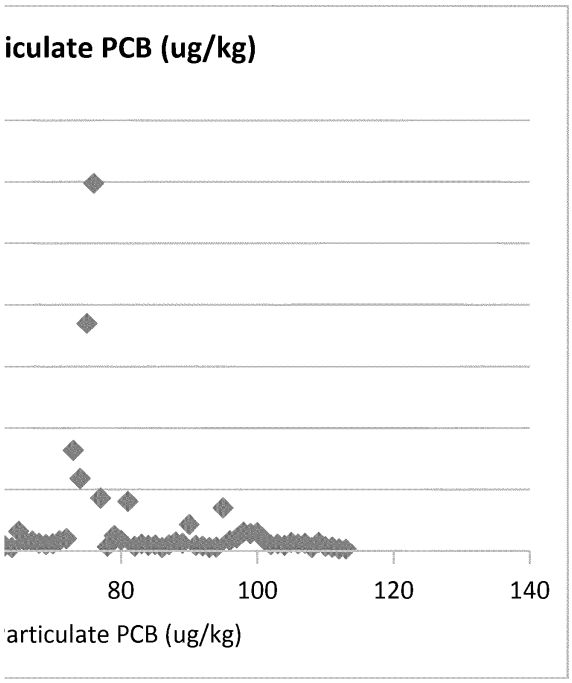

80
100
120
140
articulate PCB (ug/kg)


iculate PCB (ug/kg)
80
100
120
140
articulate PCB (ug/kg)

2.2.2.2 Sediment Bed Mass Balance

The equation describing the conservation of mass within the sediment bed, which is solved only in the vertical dimension, is similar to that used to describe contaminant fate and transport in a groundwater system (e.g., Domenico and Schwartz 1990), except that additional terms are included to represent bioturbation and exchange with the water column (e.g., Boudreau 1997); it is given by:

$$\frac{\partial}{\partial t}(c_d + c_{doc}) = \frac{\partial}{\partial z}\left[\left(E_z + D_z\right)\frac{\partial}{\partial z}(c_d + c_{doc})\right] - \frac{\partial}{\partial z}(u_z c_d) \pm \frac{c_{doc}}{h_{bed}} \pm S_{bed} \qquad (2.)$$

where:

z	=	coordinate direction – i.e., vertical distance within sediment bed [L]
E_z	=	vertical dispersion coefficient [L^2/T]
D_z	=	effective vertical porewater diffusion coefficient [L^2/T]
c_d	=	freely dissolved phase concentration of contaminant [M/L^3]
c_{doc}	=	DOC-sorbed phase concentration of contaminant [M/L^3]
u_z	=	vertical advective velocity in porewater [L/T]
h_{bed}	=	depth of the surface sediment layer within the modeled bed [L]
S_{bed}	=	source/sink terms resulting from kinetic reactions in the bed [$M/(L^3T)$]

The first three terms in the above equation represent transport processes within the sediment bed, which are discussed in Section 2.2.2.4.2. The fourth term represents the exchanges between the water column and sediment bed, which is described in Section 2.2.2.5. The final term in the above equation represents kinetic reactions within the bed and is discussed in Section 2.2.2.6.2.

2.2.2.3 Partitioning

The fate model uses partitioning relationships to calculate the concentrations of contaminant in three separate phases (particulate phase, freely dissolved phase, and DOC-bound phase[3]) that together comprise the total concentration referenced in the above mass balance equations:

$$c = c_d + c_{doc} + c_p \qquad (3.)$$

where:

[3] It should be noted that in certain cases (e.g., for metals and less hydrophobic organics) the DOC-bound phase may not be represented in the model.

c_p = concentration of contaminant sorbed to particulate matter, expressed on a volumetric basis [M/L^3]

Some terms in the model express the particulate-phase concentration on a mass of contaminant per mass of dry solids basis rather than on a volumetric basis; this is accomplished by:

$$r = \frac{c_p}{m_s} \quad (4.)$$

where:

r = concentration of contaminant sorbed to particulate matter, expressed on a mass per unit mass basis [M/M]

m_s = concentration of solids [M/L^3], which is equal to the suspended solids concentration in the water column and the dry bulk density in the sediment bed

As discussed in Appendix La, the sediment transport model simulates solids in multiple classes to represent differences in the transport characteristics of fine (i.e., silts and clays) versus coarse (i.e., sands and gravels) sediments. Therefore, the fate model's partitioning formulations compute contaminant concentrations separately for each of these classes of solids based on the above equations (i.e., using the individual concentrations of solids for each solids class computed by the sediment transport model).

It is often useful to express the individual phase concentrations in terms of their respective fractions of the total:

$$f_p = \frac{c_p}{c_T}; \quad f_d = \frac{c_d}{c_T}; \quad f_{doc} = \frac{c_{doc}}{c_T} \quad (5.)$$

where:

f_p, f_d, f_{doc} = fraction in the particulate, freely dissolved, and DOC-bound phases, respectively

The fate model uses the principles of linear equilibrium sorption to represent the relationships between the various phases. For the particulate phase, equilibrium sorption is represented by (e.g., Karickhoff 1984; Chapra 1997):

$$r = K_{oc} f_{oc} c_d \quad (6.)$$

where:

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K_d = the distribution or partition coefficient of the contaminant [L^3/M]

For hydrophobic organic contaminants, sorption is usually controlled by the organic carbon content of the solids and the contaminant's organic carbon partition coefficient (e.g., Karickhoff 1984; Chapra 1997):

$$\square = \square \qquad (7.)$$

where:

f_{oc} = the fraction of organic carbon of the suspended solids or sediment
K_{oc} = organic carbon partition coefficient of the contaminant [L^3/M]

Similar to particulate organic carbon, partitioning to DOC is described by the contaminant's partition coefficient between the DOC-bound and freely dissolved phases:

$$\square = \square / \square \qquad (8.)$$

where:

K_{doc} = contaminant's DOC partition coefficient [L^3/M]
m_{doc} = concentration of DOC in the water column or porewater [M/L^3]

Using the above equations, the equations representing the fractions in the particulate, dissolved, and DOC-bound phases are as follows:

$$\square = \square + \square + \square \qquad (9.)$$

$$\square = \square + \square + \square \qquad (10.)$$

$$\square = \square + \square + \square \qquad (11.)$$

where:

ϕ = volume fraction of water (=1 for water column and = porosity within the sediment bed)

When the sediment transport model simulates multiple classes of solids, as is the case for the Portland Harbor HST model (see Appendix La), the K_d and m_s terms in Equations 9 through 11 are repeated for each class of solids because these terms can vary by class (due to differing solids concentration and/or differing partition coefficient due to differences in organic carbon content as per Equation 7). For example, the fraction of contaminant in the particulate phase of a given solids class is represented by:

$$\text{[illegible]} \tag{12.}$$

where:

i	=	index referring to an individual class of solids simulated by the sediment transport model
n	=	total number of solids classes simulated by the sediment transport model

The contaminant mass calculated for each individual solids class is also summed in the model to allow for aggregation into the total particulate-phase concentration.

2.2.2.4 Mass Transport Processes

The terms in the general mass balance equations that describe the movement or transport of contaminants within the water column and within the sediment bed (i.e., Equations 1 and 2, respectively) are discussed in the following two subsections.

2.2.2.4.1 Water Column

The first two terms in the water column mass balance (Equation 1) represent transport by longitudinal and lateral dispersion in the water column, respectively, which results from turbulent mixing processes. The second two terms in Equation 1 represent transport by advection, or movement of the contaminants with flow of water. In the model, the dispersion coefficients and current velocities that describe these processes are predicted by the hydrodynamic model, which is discussed in Appendix La.

2.2.2.4.2 Sediment Bed

The first term in the sediment bed mass balance equation (Equation 2) represents mixing by bioturbation, which is based on the typical approach of representing it as a vertical dispersion process (e.g., Boudreau 1997; Lampert and Reible 2009). This mixing is applied to all phases of contaminant in the model, although for sorptive compounds, the particulate-phase dispersive flux accounts for the vast majority of the mass transport associated with this process. Bioturbation is usually specified in the model to occur over the upper layers of the simulated sediment bed, which are the layers that correspond to the "active layer" or the depth of biological mixing at a site. This process can also be used to represent other non-biological mixing processes that occur at some sites, as long as they can be represented as a dispersion process.

To: Humphrey, Chip[Humphrey.Chip@epa.gov]
Cc: Gustavson, Karl[Gustavson.Karl@epa.gov]
From: King, Todd W.
Sent: Wed 11/20/2013 3:15:13 PM
Subject: FW: model agreement
SedTransModel-agreement-disagreement.pdf

Another item for our LWG "wish list"

From: Gustavson, Karl [mailto:Gustavson.Karl@epa.gov]
Sent: Thursday, November 07, 2013 2:46 PM
To: King, Todd W.; Hayter, Earl J ERDC-RDE-EL-MS
Cc: Humphrey, Chip; Koch, Kristine
Subject: model agreement

It would be useful to get this layer to superimpose on our "cookies".

****

Karl Gustavson, Ph.D.

Army Engineer Research and Development Center (ERDC)

Duty Station:

EPA Office of Superfund Remediation and Technology Innovation (OSRTI)

2777 S. Crystal Drive

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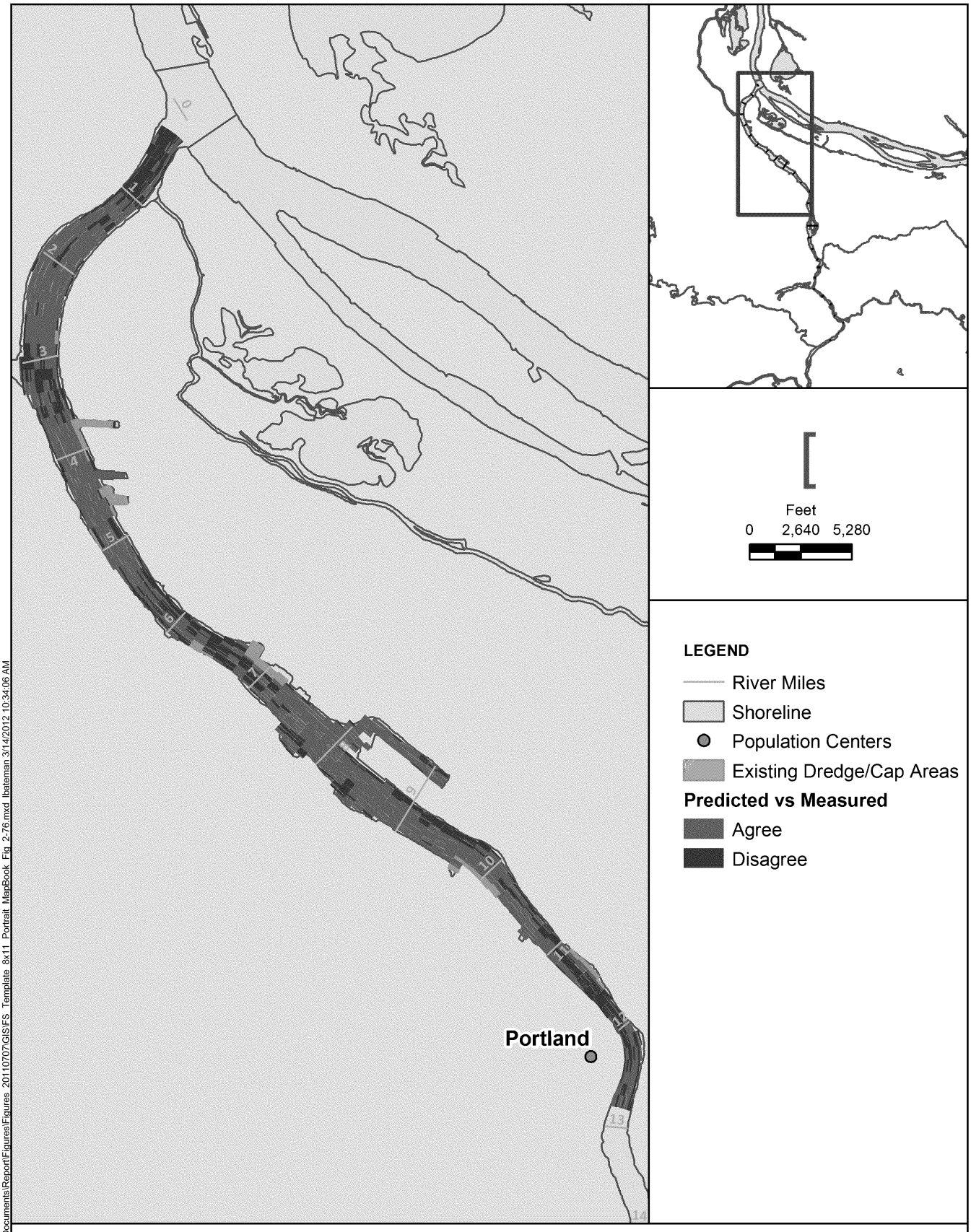

\\montvale\u\Jobs26a\Jobs\LWG\Documents\Report\Figures\Figures_20110707\GIS\FS_Template_8x11_Portrait_MapBook_Fig_2-76.mxd lbateman 3/14/2012 10:34:06 AM

ANCHOR QEA

LWG LOWER WILLAMETTE GROUP

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Figure 2-76
Portland Harbor RI/FS
Draft Feasibility Study
Spatial Comparison of Predicted and Measured Bed Elevation Change

To: Gustavson, Karl[Gustavson.Karl@epa.gov]
From: Penoyar, Susan
Sent: Fri 11/15/2013 9:21:37 PM
Subject: RE: Draft, Deliberative, Confidential: technology assignment
PH_TWS_2_07-31-13 Criteria slides.pptx

Hi Karl – I am attaching a trimmed version of the PowerPoint we presented in July which includes listing of the criteria. Let me know if this is good for what you are looking for; otherwise I'll keep looking. Have a good weekend!

- Susan

From: Gustavson, Karl [mailto:Gustavson.Karl@epa.gov]
Sent: Friday, November 15, 2013 1:03 PM
To: King, Todd W.; Blischke, Eric
Cc: Penoyar, Susan; Humphrey, Chip; Koch, Kristine
Subject: Draft, Deliberative, Confidential: technology assignment

We chatted about objectives of the meeting next week, including developing a structure for deriving an EPA preferred alternative.

As we've discussed each RAL/alternative really has two components:

1) Where will you do stuff? This is addressed through the cookie pan/cookie analysis

2) What will you do?

I've attached a short discussion document with a structure to address #2. It builds off the technology matrix done by Eric and others. This will be challenging to build out, but I believe, worthwhile. Let's see what this comes up with and whether we prefer it to sets of EPA-Removal and EPA-capping based alternatives for the B-G rals. The primary advantage is that it gives 6 alternatives ("B-G optimized"), compared to 12 ("B-G Removal" and "B-G Capping"). Obviously, it's just draft, intended to be built upon and modified.

If this is successful, we can then compare the B-G Optimized to LWGs preferred alts of Bi and

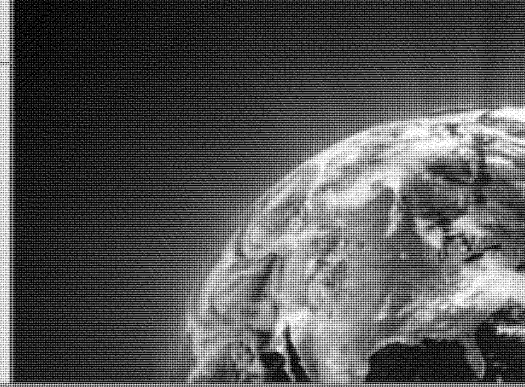
Ci using a RAL SWAC curve for each of the DMUs. A preferred remedy can be selected for each DMU that achieves an acceptable balance of t=0 SWAC concentration and acres remediated.

Cheers,

Karl

Portland Harbor Feasibility Study
Technical Work Session 2

Technology Screening and Alternative Development



Feasibility Study Team

July 31, 2013

CDM Smith

Criteria to be used in technology screening Mapping

- Principal Threat Waste
- Sediment deposition rate and grain size
- Navigation channel and future maintenance dredge areas
- Nearshore areas subject to wind and wake waves
- Surface to subsurface sediment concentration ratios
- Presence of structures
- Sediment bed slope
- Groundwater flux rate
- In-situ treatment concentration threshold (10X PRG)
- Presence of debris and bedrock
- Sediment strength
- Current and water depth
- Habitat areas

Principal Threat Waste and Hot Spots of Contamination

- NCP expectation to treat PTW to the extent practicable
- Multiple lines of evidence used to identify PTW
  - Direct observance of NAPL in sediment
    - Observed in sediment cores at GASCO and Arkema
  - Sediment concentrations greater than estimated solubility limits
    - GASCO, Arkema, RM 5.2 navigation channel, Terminal 4
  - Evaluation of whether contamination can be reliably contained
    - FS level evaluation required
- PTW present in sediments offshore of the GASCO and Arkema
- Hot Spots of Contamination
  - Current ODEQ position is that most of the site exceeds high concentration hot spot criteria for PCBs (1.2 ug/kg)
  - Evaluate reliably containable in FS

Technology Discussion

- Representative process options identified (Table 1)
- MNR and EMNR
- Containment
  - Conventional and reactive capping
- In-situ treatment
  - Carbon amendments (GAC and organophilic clay)
- Removal
  - Mechanical, hydraulic and nearshore excavation
- Disposal
  - Upland landfill, nearshore CDF and in-water CAD
- Ex-Situ Treatment
  - As necessary to meet disposal requirements (doesn't apply to mapping)

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Technology Evaluation Criteria – MNR

- Principal threat waste (NAPL)
  - Presence of NAPL excludes MNR
- Sediment deposition rate
  - >2.5 cm/year sediment deposition rate
- Sediment grain size
  - 50% fines (silts and clays; 63 micron or less)
- Surface to subsurface sediment concentration ratio
  - Subsurface sediment > surface sediment
- Future maintenance dredge area
  - Must be outside future maintenance dredge areas for MNR
- Wind and vessel generated wave areas
  - Near shore areas (-0.5’ to 14.8’ CRD, 4.5’ to 20’ NAVD88) – exclude for MNR

Technology Evaluation Criteria– EMNR

- Principal threat waste (NAPL)
  - Presence of NAPL excludes EMNR
- Sediment deposition rate
  - +/- 2.5 cm/year sediment deposition rate
- Sediment grain size
  - 40% fines (silts and clays; 63 micron or less) -
- Surface to subsurface sediment concentration ratio
  - Subsurface sediment > surface sediment
- Future maintenance dredge area
  - Must be outside future maintenance dredge areas or have possibility of Institutional Control
- Wind and vessel generated wave areas
  - Near shore areas (-0.5’ to 14.8’ CRD)

Technology Evaluation Criteria– In-Situ Treatment

- Sediment Concentration Threshold
  - Must be less than 10X PRG based on 90% effectiveness rate (organics with activated carbon)
- Sediment deposition rate
  - +/-2.5 cm/year sediment deposition rate
- Sediment grain size
  - 40% fines (silts and clays; 63 micron or less)
- Surface to subsurface sediment concentration ratio
  - Subsurface sediment > surface sediment
- Future maintenance dredge area
  - Must be outside future maintenance dredge areas or have possibility of institutional controls
- Wind and vessel generated wave areas
  - Near shore areas (-0.5’ to 14.8’ CRD)

Technology Evaluation Criteria – Capping

- Principal threat waste (NAPL or substantial product)
  - Presence of NAPL requires source control and organoclay mats
- Sediment bed strength
  - Soft sediments may require special considerations
- Groundwater flux rate
  - Caps on west side of river require GAC layer due to high groundwater flux rates
- Wind and vessel generated wave areas
  - Near shore areas (-0.5’ to 14.8’ CRD) require armoring
- Structures
  - Presence of structures may increase cost of capping

Technology Evaluation Criteria – Capping (continued)

- Debris and Pilings
  - May require complete removal or at mudline
- Current induced erosion potential
  - Areas subject to high current may require armoring
- Navigation/Future Maintenance Dredging requirements
  - Capping is not implementable within navigation channel or future maintenance dredge areas unless ICs are obtained
- Sediment bed slope
  - Capping may not be implementable along margins of navigation channel due to steep slope and need for buttressing
- Habitat areas
  - Requires suitable habitat layer is used for surface of cap

Technology Evaluation Criteria – Dredging

- Principal threat waste (NAPL or substantial product)
  - May require use of closed bucket and greater water quality controls (e.g., sheet pile containment) to reduce release rate
- Sediment bed strength
  - Soft sediments may require additional water quality controls
- Sediment bed slope
  - Steep slopes (>3:1) may increase release rates due to sloughing
- Navigation requirements
  - Dredging may be favored within the navigation channel and future maintenance dredge areas
- Structures and utilities
  - Structures and utilities may increase cost and/or limit implementability of dredging

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Technology Evaluation Criteria – Dredging (continued)

- Debris and Pilings
  - Presence of debris and pilings may require removal prior to dredging and/or increase release rates during dredging
- Water Depth
  - Deep water may limit the effectiveness of silt curtain controls and reduce production rates
- Current induced release potential
  - Areas subject to high current may limit the effectiveness of silt curtain controls
- Presence of hard pan or bedrock
  - Hard pan or bedrock may increase release rates during dredging

Technology Screening – Disposal Options

Disposal Option	Effectiveness	Implementability	Cost	Overall Assessment
Upland Disposal at Commercial Subtitle D Upland Landfill (Columbia Ridge Landfill)	High	High	Moderate $117/cy	Effective and implementable. Cost is slightly higher than on-site disposal at a Terminal 4 CDF.
On-site Disposal at a to be constructed CDF at either Terminal 4 or Swan Island Lagoon.	High to Moderate	Moderate	Low $87/cy	Effective. More difficult to implement from a technical and administrative perspective than off-site disposal at a permitted landfill. Costs for on-site disposal in a Terminal 4 CDF are presented as slightly lower than for off-site disposal in a commercial Subtitle D upland landfill.
On-site Disposal at a to be constructed CAD at Swan Island Lagoon.	Moderate	Low	Moderate $112/cy	Greater potential for short-term impacts than other options. More difficult to implement. Cost is considered comparable to costs for off-site disposal.

Technology Assignment

- Technology evaluation criteria were applied to each SDU based on site specific conditions
- Primary site conditions effecting technology assignments include:
  - Navigation channel or future maintenance dredge areas
  - Nearshore areas subject to wind and vessel generated waves
  - Presence of structures
  - Sediment deposition rate and grain size
  - Sediment bed slope
  - Presence of NAPL or substantial product
  - Presence of debris/utilities

Remedial Alternative Development

- Optimum RALs determined based on post remediation SWAC and area estimates
  - Generally D,E and F RALs
- Two classes of alternatives developed
  - Capping based
  - Removal based
- Elements common to capping and removal based alternatives
  - Removal in navigation channel and future maintenance dredge areas and areas with slopes greater than 3:1
  - EMNR in areas with stable sediments not subject to propwash
  - In-situ treatment in areas with stable sediment below treatment threshold
  - MNR in depositional areas
  - CDF construction at Terminal 4 or offsite disposal

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Remedial Alternative Development

- Capping based alternatives
  - Cap nearshore areas subject to wave action, net erosion areas and areas subject to propwash
  - Reactive GAC cap in areas with high groundwater flux
  - Reactive organophillic clay cap in areas with NAPL
- Removal based alternatives
  - Dredge nearshore areas subject to wave action, net erosion areas and areas subject to propwash
  - Apply specialized dredging techniques to dredge beneath dock structures

Evaluation of Remedial Alternatives
Evaluation Criteria

- Effectiveness
  - Post Remediation SWAC
  - Cap model outputs
  - Time to achieve protectiveness
- Reduction in toxicity mobility and volume through treatment
  - In-situ treatment
  - Reactive capping technologies
- Short-term effectiveness
  - Contaminant release estimates and production rates
  - Sediment handling and transport
- Implementability
  - Presence of structures
  - Navigation requirements

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Evaluation of Remedial Alternatives
Evaluation Criteria

- Cost -
  - Area and volume estimates
  - Unit cost estimates
    - Capping material
    - Treatment amendments
    - Dredging
    - Transport and Disposal
  - Mobilization
  - Engineering and oversight
  - Capital Costs
    - Transload facility
  - Long-term monitoring and maintenance

To: Jennifer Woronets (jworonets@anchorqea.com)[jworonets@anchorqea.com]
Cc: Koch, Kristine[Koch.Kristine@epa.gov]; Humphrey, Chip[Humphrey.Chip@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]; Penoyar, Susan[PenoyarSJ@cdmsmith.com]; Blischke, Eric[blischkee@cdmsmith.com]
From: King, Todd W.
Sent: Wed 11/13/2013 4:45:56 PM
Subject: Today's Presentation and Handouts
Handout5_SedOnlyPRGs.pdf
EPA_LWG_Meetings_20131113v2.pptx
Handout1_Background.pdf
Handout2_HHPRGs.pdf
Handout3_EcoPRGs.pdf
Handout4_SelectedPRGs.pdf

Hi Jen-

Here are the handouts and presentation for today.

Sorry for the tight timing!

TK

Portland Harbor Superfund Site

EPA Selected Sediment Preliminary Remedial Goals, November 2013

		Human Health			Ecological	
		RAO 1		RAO 2	RAO 5	RAO 6
COCs	**Units**	**Beach**	**Direct**	**Consumption**	**Direct**	**Prey**
Persistent						
Total PCBs	ug/kg	200	400	4	64	31
2,3,4,7,8-PeCDF (surrogate for dioxin/furan)	ug/kg	--	--	9.0E-05	--	0.019
Dioxin/Furan (2,3,7,8-TCDD Eq)	ug/kg	--	0.01	3.0E-05	--	--
Hydrocarbons						
Total cPAH (BaP Eq)	ug/kg	10	9	50	--	--
Total PAH	ug/kg	--	--	--	23,000	--
Total LPAH	ug/kg	--	--	--	1,600	--
Total HPAH	ug/kg-%fines	--	--	--	150,000	--
TPH (C-10 to C-12 aliphatic/aromatic)	ug/kg	--	--	--	11,000	---
Pesticides						
Aldrin	ug/kg	--	--	0.1	40	--
Dieldrin	ug/kg	--	--	0.1	6.7	--
Total DDx	ug/kg	--	--	7	572	2.8[8]
gamma-BHC (Lindane)	ug/kg	--	--	--	1.4	--
Total Chlordanes	ug/kg	--	--	1	8.9	--
Metals						
Arsenic	mg/kg	3	3		--	--
Cadmium	mg/kg	--	--	--	3.5	--
Copper	mg/kg	--	--	--	150	--
Lead	mg/kg	--	--	--	91	1,900
Zinc	mg/kg	--	--	--	315	--
Butyltins						
TBT	mg/kg	--	--	--	3.1	--
SVOCs						
Hexachlorobenzene	ug/kg	--	--	1	--	--
Toxicity						
Benthic Toxicity	Chironomus dilutus 10-day survival: survival > 84% Chironomus dilutus 10-day biomass: biomass > 82% of the laboratory negative control biomass Hyalella azteca 28-day survival: survival > 79% Hyalella azteca 28-day biomass: biomass > 66% of the laboratory negative control biomass In addition to having survival or biomass values lower than the above PRG percentages, each individual sample with survival or biomass lower than its respective PRGs must have survival or biomass statistically significantly lower than that of the laboratory negative control sediment response, as determined using either a one-tailed parametric t-test, or a one-tailed non-parametric Mann-Whitney U test (sometimes referred to as the Wilcoxon rank sum test or WRS test, either name is fine), with a statistical significance level of $p < 0.05$. Survival/biomass and statistical significance tests must both fail before an individual sample is considered to have exceeded a toxicity based PRG.					

Footnotes: 8 This value is for 4-4' DDE

EPA selected sediment PRGs

RAOs	***Human Health*** • RAO 1 – Sediments: Reduce to acceptable levels human health risks from exposure to contaminated sediments resulting from incidental ingestion of and dermal contact with sediments,4 and comply with identified ARARs. • RAO 2 – Biota Ingestion: Reduce to acceptable levels human health risks from indirect exposures to COCs through ingestion of fish and shellfish that occur via bioaccumulation pathways from sediment and/or surface water and comply with identified ARARs. ***Ecological*** • RAO 5 – Sediments: Reduce to acceptable levels the risks to ecological receptors resulting from the ingestion of and direct contact with contaminated sediments and comply with identified ARARs. • RAO 6 – Biota (Prey) Ingestion: Reduce to acceptable levels risks to ecological receptors from indirect exposures through ingestion of prey to COCs in sediments via bioaccumulation pathways from sediment and/or surface water and comply with identified ARARs.

Portland Harbor Feasibility Study

EPA LWG Stakeholder Update

Portland International Airport

St. Helens Conference Room A

Portland, Oregon

November 13, 2013

12:30 to 3:30 PST

Agenda

- Schedule to Proposed Plan
- Chemicals of Concern (COCs) to be considered in FS
- Remedial Action Objectives (RAOs)
- Sediment Background
- Preliminary Remedial Goals (PRGs)
- Remedial Action Limits (RALs)

Portland Harbor – Path to Plan

BRAs	RI	FS	Proposed Plan
Human Health Receptor Scenarios •Complete Pathways •Relevant Area for Exposure Point Concentration Calcs Ecological Receptor Scenarios •Complete Pathways •Relevant Area for Exposure Point Concentration Calcs •Benthic Tox - Predicted vs. Actual	Characterization Background Concentrations Depositional Areas Areal and vertical extent of COPCs	Screening of Technologies Remedial Action Alternatives RAOs PRGs RALs Screen Alternatives Detailed Alternative Analysis	Basis for action Preferred remedy components Expected outcomes Institutional Controls Long Term Monitoring Community Participation
HHRA-Complete **BERA-Dec 2013**	**Summer 2014**	**Fall 2014**	**Dec 2014**

Key Discussion Topics

- COCs
  - Human Health Based
  - Ecological Risk Based
- RAOs
- Sediment Background
  - Outliers
  - PCB congener vs. Aroclor
- PRGs
- RALs

Human Health COCs

Chemical	Direct Contact	Fish and Shellfish Consumption
Total PCBs	X	X
2,3,4,7,8-PeCDF		X
Dioxin/Furan TEQ	X	X
Carcinogenic PAHs (BaP eq)	X	X
DDx		X
Aldrin		X
Dieldrin		X
Total Chlordane		X

Red: EPA RAL COCs

Human Health COCs (Continued)

Chemical	Direct Contact	Fish and Shellfish Consumption
Arsenic	X	X
Mercury		X
BEHP		X
Hexachlorobenzene		X
Pentachlorophenol		X
Total PBDEs		X

Ecological COCs

Chemical	Benthic	Fish	Wildlife
Total PCBs	X	X	X
2,3,4,7,8-PeCDF			X
Dioxin/Furan TEQ			X
Total PAHs	X	X	
Total LPAHs	X	X	
Total HPAHs	X	X	
TPH (C10 – C12)	X		
Aldrin	X	X	
Dieldrin	X	X	
Total DDx	X	X	X
Gamma-HCH (Lindane)	X	X	

Red: EPA RAL COCs

Ecological COCs (Continued)

Chemical	Benthic	Fish	Wildlife
Cadmium	X		
Copper	X		
Lead	X	X	X
Zinc	X		
BEHP	X		
Tributyltin	X		
Total Chlordanes	X		
Benthic Risk	X		

TZW/Pore water COCs identified as ecologically significant in the Final BERA
(To be addressed by source control)

Chemical	Benthic	Fish	Wildlife
Ethylbenzene	X	X	
Perchlorate	X		
Manganese	X		
Vanadium	X		
Cyanide	X	X	

Sediment Background

- Background is relevant for developing PRGs for key COCs
- Initial background levels presented in draft FS
- EPA re-calculated background for sediment
- EPA finalized in Section 7 of RI
- Methodology for background calculation is unchanged
- Outlier analyses changed some values

COCs	Units	EPA Background		LWG FS Bkgd[1]	
Persistent		95% UCL	95% UPL	95% UCL	95% UPL
Total PCBs[2]	ug/kg	4	8	6.9	17
Total PCDD/Fs[3]	ug/kg	0.08	0.2	NC	NC
Hydrocarbons					
cPAH	mg/kg	0.01	0.03	0.010	0.022
Total PAH	mg/kg	0.07	0.2	0.11	0.19
Total LPAH	mg/kg	0.01	0.03	0.012	0.024
Total HPAH	mg/kg	NC	NC	NC	NC
TPH (C-10 to C-12 aliphatic/aromatic)	mg/kg	NA	NA	NA	NA
Pesticides					
Aldrin	ug/kg	MDL	MDL	0.27	0.34
Dieldrin	ug/kg	MDL	MDL	0.14	0.22
Total DDx (DDE+DDD+DDT)	ug/kg	2	3	1.6	3.0
gamma-BHC (Lindane)	ug/kg	MDL	MDL	NC	NC
Total Chlordanes	ug/kg	0.4	0.7	0.38	0.70
Metals					
Arsenic	mg/kg	3	4	3.0	4.0
Cadmium	mg/kg	0.1	0.2	0.13	0.20
Chromium	mg/kg	24	32	24	32
Copper	mg/kg	26	37	26	37
Lead	mg/kg	11	15	11	15
Zinc	mg/kg	79	111	79	110
Phthalates					
BEHP	ug/kg	40	103	50.1	118
Butyltins					
TBT	mg/kg	NA	NA	NC	NC
Other					
PBDE	ug/kg	NA	NA	NA	NA
Toxicity					
Benthic Toxicity		NA	NA	NA	NA

Remedial Action Objectives

- Eight RAOs presented in draft FS
  - Narrative RAOs are valid
  - RAO PRGs for use in the FS presented by EPA today
- Human health and ecological RAOs developed
  - Sediment (RAOs 1 and 5)
  - Biota and prey consumption (RAOs 2 and 6)
  - Surface water (RAOs 3 and 7)
  - Groundwater (RAOs 4 and 8)
- FS actions will focus on sediment RAOs
  - Sediment RALs designed to achieve remedial goals for sediment

PRGs by RAO – Human Health

- RAO 1 – Sediments: Reduce to acceptable levels human health risks from exposure to contaminated sediments resulting from incidental ingestion of and dermal contact with sediments, and comply with identified ARARs.
- RAO 2 – Biota Ingestion: Reduce to acceptable levels human health risks from indirect exposures to COCs through ingestion of fish and shellfish that occur via bioaccumulation pathways from sediment and/or surface water and comply with identified ARARs.
- RAO 3 – Surface Water: Reduce risks from COCs in surface water at the Site to acceptable exposure levels that are protective of human health risks from ingestion of, inhalation of, and dermal contact with surface water; protect the drinking water beneficial use of the Willamette River at the Site; and comply with identified ARARs.
- RAO 4 – Groundwater: Reduce to acceptable levels human health risks resulting from direct exposure to contaminated groundwater and indirect exposure to contaminated groundwater through fish and shellfish consumption, and comply with identified ARARs.

PRGs by RAO - Ecological

- RAO 5 – Sediments: Reduce to acceptable levels the risks to ecological receptors resulting from the ingestion of and direct contact with contaminated sediments and comply with identified ARARs.
- RAO 6 – Biota (Prey) Ingestion: Reduce to acceptable levels risks to ecological receptors from indirect exposures through ingestion of prey to COCs in sediments via bioaccumulation pathways from sediment and/or surface water and comply with identified ARARs.
- RAO 7 – Surface Water: Reduce risks from COCs in surface water at the Site to acceptable exposure levels that are protective of ecological receptors based on the ingestion of and direct contact with surface water and comply with identified ARARs.
- RAO 8 – Groundwater: Reduce to acceptable levels the risks to ecological receptors resulting from the ingestion of and direct contact with contaminated groundwater and indirect exposures through ingestion of prey via bioaccumulation pathways from groundwater, and comply with identified ARARs.
-

		Human Health			Ecological	
		RAO 1		RAO 2	RAO 5	RAO 6
COCs	Units	Beach	Direct	Consumption	Direct	Prey
Persistent						
Total PCBs	ug/kg	200	400	4	64	31
2,3,4,7,8-PeCDF (surrogate for dioxin/furan)	ug/kg	--	--	9.0E-05	--	0.019
Dioxin/Furan (2,3,7,8-TCDD Eq)	ug/kg	--	0.01	3.0E-05	--	--
Hydrocarbons						
Total cPAH (BaP Eq)	ug/kg	10	9	50	--	--
Total PAH	ug/kg	--	--	--	23,000	--
Total LPAH	ug/kg	--	--	--	1,600	--
Total HPAH	ug/kg-%fines	--	--	--	150,000	--
TPH (C-10 to C-12 aliphatic/aromatic)	ug/kg	--	--	--	11,000	---
Pesticides						
Aldrin	ug/kg	--	--	0.1	40	--
Dieldrin	ug/kg	--	--	0.1	6.7	--
Total DDx	ug/kg	--	--	7	572	2.8[8]
gamma-BHC (Lindane)	ug/kg	--	--	--	1.4	--
Total Chlordanes	ug/kg	--	--	1	8.9	--
Metals						
Arsenic	mg/kg	3	3		--	--
Cadmium	mg/kg	--	--	--	3.5	--
Copper	mg/kg	--	--	--	150	--
Lead	mg/kg	--	--	--	91	1,900
Zinc	mg/kg	--	--	--	315	--
Butyltins						
TBT	mg/kg	--	--	--	3.1	--
SVOCs						
Hexachlorobenzene	ug/kg	--	--	1	--	--
Toxicity						
Benthic Toxicity						

PRG changes

- Human Health
  - RAO 1 - Direct contact – no changes
  - RAO 2 – Ingestion – changes based on Final HHRA
- Ecological
  - RAO 5 – Direct – changes based on Final BERA
  - RAO 6 - Prey – changes based on Final BERA

RAL COCs

Chemical	Basis
Total PCBs	Primary chemical contributing to human health risk at the Portland Harbor Site
2,3,4,7,8-PeCDF	Predominant dioxin and furan congener, dioxin measured as 2,3,7,8-TCDD equivalents
Total DDx	Primary pesticide contributing to risk at the Portland Harbor site. Large source area.
Carcinogenic PAHs (BaP eq)	Key contributor of human health risk through direct contact exposure and correlates with total PAHs for ecological risk
Benthic Risk	Benthic risk areas are not necessarily correlated only with chemicals presented above

Note: Addressing these key COCs should address the risks posed by all COCs at the site based on co-location.

RAL development

- LWG developed initial RALs for use in draft FS
- EPA agreed with PCB, cPAHs and Benthic Toxicity
- EPA provided alternative RALs (DDx and PeCDF) in July 2011
- LWG used EPA RALs for DDx and PeCDF for Alternatives E, F, G
- Final RALs same as EPA July 2011 version
- No additional RAL chemicals identified

Remedial Action Levels

Key COC Map RALs	RALs (ppb)					
	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G
Carcinogenic PAHs (BaP eq)	20,000	20, 15,000	15, 8,000	8, 4,000	4, 1,500	1, 600
2,3,4,7,8-PeCDF	0.08	0. 0.05	0. 0.03	0. 0.02	0. 0.01	0. 0.005
Total DDx	650	550	450	300	160	40
Total PCBs	1,000	1, 750	500	200	75	50
Benthic Toxicity	No toxicity in 10 years	No toxicity at year 0				

Questions?

Portland Harbor Superfund Site

EPA re-calculated and LWG Sediment Background, November 2013

COCs		EPA Background		LWG FS Bkgd[1]	
Persistent	**Units**	95% UCL	95% UPL	95% UCL	95% UPL
Total PCBs[2]	ug/kg	4	8	6.9	17
Total PCDD/Fs[3]	ug/kg	0.08	0.2	NC	NC
Hydrocarbons					
cPAH	mg/kg	0.01	0.03	0.010	0.022
Total PAH	mg/kg	0.07	0.2	0.11	0.19
Total LPAH	mg/kg	0.01	0.03	0.012	0.024
Total HPAH	mg/kg	NC	NC	NC	NC
TPH (C-10 to C-12 aliphatic/aromatic)	mg/kg	NA	NA	NA	NA
Pesticides					
Aldrin	ug/kg	MDL	MDL	0.27	0.34
Dieldrin	ug/kg	MDL	MDL	0.14	0.22
Total DDx (DDE+DDD+DDT)	ug/kg	2	3	1.6	3.0
gamma-BHC (Lindane)	ug/kg	MDL	MDL	NC	NC
Total Chlordanes	ug/kg	0.4	0.7	0.38	0.70
Metals					
Arsenic	mg/kg	3	4	3.0	4.0
Cadmium	mg/kg	0.1	0.2	0.13	0.20
Chromium	mg/kg	24	32	24	32
Copper	mg/kg	26	37	26	37
Lead	mg/kg	11	15	11	15
Zinc	mg/kg	79	111	79	110
Phthalates					
BEHP	ug/kg	40	103	50.1	118
Butyltins					
TBT	mg/kg	NA	NA	NC	NC
Other					
PBDE	ug/kg	NA	NA	NA	NA
Toxicity					
Benthic Toxicity		NA	NA	NA	NA

Notes:

1 LWG, Appendix A, Table 1.3-5b, Draft FS, March 30, 2012

2 Aroclor and congener background calculated, congener selected by EPA

3 Sum of congener conentrations

NC - Not calculated

ND - Not detected

NA - Not applicable, background will not be considered as part of FS determinations

Portland Harbor Superfund Site

EPA re-calculated and LWG Human Health Preliminary Remedial Goals
November 2013

			Beach Sediment (Direct Contact)					In-water Sediment (Direct Contact)					Fish Consumption (Tissue)		Fish Consumption (Sediment)	
COCs	**Target Risk Level**	**Units**	**Dockside Worker**	**Transient**	**Recreational Beach User**	**High Frequency Fisher**	**Tribal Fisher**	**In-water Worker**	**High Frequency Fisher**	**Tribal Fisher**	**Diver Wet Suit**	**Diver Dry Suit**	**Subsistence Fisher**	**Subsistence Fisher Infant**	**Subsistence Fisher**	**Subsistence Fisher Infant**
Total PCBs	10^{-6}	µg/kg			200	600		30,000	1,000	400	9,000		0.5	NA	0.2	NA
	10^{-4}	µg/kg			20,000	60,000		3,000,000	100,000	40,000	900,000		50	NA	20	NA
	HQ=1	µg/kg			800			200,000	20,000	10,000	100,000		5	0.3	2	0.1
2,3,4,7,8-PeCDF	10^{-6}	µg/kg											0.00003	NA	0.0001	NA
	10^{-4}	µg/kg											0.003	NA	0.03	NA
	HQ=1	µg/kg											0.0006	0.00002	0.006	0.00009
Dioxin/Furan TEQ	10^{-6}	µg/kg			0.009			0.6	0.04	0.01	0.5		0.000008	NA	0.00004	NA
	10^{-4}	µg/kg			0.9			60	4	1	50		0.0008	NA	0.008	NA
	HQ=1	µg/kg			0.09			8	2	1	20		0.0002	0.000006	0.002	0.00003
Hydrocarbons																
cPAH (BaP Eq)	10^{-6}	µg/kg	700		10	200	42	8,600	400	100	3,000		0.05	NA	50	NA
	10^{-4}	µg/kg	70,000		1,000	20,000	4,200	860,000	40,000	10,000	300,000		5	NA	5,000	NA
	HQ=1	µg/kg	NA		NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
Pesticides																
Aldrin	10^{-6}	µg/kg											0.06	NA	0.6	NA
	10^{-4}	µg/kg											6	NA	60	NA
	HQ=1	µg/kg											8	NA	80	NA
Dieldrin	10^{-6}	µg/kg											0.06	NA	0.1	NA
	10^{-4}	µg/kg											6	NA	20	NA
	HQ=1	µg/kg											13	NA	40	NA
Total DDx	10^{-6}	µg/kg											3	NA	7	NA
	10^{-4}	µg/kg											300	NA	800	NA
	HQ=1	µg/kg											130	95	400	200
Total Chlordane	10^{-6}	µg/kg											3	NA	1	NA
	10^{-4}	µg/kg											300	NA	400	NA
	HQ=1	µg/kg											130	NA	200	NA
Metals																
Arsenic	10^{-6}	mg/kg			0.7	2	0.4		4	0.4			0.001	NA	NA	NA
	10^{-4}	mg/kg			70	200	40		400	40			0.1	NA	NA	NA
	HQ=1	mg/kg			40	300.0	195		700	200			0.1	NA	NA	NA
Mercury	10^{-6}	mg/kg											NA	NA	NA	NA
	10^{-4}	mg/kg											NA	NA	NA	NA
	HQ=1	mg/kg											0.03	NA	NA	NA
Phthalates																
BEHP	10^{-6}	µg/kg											70	NA	NA	NA
	10^{-4}	µg/kg											5,000	NA	NA	NA
	HQ=1	µg/kg											7000	NA	NA	NA
SVOCs																
Hexachlorobenzene	10^{-6}	µg/kg											NA	NA	NA	NA
	10^{-4}	µg/kg											NA	NA	NA	NA
	HQ=1	µg/kg											0.6	NA	1	NA
Pentachlorophenol	10^{-6}	µg/kg											NA	NA	NA	NA
	10^{-4}	µg/kg											NA	NA	NA	NA
	HQ=1	µg/kg											NA	NA	NA	NA
Other																
PBDE	10^{-6}	µg/kg											NA	NA	NA	NA
	10^{-4}	µg/kg											NA	NA	NA	NA
	HQ=1	µg/kg											30	NA	NA	NA

Notes:
values are based on FWM with water = 0 ug/L (using AWQC results in negative number using the model)
NA not available

Portland Harbor Superfund Site

EPA re-calculated and LWG Human Health Preliminary Remedial Goals
November 2013

COCs	Target Risk Level	Units	RAO 1 - Beach				RAO 1 - Sediment				RAO 2 - Tissue				RAO 2 - Sediment			
			RBTs	ARARs	Background	PRGs	RBTs	ARARs	Background	PRGs	RBTs	ARARs	Background	PRGs	RBTs	ARARs	Background	PRGs
Total PCBs	10^{-6}	µg/kg	200	NA	4	**200**	400	NA	4	**400**	0.3	NA	NA	**0.3**	0.1	NA	4	**4**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
2,3,4,7,8-PeCDF	10^{-6}	µg/kg	NA	NA	NA	**NA**	NA	NA	NA	**NA**	0.00002	NA	NA	**0.00002**	0.00009	NA	NA	**0.00009**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Dioxin/Furan TEQ	10^{-6}	µg/kg	NA	NA	NA	**NA**	0.01	NA	NA	**0.01**	0.000006	NA	NA	**0.000006**	0.00003	NA	NA	**0.00003**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Hydrocarbons																		
cPAH (BaP Eq)	10^{-6}	µg/kg	10	NA	0.008	**10**	100	NA	0.008	**100**	0.1	NA	NA	**0.1**	50	NA	0.008	**50**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Pesticides																		
Aldrin	10^{-6}	µg/kg	NA	NA	ND	**NA**	NA	NA	ND	**NA**	0.1	NA	NA	**0.1**	0.6	NA	ND	**0.6**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Dieldrin	10^{-6}	µg/kg	NA	NA	ND	**NA**	NA	NA	ND	**NA**	0.1	NA	NA	**0.1**	0.1	NA	ND	**0.1**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Total DDx	10^{-6}	µg/kg	NA	NA	2	**NA**	NA	NA	ND	**NA**	3	NA	NA	**3**	7	NA	2	**7**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Total Chlordane	10^{-6}	µg/kg	NA	NA	0.4	**NA**	NA	NA	ND	**NA**	3	NA	NA	**3**	1	NA	0.4	**1**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Metals																		
Arsenic	10^{-6}	mg/kg	0.4	NA	3	**3**	0.4	NA	3	**3**	0.001	NA	NA	**0.001**	NA	NA	3	**NA**
	10^{-4}	mg/kg																
	HQ=1	mg/kg																
Mercury	10^{-6}	mg/kg	NA	NA	0.03	**NA**	NA	NA	0.03	**NA**	0.03	NA	NA	**0.03**	NA	NA	0.03	**NA**
	10^{-4}	mg/kg																
	HQ=1	mg/kg																
Phthalates																		
BEHP	10^{-6}	µg/kg	NA	NA	40	**NA**	NA	NA	ND	**NA**	70	NA	NA	**70**	NA	NA	40	**NA**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
SVOCs																		
Hexachlorobenzene	10^{-6}	µg/kg	NA	NA	NA	**NA**	NA	NA	NA	**NA**	0.6	NA	NA	**0.6**	1	NA	NA	**1**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Pentachlorophenol	10^{-6}	µg/kg	NA	NA	NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**	NA	NA	NA	**NA**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																
Other																		
PBDE	10^{-6}	µg/kg	NA	NA	ND	**NA**	NA	NA	ND	**NA**	30	NA	NA	**30**	NA	NA	ND	**NA**
	10^{-4}	µg/kg																
	HQ=1	µg/kg																

Notes:
selected PRG
NA not available
ND background below detection limits

Portland Harbor Superfund Site

EPA re-calculated and LWG Ecological Preliminary Remedial Goals, November 2013

COCs	Target Risk Level	Units	Tissue Residual Assessment											Fish Dietary Assessment							
			Benthic					Invertivore		Omnivore	Piscivore		Detrivore	Invertivore			Omnivore			Piscivore	
			Clams	Crayfish	Worms	LRM	PEC/PEL	Sculpin	Peamouth	Largescale Sucker	Northern Pikeminnow	Smallmouth Bass	Pacific Lamprey	Sculpin	Peamouth	Juvenile Chinook	Largescale Sucker	Carp	White Sturgeon	Northern Pikeminnow	Smallmouth Bass
														clams worms sculpin	clams worms sculpin	clams worms multiplates	clams worms		clams worms	carp crayfish largescals sucker northern pikeminnow peamouth sculpin worms	crayfish sculpin worms
Persistent																					
Total PCBs	HQ=1	ug/kg	2420	1370	1470	2670	277	272		152	86	64									
2,3,4,7,8-PeCDF (surrogate for dioxin/furan TEQ)	HQ=1	ug/kg																			
Hydrocarbons																					
Total PAH	HQ=1	mg/kg					23														
Total LPAH	HQ=1	mg/kg					1.6														
Total HPAH	HQ=1	mg/kg - %fines				150															
TPH (C10 to C12 aliphatic/aromatic)	HQ=1	mg/kg				11															
Pesticides																					
Aldrin	HQ=1	ug/kg					40														
Dieldrin	HQ=1	ug/kg					6.7														
Total DDx	HQ=1	ug/kg				1400	572	760													
gamma-HCH (Lindane)	HQ=1	ug/kg					1.4														
Total Chlordanes	HQ=1	ug/kg					8.9														
Metals																					
Cadmium	HQ=1	mg/kg					3.5														
Chromium	HQ=1	mg/kg					90														
Copper	HQ=1	mg/kg					150														
Lead	HQ=1	mg/kg					91		36												
Zinc	HQ=1	mg/kg					315														
Phthalates																					
BEHP	HQ=1	ug/kg																			
Butyltins																					
TBT	HQ=1	mg/kg			24	3.1															
Toxicity																					
Benthic Toxicity	HQ=1																				

Chironomus dilutus 10-day survival: survival > 84%
Chironomus dilutus 10-day biomass: biomass > 82% of the laboratory negative control biomass
Hyalella azteca 28-day survival: survival > 79%
Hyalella azteca 28-day biomass: biomass > 66% of the laboratory negative control biomass

_____

In addition to having survival or biomass values lower than the above PRG percentages, each individual sample with survival or biomass lower than its respective PRGs must have survival or biomass statistically significantly lower than that of the laboratory negative control sediment response, as determined using either a one-tailed parametric t-test, or a one-tailed non-parametric Mann-Whitney U test (sometimes referred to as the Wilcoxon rank sum test or WRS test, either name is fine), with a statistical significance level of $p < 0.05$. Survival/biomass and statistical significance tests must both fail before an individual sample is considered to have exceeded a toxicity based PRG.

Portland Harbor Superfund Site

EPA re-calculated and LWG Ecological Preliminary Remedial Goals, November 2013

				Bird Egg Assessment		Bird Dietary Assessment						Mammal Dietary Assessment	
			Detrivore	Piscivore		Piscivore		Omnivore		Sediment Probing Invertivore		Aquatic-Dependent Carnivore	
COCs			Pacific Lamprey	Osprey	Bald Eagle	Osprey	Bald Eagle	Hooded Merganser	Belted Kingfisher	Spotted Sandpiper		Mink	River Otter
				population	population	carp brown bullhead largescal sucker northern pikeminnow smallmouth bass	carp largescale sucker northern pikeminnow peamouth	clams worms peamouth sculpin		clams	worms	carp crayfish sculpin smallmouth bass	clams carp crayfish sculpin smallmouth bass
Persistent	**Target Risk Level**	**Units**											
Total PCBs	HQ=1	ug/kg				423	730	618		996	606	31	68
2,3,4,7,8-PeCDF (surrogate for dioxin/furan TEQ)	HQ=1	ug/kg				0.019	0.032				0.0541	0.056	0.171
Hydrocarbons													
Total PAH	HQ=1	mg/kg											
Total LPAH	HQ=1	mg/kg											
Total HPAH	HQ=1	mg/kg - %fines											
TPH (C10 to C12 aliphatic/aromatic)	HQ=1	mg/kg											
Pesticides													
Aldrin	HQ=1	ug/kg											
Dieldrin	HQ=1	ug/kg											
Total DDx	HQ=1	ug/kg		2.8	1.92	434	760	246	182		110		
gamma-HCH (Lindane)	HQ=1	ug/kg											
Total Chlordanes	HQ=1	ug/kg											
Metals													
Cadmium	HQ=1	mg/kg											
Chromium	HQ=1	mg/kg											
Copper	HQ=1	mg/kg											
Lead	HQ=1	mg/kg				1900	43100					1310000	11000
Zinc	HQ=1	mg/kg											
Phthalates													
BEHP	HQ=1	ug/kg											
Butyltins													
TBT	HQ=1	mg/kg											
Toxicity													
Benthic Toxicity	HQ=1												

Portland Harbor Superfund Site

EPA re-calculated and LWG Ecological Preliminary Remedial Goals, November 2013

COCs	Target Risk Level	Units	RBTs		ARARs	Background	PRGs	
			RAO 5	RAO 6			RAO 5 Ingestion	RAO 6 Dietary
Persistent								
Total PCBs	HQ=1	ug/kg	64	31	NA	4	**64**	**31**
2,3,4,7,8-PeCDF (surrogate for dioxin/furan TEQ)	HQ=1	ug/kg	NA	0.019	NA	ND	**NA**	**0.019**
Hydrocarbons								
Total PAH	HQ=1	mg/kg	23	NA	NA	0.07	**23**	**NA**
Total LPAH	HQ=1	mg/kg	1.6	NA	NA	0.02	**1.6**	**NA**
Total HPAH	HQ=1	mg/kg - %fines	150	NA	NA	NA	**150**	**NA**
TPH (C10 to C12 aliphatic/aromatic)	HQ=1	mg/kg	11	NA	NA	NA	**11**	**NA**
Pesticides								
Aldrin	HQ=1	ug/kg	40	NA	NA	ND	**40**	**NA**
Dieldrin	HQ=1	ug/kg	6.7	NA	NA	ND	**6.7**	**NA**
Total DDx	HQ=1	ug/kg	572	2.8	NA	2	**572**	**2.8**
gamma-HCH (Lindane)	HQ=1	ug/kg	1.4	NA	NA	ND	**1.4**	**NA**
Total Chlordanes	HQ=1	ug/kg	8.9	NA	NA	0.4	**8.9**	**NA**
Metals								
Cadmium	HQ=1	mg/kg	3.5	NA	NA	0.1	**3.5**	**NA**
Chromium	HQ=1	mg/kg	90	NA	NA	24	**90**	**NA**
Copper	HQ=1	mg/kg	150	NA	NA	26	**150**	**NA**
Lead	HQ=1	mg/kg	91	1900	NA	11	**91**	**1900**
Zinc	HQ=1	mg/kg	315	NA	NA	77	**315**	**NA**
Phthalates								
BEHP	HQ=1	ug/kg	NA	NA	NA	40	**NA**	**NA**
Butyltins								
TBT	HQ=1	mg/kg	3.1	NA	NA	ND	**3.1**	**NA**
Toxicity								
Benthic Toxicity	HQ=1							

Portland Harbor Superfund Site

EPA Re-calculated and LWG Preliminary Remedial Goals, November 2013

COCs	Units	RAO 1		RAO 2		RAO 3	RAO 4	RAO 5	RAO 6	RAO 7	RAO 8
		Beach	Sediment	Tissue[9]	Sediment	ug/L	ug/L			ug/L	ug/L
Persistent											
Total PCBs	ug/kg	200	400	0.3	4	6.40E-06	0.5	64	31	0.014	--
2,3,4,7,8-PeCDF (surrogate for dioxin/furan)	ug/kg	--	--	--	9.00E-05	--	--	--	0.019	--	--
Dioxin/Furan (2,3,7,8-TCDD Eq)	ug/kg	--	0.01	6.00E-06	3.00E-05	5.1E-10	3.00E-05	--	--	3.80E-04	--
Hydrocarbons											
Total cPAH (BaP Eq)	ug/kg	10	9	0.1	50	--	--	--	--	--	--
Total PAH	ug/kg	--	--	--	--	--	--	23,000	--	--	--
Total LPAH	ug/kg	--	--	--	--	--	--	1,600	--	--	--
Total HPAH	ug/kg-%fines	--	--	--	--	--	--	150,000	--	--	--
TPH (C-10 to C-12 aliphatic/aromatic)	ug/kg	--	--	--	--	---	---	11,000	---	--	---
Pesticides											
Aldrin	ug/kg	--	--	0.1	0.6	5.0E-06	0.004[7]	40	--	--	--
Dieldrin	ug/kg	--	--	0.1	0.1	5.3E-06	0.0015[7]	6.7	--	0.0019	--
Total DDx	ug/kg	--	--	3	7	2.2E-05[4]	--	572	2.8[8]	.001[3]	--
Dichlorprop		--	--	--	--	--	370[7]	--	--	--	--
gamma-BHC (Lindane)	ug/kg	--	--	--	--	1.8	0.2	1.4	--	0.08	--
Total Chlordanes	ug/kg	--	--	3	1	0.000081	2	8.9	--	0.0043	--
2,4-D		--	--	--	--	100	100	--	--	--	--
2,4,5-TP (Silvex)		--	--	--	--	10	10	--	--	--	--
Metals											
Arsenic	mg/kg	3	3	0.001		2.1[5]	10	--	--	190[1]	--
Cadmium	mg/kg	--	--	--	--	--	--	3.5	--	0.38	--
Chromium	mg/kg	--	--	--	--	--	--	--	--	11[2]	--
Copper	mg/kg	--	--	--	--	--	--	150	--	3.6	--
Lead	mg/kg	--	--	--	--	--	--	91	1,900	0.54	--
Manganese		--	--	--	--	10	32[7]	--	--	--	120
Mercury	mg/kg	--	--	0.03	--	0.0146	2	--	--	0.012	--
Vanadium		--	--	--	--	--	--	--	--	--	20
Zinc	mg/kg	--	--	--	--	2,100	5,000	315	--	33	--
Phthalates											
BEHP	ug/kg	--	--	72	--	0.22	6	--	--	3	--
Butyltins											
TBT	mg/kg	--	--	--	--	--	--	3.1	--	0.072	--
SVOCs											
1,2-Dichlorobenzene		--	--	--	--	130	600	--	--	763	14
1,3-Dichlorobenzene		--	--	--	--	96	14[7]	--	--	763	71
Hexachlorobenzene	ug/kg	--	--	0.6	1	0.000029	1	--	--	--	--
Pentachlorophenol		--	--	--	--	0.15	1	--	--	13	--
VOCs											
Benzene		--	--	--	--	--	--	--	--	--	130
Chlorobenzene		--	--	--	--	160	100	--	--	50	64
Chloroform		--	--	--	--	47	0.17[7]	--	--	1,240	28
1,1-Dichloroethane (1,1-DCE)		--	--	--	--	--	1200[7]	--	--	--	47
cis-1,2-Dichloroethylene (c-1,2-DCE)		--	--	--	--	--	--	--	--	--	590
trans-1,2-Dichloroethylene (t-1,2-DCE)		--	--	--	--	1,000	100	--	--	--	590
Ethylbenzene		--	--	--	--	--	--	--	--	--	7.3
Tetrachloroethene (PCE)		--	--	--	--	0.33	5	--	--	840	98
TCE		--	--	--	--	1.4	5	--	--	21,900	47
Toluene		--	--	--	--	--	--	--	--	--	9.8
1,1,1- Trichloroethane (TCA)		--	--	--	--	--	200	--	--	--	11
Vinyl chloride		--	--	--	--	0.24	2	--	--	--	--
o-Xylene		--	--	--	--	--	--	--	--	--	13
m- and p-Xylene		--	--	--	--	--	--	--	--	--	67
Total Xylene		--	--	--	--	--	--	--	--	--	13
Other											
PBDE	ug/kg	--	--	0.00002	--	--	--	--	--	--	--
Cyanide		--	--	--	--	130[6]	200	--	--	5.2	5.2
Perchlorate		--	--	--	--	15	15	--	--	--	9300
Toxicity											
Benthic Toxicity	Chironomus dilutus 10-day survival: survival > 84% Chironomus dilutus 10-day biomass: biomass > 82% of the laboratory negative control biomass Hyalella azteca 28-day survival: survival > 79% Hyalella azteca 28-day biomass: biomass > 66% of the laboratory negative control biomass In addition to having survival or biomass values lower than the above PRG percentages, each individual sample with survival or biomass lower than its respective PRGs must have survival or biomass statistically significantly lower than that of the laboratory negative control sediment response, as determined using either a one-tailed parametric t-test, or a one-tailed non-parametric Mann-Whitney U test (sometimes referred to as the Wilcoxon rank sum test or WRS test, either name is fine), with a statistical significance level of $p < 0.05$. Survival/biomass and statistical significance tests must both fail before an individual sample is considered to have exceeded a toxicity based PRG.										

Footnotes:

1 This value is for Arsenic III.
2 This value is for Chromium VI.
3 This value is for the sum of 2-4' and 4-4' DDT isomers.
4 This value is for the sum of 2-4' and 4-4' isomers of either DDE or DDT; 0.000031 ug/L is the value for the sum of 2-4' and 4-4' DDD isomer.
5 The arsenic criteria are expressed as total inorganic arsenic. The "organism only" criteria are based on a risk level of
6 The cyanide criterion is expressed as total cyanide (CN)/L.
7 Value is PRG from EPA RSL Table (May 2013).
8 This value is for 4-4' DDE
9 Tissue concentrations calculated with 10-6 increased cancer risk or HI>1

RAOs	
	Human Health
	• RAO 1 – Sediments: Reduce to acceptable levels human health risks from exposure to contaminated sediments resulting from incidental ingestion of and dermal contact with sediments,4 and comply with identified ARARs. • RAO 2 – Biota Ingestion: Reduce to acceptable levels human health risks from indirect exposures to COCs through ingestion of fish and shellfish that occur via bioaccumulation pathways from sediment and/or surface water and comply with identified ARARs. • RAO 3 – Surface Water: Reduce risks from COCs in surface water at the Site to acceptable exposure levels that are protective of human health risks from ingestion of, inhalation of, and dermal contact with surface water; protect the drinking water beneficial use of the Willamette River at the Site; and comply with identified ARARs. • RAO 4 – Groundwater: Reduce to acceptable levels human health risks resulting from direct exposure to contaminated groundwater and indirect exposure to contaminated groundwater through fish and shellfish consumption, and comply with identified ARARs.
	Ecological
	• RAO 5 – Sediments: Reduce to acceptable levels the risks to ecological receptors resulting from the ingestion of and direct contact with contaminated sediments and comply with identified ARARs. • RAO 6 – Biota (Prey) Ingestion: Reduce to acceptable levels risks to ecological receptors from indirect exposures through ingestion of prey to COCs in sediments via bioaccumulation pathways from sediment and/or surface water and comply with identified ARARs. • RAO 7 – Surface Water: Reduce risks from COCs in surface water at the Site to acceptable exposure levels that are protective of ecological receptors based on the ingestion of and direct contact with surface water and comply with identified ARARs. • RAO 8 – Groundwater: Reduce to acceptable levels the risks to ecological receptors resulting from the ingestion of and direct contact with contaminated groundwater and indirect exposures through ingestion of prey via bioaccumulation pathways from groundwater, and comply with identified ARARs.

RESPONSE TO EPA COST COMMENTS

PURPOSE

The purpose of this memorandum is to provide additional cost backup information as requested in the U.S. Environmental Protection Agency (EPA) September 10, 2013 email (EPA 2013). The cost backup information request pertains to Appendix K (Cost Estimates) of the Draft Lower Willamette Group Feasibility Study (draft FS) submitted to the EPA for review on March 30, 2013 (Anchor QEA 2013). EPA requested cost backup, including vendor quotes on material prices, assumptions used in determining unit costs for construction tasks, as well as more information on the present worth analysis for operations, maintenance, and monitoring tasks.

Other elements of EPA's backup requests include a request for additional data tables to summarize cost and quantity information on a more refined level than previously presented. EPA is requesting additional cost and quantity data tables on the sub-Sediment Management Areas (SMAs). In order to streamline efforts and provide useful data to EPA, this submittal includes a draft template of the EPA-requested data tables. These draft tables currently include "dummy" data that, after EPA approval of the table format, will be populated with actual cost data and submitted to the EPA within 45 days of EPA approval.

COST BACKUP

Unit Costs Buildups

To estimate construction costs, unit costs were calculated for a variety of construction elements. Table 1 presents the unit cost summary used in the draft FS. Section 2.3 of Appendix K of the draft FS describes how the unit costs were developed. These unit cost buildups are included with the tables attached to this memorandum and are listed in the table of contents of the attached tables. Tables 2 through 26 present the unit cost buildup for different construction elements. Unit costs were estimated from the sum total of equipment, materials, and labor costs and then normalized by the assumed production rate.

- Equipment
  - Equipment pricing was obtained from Rental Rate Blue Book for Construction Equipment (version 2008.1.1). Table 27 presents the used equipment rates.
- Labor
  - Labor rates are Davis-Bacon wage determinations issued by the Department of Labor for Multnomah County, Oregon (updated August 20, 2010). Table 28 presents the used labor rates.
- Materials
  - Materials for construction equipment include miscellaneous expendable items specific to the construction task, including Personal Protection Equipment, Fuel-Oil-Grease, or equipment repairs (assumed to be a percent of the equipment costs).

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- Production Rates
  - The rates are assumed based on site conditions and experience. Section 2.3 of Appendix K details the assumed production rates for each construction element.
- Overhead and Profit
  - A 25-percent markup is applied to labor, materials, and equipment to account for overhead and profit.

Materials Costs

Quotes were received from a Portland-area vendor for the purchase and transport of engineered cap materials, residuals cover material, and organoclay mat material. Table 29A presents the cost buildup for the purchase and transport costs for cap materials. Table 29B presents the vendor quote.

Indirect Construction Costs

Unit cost backup for the following indirect construction tasks are included in Table 30.

- Daily oversight and project management including environmental monitoring
- Engineering support during construction

These, and other indirect construction costs, including Daily Agency Oversight and Project Management are discussed in more detail in Section 2.1.1 of Appendix K of the draft FS.

PRESENT VALUE ANALYSES

For clarity, EPA reviewers requested additional information in regards to the present value analysis and, specifically, additional information on present value analyses for Long Term Monitoring, Maintenance, and Operations and Institutional Controls, and the discount factors associated with these elements.

Direct Construction Costs

Construction durations for the different alternatives vary significantly with the higher alternatives taking much longer. Within each alternative, assumptions were made concerning sequencing of the SMAs (see Section 7.5 of the draft FS). For direct construction elements like dredging and capping, discount factors for construction operations were applied on a SMA basis for each alternative, based on the year the SMA work was implemented. Discount factors for construction in the first SMA began at year 1. Discount factors for each subsequent SMA remediated under each alternative are summarized in Table 2 of Appendix K of the draft FS.

Long Term Monitoring, Maintenance, and Operations and Institutional Controls

Assumptions for Long Term Monitoring, Maintenance, and Operations (LTMMO) costs are discussed in Appendix K (Section 2.1.1) and Appendix T (Section 3.4) of the draft FS. Assumptions for Institutional Controls (IC) costs are discussed in Appendix K (Section 2.4) of

the draft FS. Together, these elements sum to the LTMMO costs presented in Table 2 of Appendix K of the draft FS.

- For alternatives associated with remedial action levels B, C, D, and E, LTMMO and IC costs were assumed to occur following the completion of all construction activities.
- For alternatives associated with remedial action level F, construction durations were typically greater than 10 years, so it was assumed that monitoring events for the previously completed SMAs would occur prior to the completion of remedial activities for all SMAs. Discount factors for LTMMO and IC costs were calculated for each alternative, assuming that the first monitoring event would occur within a few years after the midpoint of the total duration of the alternative. Table 31 provides the assumptions necessary to calculate discount factors for LTMMO and IC costs.

In order to provide an estimate of LTMMO and IC costs on a SMA level, these costs were distributed among the SMAs based on the size of the remedial area for each SMA.

SUPPLEMENTAL COST TABLES

EPA is requesting additional cost and quantity data tables to the detail of the sub-SMA to assist with their evaluation. A complete set of all cost and quantity data has already been provided to the EPA in the form of an Excel spreadsheet (Attachment 1 of Appendix K of the draft FS). However, the requested table will present the requested data in a more focused form.

There are over 3,200 sub-SMAs, each with its own cost estimate for each of the ten action alternatives. Due to the high level of detail associated with this request, this submittal includes a template table showing the proposed format of the sub-SMA data presentation (Table 32) for EPA review and approval to help avoid unnecessary iterations of these highly detailed tables. This draft table includes "dummy" values that, after EPA approval, will be populated with actual quantity and cost data, and submitted to the EPA within 45 days of EPA approval. LWG proposes that the draft template table have the following properties:

- One table will be provided for each action alternative (B, C, D, E, and F).
- To streamline review efforts, sub-SMAs will be organized from the highest cost to the lowest for each alternative.
- Separate columns will be provided for costs and quantities for the removal and in situ treatment-focused options under each alternative.

LIST OF TABLES

Table # Title

1. Unit Cost Summary
2. Debris Removal and Disposal (Item No. 3.1)
3. Pile Removal (Item No. 3.2)

4. Pile Replacement (Item No. 3.3)
5. Temporary Dock Relocation (Item No. 3.4)
6. Temporary Sheetpile Walls (Item No. 5.2)
7. Silt Curtain Installation (Item No. 5.1)
8. Open Water Dredging and Transport (Item No. 4.1)
9. Confined Dredging (Item No. 4.3)
10. Dredging from Shore and Transport (Item No. 4.2)
11. Residual Dredging (Item No. 4.4)
12. Stabilization (Item No. 6.3)
13. Scow Transportation (Item No. 6.1)
14. Hydraulic Offloading (Item No. 6.5)
15. Open Water Capping (Item No. 7.1)
16. EMNR Layer Placement (Item No. 7.1.1)
17. Residuals Cap Placement (Item No. 7.1.2)
18. Backfill Placement (Item No. 7.1.3)
19. Confined Underpier Capping (Item No. 7.2)
20. Confined EMNR Layer Placement (Item No. 7.2.1)
21. Confined Residuals Cap Placement (Item No. 7.2.2)
22. Confined Backfill Placement (Item No. 7.2.3)
23. Organoclay Mat (Item No. 7.3)
24. Upland Subtitle D Landfill Disposal Cost Buildup
25. Upland Subtitle C Landfill Disposal Cost Buildup
26. In Situ Treatment Cost Buildups
27. Equipment Rates
28. Labor Rates

29A Material Costs

29B Vendor Quote

30 Indirect Construction Cost Buildup

31 Discount Factors for Long Term Monitoring, Maintenance and Operations Costs

32 Draft Template Table for EPA Comment: Cost and Quantity Estimates by sub-SMA

REFERENCES

Anchor QEA (Anchor QEA, LLC), 2012. Portland Harbor RI/FS—Draft Feasibility Study (draft FS). Prepared for Lower Willamette Group. March 2012

EPA, 2013. Regarding: Request for backup cost information. Email from: C. Humphrey, EPA Region 10. Email to: Bob Wyatt and James McKenna. September 10, 2013.

Table of Contents

Construction Task Cost Tables:

Table No.	
1	Unit Cost Summary

Unit Cost Buildup Tables:

2	Debris Removal and Disposal (Item No. 3.1)
3	Pile Removal (Item No. 3.2)
4	Pile Replacement (Item No. 3.3)
5	Temporary Dock Relocation (Item No. 3.4)
6	Temporary Sheetpile Walls (Item No. 5.2)
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10	Dredging from Shore and Transport (Item No. 4.2)
11	Residual Dredging (Item No. 4.4)
12	Stabilization (Item No. 6.3)
13	Scow Transportation (Item No. 6.1)
14	Hydraulic Offloading (Item No. 6.5)
15	Open Water Capping (Item No. 7.1)
16	EMNR Layer Placement (Item No. 7.1.1)
17	Residuals Cap Placement (Item No. 7.1.2)
18	Backfill Placement (Item No. 7.1.3)
19	Confined Underpier Capping (Item No. 7.2)
20	Confined EMNR Layer Placement (Item No. 7.2.1)
21	Confined Residuals Cap Placement (Item No. 7.2.2)
22	Confined Backfill Placement (Item No. 7.2.3)
23	Organoclay Mat (Item No. 7.3)
24	Upland Subtitle D Landfill Disposal Cost Buildup
25	Upland Subtitle C Landfill Disposal Cost Buildup
26	In Situ Treatment Cost Buildups

Equipment and Labor Rate Tables:

27	Equipment Rates
28	Labor Rates

Material Cost Tables:

29A	Material Costs
29B	Vendor Quote

Indirect Construction Support Tables:

30	Indirect Construction Cost Buildup

Long Term Monitoring, Maintenance, and Operations Costs

31	Discount Factors for Long Term Monitoring, Maintenance and Operations Costs

Supplemental Cost Tables

32	Draft Template Table for EPA Comment: Cost and Quantity Estimates by sub-SMA

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Table 1. Unit Cost Summary

Technology/Construction Task Element	Cost	Unit Type
Direct Construction Costs		
Mobilization and Demobilization (1)	15%	%
Debris Removal & Disposal	$11,630	ACRE
Pile Removal & Disposal	$635	PILE
Pile Replacement	$6,636	PILE
Temporary Dock Relocation	$89,173	DOCK
Dredging & Transport to Offloading Facility		
Water Quality Control Structures		
Purchase, Install and Maintain Silt Curtains	$86	LF
Purchase, Install and Remove Sheet Pile Walls	$2,440	LF
Dredging		
Open water	$33.80	CY
Confined or shallow water	$47.70	CY
Dredging from shore	$41.60	CY
Residual Dredging	$79.60	CY
Miscellaneous		
Stabilization	$31.30	CY
Barge Transportation	$126.00	MILE
Hydraulically Offloading	$5.60	CY
Capping		
Material Purchase and Deliver		
Base Cap - Sand	$14.60	TON
Armor A material	$18.00	TON
Armor B material	$18.00	TON
Armor C material	$18.00	TON
Armor D material	$18.00	TON
Armor ODOT 100 material	$31.50	TON
Armor ODOT 200 material	$31.50	TON
Cap Material Placement		
Open Water Placement		
Base Cap - Open Water	$17.60	TON
Armor - Open Water	$15.50	TON
Organoclay Mat - Open Water (Purchase and Place)	$6.30	SF
EMNR Layer - Open Water	$22.00	TON
Residuals Cap - Open Water	$22.00	TON
Backfill - Open Water	$17.60	TON
Confined or Under Pier Placement		
Base Cap	$36.20	TON
Armor	$32.00	TON
Organoclay Mat (Purchase and Place)	$21.10	SF
EMNR Layer	$45.30	TON
Residuals Cap	$45.30	TON
Backfill	$36.20	TON
In Situ Treatment		
In Situ Treatment - Open Water	$4.50	SF
In Situ Treatment - Confined/Underpier	$5.80	SF
DSL Land Purchase	$142,877	ACRE
Mitigation (2)		
On site	$2,260,000	ACRE
Off site	$350,000	ACRE
Disposal		
Upland Subtitle D	$79	TON
Upland Subtitle C	$226	TON
In-Water CDF	$87	CY
Total Direct Construction Costs (3)		
Indirect Construction Costs		
Design	15%	%
Daily Responsible Party oversight and project management	$292,000	MONTHLY
Daily Agency Oversight and project management and Project Management including Environmental Monitoring	$100,000	MONTHLY
Engineering Support During Construction	$78,000	MONTHLY
Special Insurance, Bonding	5%	%
Total Indirect Construction Cost (4)		
Total Capital Costs (5)		
Contingency (6)	40%	%
Long Term Monitoring and Maintenance (7)		
ENGINEER'S OPINION OF PROBABLE COST(8)		

Notes:
General: With the exception of Long term Monitoring and Maintenance, sub-SMA Costs are presented for all Construction tasks included in this table.
(1) Mobilization and Demobilizations costs are a percentage of the Total Direct Construction Costs
(2) Mitigation Costs were determined on a SMA basis for each alternative. These costs were extrapolated to the sub-SMA level. Caution should be excercised interpreting these costs on a sub-SMA level.
(3) The Total Direct Construction Cost is defined as the sum of the Direct Construction Tasks listed above.

(4) The Total Indirect Construction Cost is defined as the sum of the Indirect Construction tasks listed above.

(5) The Total Capital Cost is the Sum of The Total Direct and Indirect Construction Costs
(6) The Contingency is defined as a percent of the Total Direct Construction Costs.
(7) Due to the nature of Long Term Monitoring activities, the Long Term Monitoring and Maintenance costs are calculated on an alternative wide basis. The costs are presented on an alternative and SMA basis for each alternative. Caution should be excercised interpreting these numbers on a SMA basis. Due to the relative size of Long term monitoring events, and the size of sub-SMAs, these costs are not extrapolated to the sub-SMA level. Refer to table 1 for Long Term Monitoring and Maintenance Costs.

(8) The Engineer's Opinion of Probable Cost is calculated for each sub-SMA, SMA, and Alternative. The sub-SMA level cost estimates presented in the Cost Tools Spreadsheet do not include modifications for a Net Present Value Analysis, or Long Term Monitoring and Maintenance Costs. Caution should be used interpreting sub-SMA level Cost Estimates.

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Table 2. Debris Removal and Disposal

ESTIMATE WORKSHEET 3.1

DEBRIS REMOVAL & DISPOSAL

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			3.1

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	2 Acre							
QUANTITY				10	1	6	2	1
ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT		TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 3.1		$4,516.20	$3,614.00	$0.00	$5,076.00		$750.00	$13,956.20
								$0.00
GRAND TOTALS		$4,516.20	$3,614.00	$0.00	$5,076.00		$750.00	$13,956.20
UNIT PRICES		$3,010.80	$2,409.34	$0.00	$3,384.00		$500.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST				UNIT PRICE	$9,304.14
									UNIT OF MEASURE	Acre
Disposal Assumption		15	$50.00		$750.00				OH&P 25%	$11,630
					$0.00					
					$0.00					
					$0.00					
					$0.00					
					$0.00					
BARE UNIT COST	$500.00	TOTAL COST			$750.00					

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00							
Oiler		1	10	$50.00	$500.00							
Captain	Tug	1	10	$54.00	$540.00							
Laborer		3	10	$37.00	$1,110.00							
Work Boat Labor		1	10	$37.00	$370.00							
Teamster		1	10	$37.00	$370.00							
Operator	Offload	1	10	$46.00	$460.00							
17% OT			0		$656.20							
BARE UNIT COST	$3,010.80	TOTAL LABOR COS T			$4,516.20	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Fuel / Oil / Grease		405	$4.00		$1,620.00	150 Ton Crane	Removal	120	1	10	$111.00	$1,110.00
PPE		9	$15.00		$135.00	Tug	Move	150	1	10	$60.00	$600.00
Equipment Repair	7%	1	$216.30		$216.30	Work Boat		15	1	10	$56.00	$560.00
Oil Boom (FT)		250	$2.00		$500.00	Scows	Debris	0	1	10	$68.00	$680.00
Debris Curtain (FT)		250	$3.50		$875.00	Barge		0	1	10	$54.00	$540.00
					$0.00	PC 300 long front	Unload	60	1	10	$50.00	$500.00
					$0.00	Dump Truck	Move	60	1	10	$32.00	$320.00
					$0.00	Clam Buck (10 cy)		0	1	10	$39.00	$390.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX AT 8%					$267.70	TAX 8%		0		0	$0.00	$376.00
BARE UNIT COST	$0.00	TOTAL MATERIAL COS T			$3,614.00	BARE UNIT COS	$0.00	405		TOTAL RENTED EQUIP		$5,076.00

Table 3. Pile Removal

ESTIMATE WORKSHEET 3.2

PILE REMOVAL

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			3.2

				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	25 EA							
QUANTITY				10	1	6	25	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
		$3,510.00	$3,651.80		$4,287.60	$1,250.00	$12,699.40
GRAND TOTALS		$3,510.00	$3,651.80	$0.00	$4,287.60	$1,250.00	$12,699.40
UNIT PRICES		$140.40	$146.07	$0.00	$171.50	$50.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
Pile Disposal		25	$50.00		$1,250.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$50.00	TOTAL COST			$1,250.00

UNIT PRICE	$507.98
UNIT OF MEASURE	EA
OH&P 25%	$635

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00
Operator		2	10	$46.00	$920.00
Oiler		1	10	$46.00	$460.00
Laborer		3	10	$37.00	$1,110.00
17% OT					$510.00
BARE UNIT COST	$140.40	TOTAL LABOR COS T			$3,510.00

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS'	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES	QUANTITY UNITS	UNIT COST	UNIT OF MEAS.	TOTAL COST
Fuel / Oil / Grease	345	$ 4.00	GAL	$1,380.00
Equipment Repairs 7%				$135.10
PPE	7	$15.00		$116.20
Oil Boom (FT)	250	$2.00		$500.00
Debris Curtain (FT)	250	$5.00		$1,250.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
TAX AT 8%				$270.50
BARE UNIT COST	$146.07	TOTAL MATERIAL COS T		$3,651.80

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
150 Ton Crane		120	1	10	$111.00	$1,110.00
Barge 200x50		0	1	10	$107.00	$1,070.00
Tender 200 HP		20	1	10	$16.00	$160.00
Tug 800 HP		150	1	10	$60.00	$600.00
Debris Barge		0	1	10	$54.00	$540.00
ICE Vibratory		15	1	10	$22.00	$220.00
Air compressor		20	1	10	$5.00	$50.00
Welder/ Torch		20	1	10	$22.00	$220.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$317.60
BARE UNIT COS'	$171.50	345		TOTAL RENTED EQUIP		$4,287.60

Table 4. Pile Replacement

ESTIMATE WORKSHEET 3.3

PILE REPLACEMENT

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			3.3

				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	15 EA							
QUANTITY				10	1	6	15	1
ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT		TOTAL SUB-CONTRACTOR	TOTAL
		$5,545.80	$68,863.18		$5,227.20		$0.00	$79,636.18
GRAND TOTALS		$5,545.80	$68,863.18	$0.00	$5,227.20		$0.00	$79,636.18
UNIT PRICES		$369.72	$4,590.88	$0.00	$348.48		$0.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$0.00	TOTAL COST			$0.00

UNIT PRICE	$5,309.08
UNIT OF MEASURE	EA
OH&P 25%	$6,636

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00
Operator		3	10	$46.00	$1,380.00
Oiler		2	10	$50.00	$1,000.00
Laborer		5	10	$37.00	$1,850.00
17% OT					$805.80
BARE UNIT COST	$369.72	TOTAL LABOR COST			$5,545.80

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COST	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES	QUANTITY UNITS	UNIT COST	UNIT OF MEAS.	TOTAL COST
Fuel / Oil / Grease	425	$ 4.00	GAL	$1,700.00
Equipment Repairs 7%				$196.00
PPE	11	$15.00		$116.20
Oil Boom	250	$2.00		$500.00
Debris Curtain	250	$5.00		$1,250.00
12" Dia. Replacement Pile	15	$4,000.00		$60,000.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
TAX AT 8%				$5,100.98
BARE UNIT COST	$4,590.88	TOTAL MATERIAL COST		$68,863.18

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
150 Ton Crane		120	1	10	$111.00	$1,110.00
Barge 200x50		0	1	10	$107.00	$1,070.00
Tender 200 HP		20	1	10	$16.00	$160.00
Tug 800 HP		150	1	10	$60.00	$600.00
Debris Barge		0	1	10	$54.00	$540.00
ICE Vibratory		15	1	10	$22.00	$220.00
Air compressor		20	1	10	$5.00	$50.00
Welder/ Torch		20	1	10	$22.00	$220.00
100 Ton Crane		80	1	10	$87.00	$870.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$387.20
BARE UNIT COST	$348.48	425		TOTAL RENTED EQUIP		$5,227.20

Table 5. Temporary Dock Relocation

ESTIMATE WORKSHEET 3.4

TEMPORARY DOCK RELOCATION

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			3.4

				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	1 Dock							
QUANTITY				10	1	6	1	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
		$4,914.00	$3,793.50		$4,460.40	$58,170.55	$71,338.45
GRAND TOTALS		$4,914.00	$3,793.50	$0.00	$4,460.40	$58,170.55	$71,338.45
UNIT PRICES		$4,914.00	$3,793.50	$0.00	$4,460.40	$58,170.55	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
10 Pile Replacement		10	$5,309.08		$53,090.78
10 Pile Removal		10	$507.98		$5,079.76
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$58,170.55	TOTAL COST			$58,170.55

UNIT PRICE	$71,338.45
UNIT OF MEASURE	Dock
OH&P 25%	$89,173

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00
Operator		3	10	$46.00	$1,380.00
Oiler		1	10	$46.00	$460.00
Laborer		5	10	$37.00	$1,850.00
17% OT					$714.00
BARE UNIT COST	$4,914.00	TOTAL LABOR COST			$4,914.00

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COST	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES	QUANTITY UNITS	UNIT COST	UNIT OF MEAS.	TOTAL COST
Fuel / Oil / Grease	375	$ 4.00	GAL	$1,500.00
Equipment Repairs 7%				$146.30
PPE	10	$15.00		$116.20
Oil Boom	250	$2.00		$500.00
Debris Curtain	250	$5.00		$1,250.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
TAX AT 8%				$281.00
BARE UNIT COST	$3,793.50	TOTAL MATERIAL COST		$3,793.50

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
150 Ton Crane		120	1	10	$111.00	$1,110.00
Barge 200x50		0	1	10	$107.00	$1,070.00
Tender 200 HP		20	1	10	$16.00	$160.00
Tug 800 HP		150	1	10	$60.00	$600.00
Pile Barge		0	1	10	$54.00	$540.00
ICE Vibratory		15	1	10	$22.00	$220.00
Air compressor		20	1	10	$5.00	$50.00
Welder/ Torch		20	1	10	$22.00	$220.00
Forklift		30	1	10	$16.00	$160.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$330.40
BARE UNIT COST	$4,460.40	375		TOTAL RENTED EQUIP		$4,460.40

Table 6. Temporary Sheetpile Walls

ESTIMATE WORKSHEET 5.2

Temp. Sheet Pile Walls

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			5.2

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	14 LF	3 pairs per day						
QUANTITY		Assume sheets 80'		10	1	6	14	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 5.2		$4,800.00	$1,756.51		$5,130.00	$14,675.28	$26,362
							$0
							$0
							$0
GRAND TOTALS		$4,800.00	$1,756.51	$0.00	$5,130.00	$14,675.28	$26,362
UNIT PRICES		$355.56	$130.11	$0.00	$380.00	$1,087.06	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
Purchase and deliver steel sheets		14	$1,082		$14,601
Remove sheet pile wall		14	$433		$5,843
Salvage Cost		14	-$427		-$5,769
					$0
					$0
					$0
BARE UNIT COST	$1,087.06	TOTAL COST			$14,675.28

UNIT PRICE	$1,953
UNIT OF MEASURE	LF
OH&P 25%	$2,440

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Laborer		8	10	$37.00	$2,960.00
Operator		4	10	$46.00	$1,840.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$0.00
BARE UNIT COST	$0.00	TOTAL LABOR COS T			$4,800.00

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES	QUANTITY UNITS	UNIT COST		TOTAL COST
Fuel / Oil / Grease	345	$ 4.00	GAL	$1,380.00
Equipment Repairs 7%				$152.60
PPE	12	$15.00		$93.80
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
				$0.00
TAX AT 8%				$130.11
BARE UNIT COST	$130.11	TOTAL MATERIAL COS T		$1,756.51

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
150 Ton Crane		120	1	10	$111.00	$1,110.00
Barge 200x50		0	1	10	$107.00	$1,070.00
Tender 200 HP		20	1	10	$16.00	$160.00
Tug 800 HP		150	1	10	$60.00	$600.00
ICE Vibratory		15	1	10	$22.00	$220.00
Air compressor		20	1	10	$47.00	$470.00
Welder/ Torch		20	1	10	$5.00	$50.00
Material Barge		0	1	10	$107.00	$1,070.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$380.00
BARE UNIT COS	$380.00	345		TOTAL RENTED EQUIP		$5,130.00

Table 7. Silt Curtain Installation

ESTIMATE WORKSHEET 5.1

SILT CURTAIN INSTALLATION

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			5.1

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	750 LF							
QUANTITY				10	1	6	750	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 5.1		$2,808.00	$44,788.90		$1,252.80	$2,800.00	$51,649.70
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$2,808.00	$44,788.90	$0.00	$1,252.80	$2,800.00	$51,649.70
UNIT PRICES		$3.74	$59.72	$0.00	$1.67	$3.73	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
IWT Delivery		1	$2,800.00		$2,800.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$0.00	TOTAL COST			$2,800.00

UNIT PRICE	$68.87
UNIT OF MEASURE	LF
OH&P 25%	$86

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Laborer		4	10	$37.00	$1,480.00
Operator		2	10	$46.00	$920.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$408.00
BARE UNIT COST	$0.00	TOTAL LABOR COS T			$2,808.00

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	45	$4.00		$180.00
Equipment Repair	7%	1	$81.20		$81.20
PPE		6	$15.00		$90.00
Turbidity Curtains		800	$51.40		$41,120.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$3,317.70
BARE UNIT COST	$59.72	TOTAL MATERIAL COS T			$44,788.90

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Work Boat		15	2	10	$56.00	$1,120.00
Forklift		30	1	2.5	$16.00	$40.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$92.80
BARE UNIT COS	$1.67	45		TOTAL RENTED EQUIP		$1,252.80

Table 8. Open Water Dredging and Transport

ESTIMATE WORKSHEET 4.1

OPEN WATER DREDGING AND TRANSPORT

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			4.1

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	700 CY							
QUANTITY				10	1	6	700	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 4.1		$2,047.50	$1,425.82	$0.00	$11,944.80	$3,500.00	$18,918.12
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$2,047.50	$1,425.82	$0.00	$11,944.80	$3,500.00	$18,918.12
UNIT PRICES		$2.93	$2.04	$0.00	$17.06	$5.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
SURVEY/CREW/BOAT			$12,000.00	WK	$2,000
SCOW HAUL TO OFFLOAD FACILITY			$1,500.00	TRIP	$1,500
BARE UNIT COST	$0.00	TOTAL COST			$3,500

UNIT PRICE	$27.03
UNIT OF MEASURE	CY
OH&P 25%	$33.8

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510
Oiler		1	10	$50.00	$500
Work Boat Laborer		1	10	$37.00	$370
Laborer		4	10	$37.00	$370
					$0
					$0
					$0
					$0
					$0
					$0
					$0
17% OT					$298
BARE UNIT COST	$4.73	TOTAL LABOR COST			$2,048

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	140	$4.00		$560.00
Equipment Repair	7%	1	$655.20		$655.20
PPE		7	$15.00		$105.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$105.62
BARE UNIT COST	$2.04	TOTAL MATERIAL COST			$1,425.82

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Derrick Rig		125	1	10	$776.00	$7,760.00
Material Scow		0	2	20	$85.00	$1,700.00
Work Boat		15	2	20	$56.00	$1,120.00
Clam Bucket		0	1	10	$48.00	$480.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$884.80
BARE UNIT COS	$17.06	140		TOTAL RENTED EQUIP		$11,944.80

Table 9. Confined Dredging

ESTIMATE WORKSHEET 4.3

CONFINED AREA DREDGING & TRANSPORT

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			4.3

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	300 CY							
QUANTITY				10	1	6	300	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 4.3		$2,082.60	$546.26	$0.00	$6,328.80	$2,500.00	$11,457.66
							$0.00
							$0.00
GRAND TOTALS		$2,082.60	$546.26	$0.00	$6,328.80	$2,500.00	$11,457.66
UNIT PRICES		$6.94	$1.82	$0.00	$21.10	$8.33	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
SURVEY/CREW/BOAT			$12,000.00	WK	$2,000
SCOW HAUL TO OFFLOAD FACILITY			$1,500.00	TRIP	$500
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$8.33	TOTAL COST			$2,500.00

UNIT PRICE	$38.19
UNIT OF MEASURE	CY
OH&P 25%	$47.7

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Dredge Operator	Dredge	1	10	$54.00	$540.00
Deck Hand	Deck Hand	2	20	$37.00	$740.00
Boat Operator	Wrk Boat	1	10	$50.00	$500.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$302.60
BARE UNIT COST	$6.94	TOTAL LABOR COST			$2,082.60

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0	0	10	$45.00	$0.00
		0	0	10	$100.00	$0.00
		0	0	10	$10.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	95	$4.00		$380.00
PPE		4	$15.00		$60.00
Equipment Repairs	7%	1	$65.80		$65.80
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX at 8%					$40.46
BARE UNIT COST	$1.82	TOTAL MATERIAL COST			$546.26

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
PC 600 Long Front	Load	60	1	10	$82.00	$820.00
Push Boat	Move	20	1	10	$40.00	$400.00
Work Boat		15	1	10	$56.00	$560.00
Barge (10'*40')		0	4	40	$31.00	$1,240.00
Scows		0	4	40	$68.00	$2,720.00
Spuds		0	4	40	$2.00	$80.00
Spud wells		0	4	40	$1.00	$40.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX at 8%		0		0	$0.00	$468.80
BARE UNIT COS	$21.10	95		TOTAL RENTED EQUIP		$6,328.80

Table 10. Dredging from Shore and Transport

ESTIMATE WORKSHEET 4.2

DREDGING FROM SHORE & TRANSPORT

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			4.2

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER Day	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	300 CY							
QUANTITY				10	1	6	300	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 4.2		$3,568.50	$3,501.36	$0.00	$2,916.00	$0.00	$9,985.86
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,568.50	$3,501.36	$0.00	$2,916.00	$0.00	$9,985.86
UNIT PRICES		$11.90	$11.67	$0.00	$9.72	$0.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$0.00	TOTAL COST			$0.00

UNIT PRICE	$33.29
UNIT OF MEASURE	CY
OH&P 25%	$41.6

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Operator		1	10	$46.00	$460.00
Laborer		3	10	$37.00	$1,110.00
Teamster		4	10	$37.00	$1,480.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$518.50
BARE UNIT COST	$11.90	TOTAL LABOR COS T			$3,568.50

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	90	$4.00		$360.00
EQUIPMENT REPAIRS	7%	1	$147.00		$147.00
PPE		8	$15.00		$120.00
Poly		1	$500.00		$500.00
Diamataceous earth		23	$94.00		$2,115.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$259.36
BARE UNIT COST	$11.67	TOTAL MATERIAL COS T			$3,501.36

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
PC 600 Long Front	Dredge	60	1	10	$82.00	$820.00
Dump Truck	Trans	30	4	40	$32.00	$1,280.00
Hydraulic Clam Bucket	Dredge	0	1	10	$60.00	$600.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$216.00
BARE UNIT COS	$9.72	90		TOTAL RENTED EQUIP		$2,916.00

Table 11. Residual Dredging

ESTIMATE WORKSHEET 4.4

Residual Dredging

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			4.4

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	250 CY							
QUANTITY				10	1	6	250	1
ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT		TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 4.4		$2,047.50	$1,425.82	$0.00	$11,944.80		$500.00	$15,918.12
								$0.00
								$0.00
								$0.00
GRAND TOTALS		$2,047.50	$1,425.82	$0.00	$11,944.80		$500.00	$15,918.12
UNIT PRICES		$8.19	$5.70	$0.00	$47.78		$2.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST			UNIT PRICE	$63.67
								UNIT OF MEASURE	CY
SCOW HAUL TO OFFLOAD FACILITY			$1,500.00	TRIP	$500			OH&P 25%	$79.6
BARE UNIT COST	$0.00	TOTAL COST			$500				

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510			0		0	$0.00	$0.00
Oiler		1	10	$50.00	$500			0		0	$0.00	$0.00
Work Boat Laborer		1	10	$37.00	$370			0		0	$0.00	$0.00
Laborer		4	10	$37.00	$370			0		0	$0.00	$0.00
					$0			0		0	$0.00	$0.00
					$0			0		0	$0.00	$0.00
					$0			0		0	$0.00	$0.00
					$0			0		0	$0.00	$0.00
					$0			0		0	$0.00	$0.00
					$0			0		0	$0.00	$0.00
					$0			0		0	$0.00	$0.00
17% OT					$298			0		0	$0.00	$0.00
BARE UNIT COST	$4.73	TOTAL LABOR COST			$2,048	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
FOG	GAL	140	$4.00		$560.00	Derrick Rig		125	1	10	$776.00	$7,760.00
Equipment Repair	7%	1	$655.20		$655.20	Material Scow		0	2	20	$85.00	$1,700.00
PPE		7	$15.00		$105.00	Work Boat		15	2	20	$56.00	$1,120.00
					$0.00	Clam Bucket		0	1	10	$48.00	$480.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX AT 8%					$105.62	TAX AT 8%		0		0	$0.00	$884.80
BARE UNIT COST	$5.70	TOTAL MATERIAL COST			$1,425.82	BARE UNIT COS	$47.78	140		TOTAL RENTED EQUIP		$11,944.80

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Table 12. Stabilization

ESTIMATE WORKSHEET 6.3

STABILIZATION

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			6.3

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	700 CY							
QUANTITY				10	1	6	700	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 6.3		$4,715.10	$5,745.60	$0.00	$7,084.80	$0.00	$17,545.50
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$4,715.10	$5,745.60	$0.00	$7,084.80	$0.00	$17,545.50
UNIT PRICES		$6.74	$8.21	$0.00	$10.12	$0.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$0.00	TOTAL COST			$0.00

UNIT PRICE	$25.07
UNIT OF MEASURE	CY
OH&P 25%	$31.3

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Foreman		1	10	$54.00	$540.00
Crane Operator	Crane	1	10	$51.00	$510.00
Operator	PC 300	1	10	$46.00	$460.00
Oiler		1	10	$50.00	$500.00
Tug Captain		1	10	$54.00	$540.00
Deck Hand		1	10	$37.00	$370.00
Work Boat		1	10	$37.00	$370.00
Laborer		2	10	$37.00	$740.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$685.10
BARE UNIT COST	$6.74	TOTAL LABOR COS T			$4,715.10

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	290	$4.00		$1,160.00
Portland Cement		115	$35		$4,025.00
PPE		9	$15.00		$135.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$425.60
BARE UNIT COST	$8.21	TOTAL MATERIAL COS T			$5,745.60

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane w/Barge		125	1	10	$225.00	$2,250.00
Material Barge		0	3	30	$54.00	$1,620.00
Transfer Barge		0	1	10	$54.00	$540.00
Lash Barges		0	1	10	$143.00	$1,430.00
Tug Boat 200 HP		150	1	10	$16.00	$160.00
Work Boat		15	1	10	$56.00	$560.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$524.80
BARE UNIT COS	$10.12	290		TOTAL RENTED EQUIP		$7,084.80

Table 13. Scow Transportation

ESTIMATE WORKSHEET 6.1

SCOW TRANSPORTATION

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			6.1

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	40 MILE							
QUANTITY				10	1	6	40	1
ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT		TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 6.1		$2,400.00	$850.18	$0.00	$777.60		$0.00	$4,027.78
								$0.00
								$0.00
								$0.00
GRAND TOTALS		$2,400.00	$850.18	$0.00	$777.60		$0.00	$4,027.78
UNIT PRICES		$60.00	$21.25	$0.00	$19.44		$0.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST			UNIT PRICE	$100.69
								UNIT OF MEASURE	MILE
					$0.00			OH&P 25%	$126
					$0.00				
					$0.00				
					$0.00				
					$0.00				
					$0.00				
BARE UNIT COST	$0.00	TOTAL COST			$0.00				

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Operator		1	10	$46.00	$460.00			0		0	$0.00	$0.00
Work Boat Laborer		1	10	$37.00	$370.00			0		0	$0.00	$0.00
Laborer		2	10	$37.00	$370.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
17% OT			0		$1,200.00			0		0	$0.00	$0.00
BARE UNIT COST	$60.00	TOTAL LABOR COS T			$2,400.00	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
FOG	GAL	165	$4.00		$660.00	Tug Boat 200 HP		150	1	10	$16.00	$160.00
Boat Repairs	10%	1	$56.00		$56.00	Work Boat		15	1	10	$56.00	$560.00
Equipment Repairs	7%	1	$11.20		$11.20			0		0	$0.00	$0.00
PPE		4	$15.00		$60.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX at 8%					$62.98	TAX AT 8%		0		0	$0.00	$57.60
BARE UNIT COST	$21.25	TOTAL MATERIAL COS T			$850.18	BARE UNIT COS	$19.44	165		TOTAL RENTED EQUIP		$777.60

Table 14. Hydraulic Offloading

ESTIMATE WORKSHEET 6.5

Hydraulic Offloading

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			6.5

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER Day	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	1,500 CY							
QUANTITY				10	1	6	1,500	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 6.5		$2,421.90	$954.40	$0.00	$3,358.80	$0.00	$6,735.10
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$2,421.90	$954.40	$0.00	$3,358.80	$0.00	$6,735.10
UNIT PRICES		$1.61	$0.64	$0.00	$2.24	$0.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$0.00	TOTAL COST			$0.00

UNIT PRICE	$4.49
UNIT OF MEASURE	CY
OH&P 25%	$5.6

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Operator	Offload	1	10	$46.00	$460.00
Laborer	Offload	3	10	$37.00	$1,110.00
Oiler	Oiler	1	10	$50.00	$500.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$351.90
BARE UNIT COST	$1.61	TOTAL LABOR COS T			$2,421.90

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	160	$4.00		$640.00
EQUIPMENT REPAIRS	7%	1	$168.70		$168.70
PPE		5	$15.00		$75.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$70.70
BARE UNIT COST	$0.64	TOTAL MATERIAL COS T			$954.40

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
100 Ton Crane	Offload	80	1	10	$87.00	$870.00
High Solids Pump		40	1	10	$47.00	$470.00
Diffuser Barge		0	1	10	$107.00	$1,070.00
Push Boat	Move	20	1	10	$40.00	$400.00
Pipe Welder		20	1	10	$30.00	$300.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$248.80
BARE UNIT COS	$2.24	160		TOTAL RENTED EQUIF		$3,358.80

Table 15. Open Water Capping

ESTIMATE WORKSHEET 7.1

OPEN WATER CAPPING

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.1

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	1,500 Ton							
QUANTITY				10	1	6	1,500	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.1		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
UNIT PRICES		$2.36	$1.38	$0.00	$9.01	$1.33	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
Survey/ Crew/ Boat					$2,000.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$0.00	TOTAL COST			$2,000.00

		UNIT PRICE	$14.08
		UNIT OF MEASURE	Ton
Base (1500 Ton / day)		OH&P 25%	$17.6
Armor (1700 Ton / day)		OH&P 25%	$15.5

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00
Deck Hand		4	40	$37.00	$1,480.00
Tug Captain		1	10	$54.00	$540.00
Oiler		1	10	$50.00	$500.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$515.10
BARE UNIT COST	$2.36	TOTAL LABOR COS T			$3,545.10

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	290	$4.00		$1,160.00
Equipment Repair	7%	1	$663.60		$663.60
PPE		6	$15.00		$90.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$153.09
BARE UNIT COST	$1.38	TOTAL MATERIAL COS T			$2,066.69

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Derrick Rig		125	1	10	$776.00	$7,760.00
Material Scow		0	3	30	$85.00	$2,550.00
Tug		150	1	10	$60.00	$600.00
Work Boat		15	2	20	$56.00	$1,120.00
Clam Bucket		0	1	10	$48.00	$480.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$1,000.80
BARE UNIT COS	$9.01	290		TOTAL RENTED EQUIP		$13,510.80

Table 16. EMNR Layer Placement

ESTIMATE WORKSHEET 7.1.1

EMNR Layer Placement

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.1.1

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	1,200 Ton							
QUANTITY				10	1	6	1,200	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.1.1		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
UNIT PRICES		$2.95	$1.72	$0.00	$11.26	$1.67	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST			UNIT PRICE	$17.60
								UNIT OF MEASURE	Ton
Survey/ Crew/ Boat					$2,000.00		Base (1200 Ton / day)	OH&P 25%	$22.0
					$0.00				
					$0.00				
					$0.00				
					$0.00				
					$0.00				
BARE UNIT COST	$0.00	TOTAL COST			$2,000.00				

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00			0		0	$0.00	$0.00
Deck Hand		4	40	$37.00	$1,480.00			0		0	$0.00	$0.00
Tug Captain		1	10	$54.00	$540.00			0		0	$0.00	$0.00
Oiler		1	10	$50.00	$500.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
17% OT			0		$515.10			0		0	$0.00	$0.00
BARE UNIT COST	$2.95	TOTAL LABOR COS T			$3,545.10	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
FOG	GAL	290	$4.00		$1,160.00	Derrick Rig		125	1	10	$776.00	$7,760.00
Equipment Repair	7%	1	$663.60		$663.60	Material Scow		0	3	30	$85.00	$2,550.00
PPE		6	$15.00		$90.00	Tug		150	1	10	$60.00	$600.00
					$0.00	Work Boat		15	2	20	$56.00	$1,120.00
					$0.00	Clam Bucket		0	1	10	$48.00	$480.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX AT 8%					$153.09	TAX AT 8%		0		0	$0.00	$1,000.80
BARE UNIT COST	$1.72	TOTAL MATERIAL COS T			$2,066.69	BARE UNIT COS	$11.26	290		TOTAL RENTED EQUIP		$13,510.80

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Table 17. Residuals Cap Placement

ESTIMATE WORKSHEET 7.1.2

Residuals Cap Placement

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.1.2

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	1,200 Ton							
QUANTITY				10	1	6	1,200	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.1.2		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
UNIT PRICES		$2.95	$1.72	$0.00	$11.26	$1.67	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST			UNIT PRICE	$17.60
								UNIT OF MEASURE	Ton
Survey/ Crew/ Boat					$2,000.00		Base (1200 Ton / day)	OH&P 25%	$22.0
					$0.00				
					$0.00				
					$0.00				
					$0.00				
					$0.00				
BARE UNIT COST	$0.00	TOTAL COST			$2,000.00				

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00			0		0	$0.00	$0.00
Deck Hand		4	40	$37.00	$1,480.00			0		0	$0.00	$0.00
Tug Captain		1	10	$54.00	$540.00			0		0	$0.00	$0.00
Oiler		1	10	$50.00	$500.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
17% OT			0		$515.10			0		0	$0.00	$0.00
BARE UNIT COST	$2.95	TOTAL LABOR COS T			$3,545.10	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
FOG	GAL	290	$4.00		$1,160.00	Derrick Rig		125	1	10	$776.00	$7,760.00
Equipment Repair	7%	1	$663.60		$663.60	Material Scow		0	3	30	$85.00	$2,550.00
PPE		6	$15.00		$90.00	Tug		150	1	10	$60.00	$600.00
					$0.00	Work Boat		15	2	20	$56.00	$1,120.00
					$0.00	Clam Bucket		0	1	10	$48.00	$480.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX AT 8%					$153.09	TAX AT 8%		0		0	$0.00	$1,000.80
BARE UNIT COST	$1.72	TOTAL MATERIAL COS T			$2,066.69	BARE UNIT COS	$11.26	290		TOTAL RENTED EQUIP		$13,510.80

Table 18. Backfill Placement

ESTIMATE WORKSHEET 7.1.3

BACKFILL PLACEMENT

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.1.3

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	1,500 Ton							
QUANTITY				10	1	6	1,500	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.1.3		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,545.10	$2,066.69	$0.00	$13,510.80	$2,000.00	$21,122.59
UNIT PRICES		$2.36	$1.38	$0.00	$9.01	$1.33	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
Survey/ Crew/ Boat					$2,000.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$0.00	TOTAL COST			$2,000.00

UNIT PRICE	$14.08
UNIT OF MEASURE	Ton
Base (1500 Ton / day) OH&P 25%	$17.60

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
Crane Operator		1	10	$51.00	$510.00
Deck Hand		4	40	$37.00	$1,480.00
Tug Captain		1	10	$54.00	$540.00
Oiler		1	10	$50.00	$500.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$515.10
BARE UNIT COST	$2.36	TOTAL LABOR COST			$3,545.10

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COST	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	290	$4.00		$1,160.00
Equipment Repair	7%	1	$663.60		$663.60
PPE		6	$15.00		$90.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$153.09
BARE UNIT COST	$1.38	TOTAL MATERIAL COST			$2,066.69

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Derrick Rig		125	1	10	$776.00	$7,760.00
Material Scow		0	3	30	$85.00	$2,550.00
Tug		150	1	10	$60.00	$600.00
Work Boat		15	2	20	$56.00	$1,120.00
Clam Bucket		0	1	10	$48.00	$480.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX AT 8%		0		0	$0.00	$1,000.80
BARE UNIT COST	$9.01	290		TOTAL RENTED EQUIP		$13,510.80

Table 19. Confined Underpier Capping

ESTIMATE WORKSHEET 7.2

CONFINED AREA CAPPING

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.2

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	500 TON							
QUANTITY				10	1	6	500	1
ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT		TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.2		$3,159.00	$1,439.53	$0.00	$7,894.80		$2,000.00	$14,493.33
								$0.00
								$0.00
								$0.00
GRAND TOTALS		$3,159.00	$1,439.53	$0.00	$7,894.80		$2,000.00	$14,493.33
UNIT PRICES		$6.32	$2.88	$0.00	$15.79		$4.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST			UNIT COST	$28.99
								UNIT OF MEASURE	TON
Survey/ Crew/ Boat					$2,000.00	Base (500 Ton / day)		OH&P 25%	$36.20
					$0.00	Armor (567 Ton/day)		OH&P 25%	$32.00
					$0.00				
					$0.00				
					$0.00				
					$0.00				
BARE UNIT COST	$4.00	TOTAL COST			$2,000.00				

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
600 Hoe Operator	Hoe	1	10	$46.00	$460.00			0	0	10	$45.00	$0.00
Tug Captain		1	10	$54.00	$540.00			0	0	10	$100.00	$0.00
Boat Operator		1	10	$50.00	$500.00			0	0	10	$10.00	$0.00
Deck Hand		2	10	$37.00	$740.00			0		0	$0.00	$0.00
Telebelt Operator	Place Cap	1	10	$46.00	$460.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
17% OT			0		$459.00			0		0	$0.00	$0.00
BARE UNIT COST	$6.32	TOTAL LABOR COS T			$3,159.00	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
FOG	GAL	285	$4.00		$1,140.00	PC 600	Load	60	1	10	$82.00	$820.00
Equipment Repairs	7%	1	$102.90		$102.90	Tug		150	1	10	$16.00	$160.00
PPE		6	$15.00		$90.00	Work Boat		15	1	10	$56.00	$560.00
						Barge		0	6	60	$54.00	$3,240.00
					$0.00	Scows		0	2	20	$68.00	$1,360.00
					$0.00	Push Boat	Move	20	1	10	$40.00	$400.00
					$0.00	Spuds		0	4	40	$2.00	$80.00
					$0.00	Spud wells		0	4	40	$1.00	$40.00
					$0.00	Telebelt		40	1	10	$65.00	$650.00
					$0.00			0	0	0	$0.00	$0.00
					$0.00			0	0	0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX AT 8%					$106.63	TAX at 8%		0		0	$0.00	$584.80
BARE UNIT COST	$2.88	TOTAL MATERIAL COS T			$1,439.53	BARE UNIT COS	$15.79	285		TOTAL RENTED EQUIP		$7,894.80

Table 20. Confined EMNR Layer Placement

ESTIMATE WORKSHEET 7.2.1

CONFINED AREA EMNR

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.2.1

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	400 TON							
QUANTITY				10	1	6	400	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.2.1		$3,159.00	$1,439.53	$0.00	$7,894.80	$2,000.00	$14,493.33
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,159.00	$1,439.53	$0.00	$7,894.80	$2,000.00	$14,493.33
UNIT PRICES		$7.90	$3.60	$0.00	$19.74	$5.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST			UNIT COST	$36.23
								UNIT OF MEASURE	TON
Survey/ Crew/ Boat					$2,000.00		Base (400 Ton / day)	OH&P 25%	$45.30
					$0.00				
					$0.00				
					$0.00				
					$0.00				
					$0.00				
BARE UNIT COST	$5.00	TOTAL COST			$2,000.00				

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
600 Hoe Operator	Hoe	1	10	$46.00	$460.00			0	0	10	$45.00	$0.00
Tug Captain		1	10	$54.00	$540.00			0	0	10	$100.00	$0.00
Boat Operator		1	10	$50.00	$500.00			0	0	10	$10.00	$0.00
Deck Hand		2	10	$37.00	$740.00			0		0	$0.00	$0.00
Telebelt Operator	Place Cap	1	10	$46.00	$460.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
17% OT			0		$459.00			0		0	$0.00	$0.00
BARE UNIT COST	$7.90	TOTAL LABOR COS T			$3,159.00	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
FOG	GAL	285	$4.00		$1,140.00	PC 600	Load	60	1	10	$82.00	$820.00
Equipment Repairs	7%	1	$102.90		$102.90	Tug		150	1	10	$16.00	$160.00
PPE		6	$15.00		$90.00	Work Boat		15	1	10	$56.00	$560.00
						Barge		0	6	60	$54.00	$3,240.00
					$0.00	Scows		0	2	20	$68.00	$1,360.00
					$0.00	Push Boat	Move	20	1	10	$40.00	$400.00
					$0.00	Spuds		0	4	40	$2.00	$80.00
					$0.00	Spud wells		0	4	40	$1.00	$40.00
					$0.00	Telebelt		40	1	10	$65.00	$650.00
					$0.00			0	0	0	$0.00	$0.00
					$0.00			0	0	0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX AT 8%					$106.63	TAX at 8%		0		0	$0.00	$584.80
BARE UNIT COST	$3.60	TOTAL MATERIAL COS T			$1,439.53	BARE UNIT COS	$19.74	285		TOTAL RENTED EQUIP		$7.894.80

Table 21. Confined Residuals Cap Placement

ESTIMATE WORKSHEET 7.2.2

CONFINED AREA RESIDUALS

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.2.2

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	400 TON							
QUANTITY				10	1	6	400	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.2.2		$3,159.00	$1,439.53	$0.00	$7,894.80	$2,000.00	$14,493.33
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,159.00	$1,439.53	$0.00	$7,894.80	$2,000.00	$14,493.33
UNIT PRICES		$7.90	$3.60	$0.00	$19.74	$5.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
Survey/ Crew/ Boat					$2,000.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$5.00	TOTAL COST			$2,000.00

Base (400 Ton / day)

UNIT COST	$36.23
UNIT OF MEASURE	TON
OH&P 25%	$45.30

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
600 Hoe Operator	Hoe	1	10	$46.00	$460.00
Tug Captain		1	10	$54.00	$540.00
Boat Operator		1	10	$50.00	$500.00
Deck Hand		2	10	$37.00	$740.00
Telebelt Operator	Place Cap	1	10	$46.00	$460.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$459.00
BARE UNIT COST	$7.90	TOTAL LABOR COS T			$3,159.00

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0	0	10	$45.00	$0.00
		0	0	10	$100.00	$0.00
		0	0	10	$10.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	285	$4.00		$1,140.00
Equipment Repairs	7%	1	$102.90		$102.90
PPE		6	$15.00		$90.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$106.63
BARE UNIT COST	$3.60	TOTAL MATERIAL COS T			$1,439.53

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
PC 600	Load	60	1	10	$82.00	$820.00
Tug		150	1	10	$16.00	$160.00
Work Boat		15	1	10	$56.00	$560.00
Barge		0	6	60	$54.00	$3,240.00
Scows		0	2	20	$68.00	$1,360.00
Push Boat	Move	20	1	10	$40.00	$400.00
Spuds		0	4	40	$2.00	$80.00
Spud wells		0	4	40	$1.00	$40.00
Telebelt		40	1	10	$65.00	$650.00
		0	0	0	$0.00	$0.00
		0	0	0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX at 8%		0		0	$0.00	$584.80
BARE UNIT COS	$19.74	285		TOTAL RENTED EQUIP		$7,894.80

Table 22. Confined Backfill Placement

ESTIMATE WORKSHEET 7.2.3

CONFINED AREA BACKFILL

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.2.3

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	500 TON							
QUANTITY				10	1	6	500	1

ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT	TOTAL SUB-CONTRACTOR	TOTAL
WORKSHEET 7.2.3		$3,159.00	$1,439.53	$0.00	$7,894.80	$2,000.00	$14,493.33
							$0.00
							$0.00
							$0.00
GRAND TOTALS		$3,159.00	$1,439.53	$0.00	$7,894.80	$2,000.00	$14,493.33
UNIT PRICES		$6.32	$2.88	$0.00	$15.79	$4.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST
Survey/ Crew/ Boat					$2,000.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
BARE UNIT COST	$4.00	TOTAL COST			$2,000.00

UNIT COST	$28.99				
UNIT OF MEASURE	TON				
Base (500 Ton / day)	OH&P	25%	$36.30		

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST
600 Hoe Operator	Hoe	1	10	$46.00	$460.00
Tug Captain		1	10	$54.00	$540.00
Boat Operator		1	10	$50.00	$500.00
Deck Hand		2	10	$37.00	$740.00
Telebelt Operator	Place Cap	1	10	$46.00	$460.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
17% OT			0		$459.00
BARE UNIT COST	$6.32	TOTAL LABOR COS T			$3,159.00

OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
		0	0	10	$45.00	$0.00
		0	0	10	$100.00	$0.00
		0	0	10	$10.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST
FOG	GAL	285	$4.00		$1,140.00
Equipment Repairs	7%	1	$102.90		$102.90
PPE		6	$15.00		$90.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
					$0.00
TAX AT 8%					$106.63
BARE UNIT COST	$2.88	TOTAL MATERIAL COS T			$1,439.53

RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
PC 600	Load	60	1	10	$82.00	$820.00
Tug		150	1	10	$16.00	$160.00
Work Boat		15	1	10	$56.00	$560.00
Barge		0	6	60	$54.00	$3,240.00
Scows		0	2	20	$68.00	$1,360.00
Push Boat	Move	20	1	10	$40.00	$400.00
Spuds		0	4	40	$2.00	$80.00
Spud wells		0	4	40	$1.00	$40.00
Telebelt		40	1	10	$65.00	$650.00
		0	0	0	$0.00	$0.00
		0	0	0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
		0		0	$0.00	$0.00
TAX at 8%		0		0	$0.00	$584.80
BARE UNIT COS	$15.79	285		TOTAL RENTED EQUIP		$7,894.80

Table 23. Organoclay Mat

ESTIMATE WORKSHEET 7.3

ORGANOCLAY MAT

BID DATE	PROJECT LOCATION	DESCRIPTION OF ITEM	ITEM NO.
			7.3

				PRODUCTION DATA				
				HOURS PER SHIFT	SHIFTS PER DAY	DAYS PER WEEK	DAILY UNIT PRODUCTION RATE	DAYS REQ. TO COMPLETE
TOTAL QUANTITY ON PROPOSAL	12,000 SF							
QUANTITY				10	1	6	12,000	1
ESTIMATE WORKSHEET		TOTAL LABOR	TOTAL MATERIAL	TOTAL EQUIPMENT	TOTAL RENTED EQUIPMENT		TOTAL SUB-CONTRACTOR	TOTAL
		$4,083.30	$35,964.00	$0.00	$3,207.60		$12,000.00	$55,254.90
								$5,525.49
								$0.00
								$0.00
GRAND TOTALS		$4,083.30	$35,964.00	$0.00	$3,207.60		$12,000.00	$60,780.39
UNIT PRICES		$0.34	$3.00	$0.00	$0.27		$1.00	

SUB-CONTRACTOR	WORK TO PERFORM	QUANTITY UNITS	UNIT COST		TOTAL COST			UNIT PRICE	$5.07
								UNIT OF MEASURE	SF
Divers		1	$10,000.00		$10,000.00	Open		OH&P 25%	$6.30
Survey/ Crew/ Boat					$2,000.00	Confined (30% Open)		OH&P 25%	$21.10
					$0.00				
					$0.00				
					$0.00				
					$0.00				
BARE UNIT COST	$1.00	TOTAL COST			$12,000.00				

LABOR CLASSIFICATION	WORK TO PERFORM	TOTAL MEN	TOTAL HOURS	HRLY RATE	TOTAL COST	OWN EQUIPMENT	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
Tug Captain		1	10	$54.00	$540.00			0		0	$0.00	$0.00
Crane Operator		1	10	$51.00	$510.00			0		0	$0.00	$0.00
Oiler		1	10	$50.00	$500.00			0		0	$0.00	$0.00
Operator		1	10	$46.00	$460.00			0		0	$0.00	$0.00
Labor		4	10	$37.00	$1,480.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
			0	$0.00	$0.00			0		0	$0.00	$0.00
17% OT			0		$593.30			0		0	$0.00	$0.00
BARE UNIT COST	$0.34	TOTAL LABOR COS T			$4,083.30	BARE UNIT COS	$0.00	0		TOTAL SES COST		$0.00

MATERIAL / SERVICES		QUANTITY UNITS	UNIT COST		TOTAL COST	RENTAL EQUIP	WORK TO PERFORM	FUEL GALS.	TOTAL UNITS	TOTAL HOURS	HRLY RATE	TOTAL COST
FOG	GAL	195	$4.00		$780.00	TUG		150	1	10	$60.00	$600.00
Reactive Core Mat (15% loss)		12,000	$2.70		$32,400.00	Crane w/ Barge		0	1	10	$111.00	$1,110.00
PPE		8	$15.00		$120.00	Material Barge		0	1	10	$54.00	$540.00
					$0.00	Forklift		30	1	10	$16.00	$160.00
					$0.00	Work Boat		15	1	10	$56.00	$560.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
					$0.00			0		0	$0.00	$0.00
TAX AT 8%					$2,664.00	TAX at 8%		0		0	$0.00	$237.60
BARE UNIT COST	$3.00	TOTAL MATERIAL COS T			$35,964.00	BARE UNIT COS	$0.27	195		TOTAL RENTED EQUIP		$3,207.60

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Table 24. Upland Subtitle D Landfill Disposal Cost Buildup

Task	Unit	Quantity	Unit Cost	Total Cost	Basis/Notes
Transload Facility Development					
Transload facility permitting	LS	1	$40,000	$5,000	(1); Based on past experience normalized over total landfill disposal volume
Transload facility development	LS	1	$7,500,000	$863,000	(1,2); One time cost normalized over total estimated landfill disposal volume
Yearly property lease rate	ACRE	20	$23,500	$470,000	(3); Lease rate based on Port of Portland T6 public records.
Yearly gondola mobilization	Cars	500	$4,000	$2,000,000	(4); Car mobilization price from Waste Management
Materials Handling and Stabilization					
Materials handling from barge to upland stockpile	TON	345,000	$6	$2,070,000	(5); Offloading rate based on crane on dock and off-road trucks hauling to stockpile
Purchase Diatomaceous Earth (DE)	TON	17,250	$94	$1,622,000	Assumed 5% by weight mixing rate. DE price from Waste Management
Mix DE with dredged material to improve handling	TON	17,250	$2	$35,000	Cost based on end loader mixing DE and dredge material
Materials handling from stockpile to rail cars	TON	362,250	$5	$1,811,000	Cost assumes end loaders loading to rail cars on each side of stockpiles
Water treatment	1,000 gal	7,500	$10	$75,000	(6); Water treatment cost based on recent construction project.
Transportation and Disposal					
Rail transportation and tipping fee at Subtitle D landfill	TON	362,250	$50	$18,113,000	Price from Waste Management for unit train service.
Inspection and Monitoring of Transload Facility					
Labor inspections during operations	FTE	2.5	$75,000	$188,000	Assumes 7 people during 4 months of dredging and 1 during subsequent 2 months
Environmental monitoring direct costs during offloading	MONTH	4	$15,000	$60,000	Cost for boat, monitoring equipment and chemistry analysis
Reporting	Year	1	$40,000	$40,000	Based on past experience
Total Estimated Cost				**$27,352,000**	
Total Cubic Yards Handled Per Season				**230,000**	(7)
Total Tons Handled Per Season				**345,000**	Assumes 1.5 tons/cy unit weight
Estimated Cost Per Cubic Yard				**$119**	
Estimated Cost Per Ton				**$79**	

Notes:

(1) Assumed total dredge volume taken to upland landfill through life of facility: 2,000,000 cy
Alts B&C - ~200,000 to 1,260,000 cy (w/o in-water); 0 to 600,000 cy (w/ in-water)
Alts D&E - ~440,000 to 2,300,000 cy (w/o in-water); 0 to 600,000 cy (w/ in-water)
Alt F - ~2,200,000 to 6,698,000 cy (w/o in-water); 0 to 4,305,000 cy (w/ in-water)

(2) Assumption for site development:
- Pier/dock structure development/upgrade (~$1.5M)
- Addition of ~10,000 feet of new rail line & ~5 switches (~$3.5M)
- Creation of 12 to 15 acres of bermed stockpile areas holding up to 70,000 cy of sediment (~$1M)
- Mobilization of offloading equipment, off-road trucks, end loaders and other equipment (~$0.5M)
- Miscellaneous site improvements (utilities, water treatment, offices, etc.) (~$1M)

(3) Assumed another ~5 acres for support activities for total site need of 20 acres. Lease rate is yearly.

(4) Assuming 3,000 to 5,000 tons/day loaded out, 100 tons/gondola, and 10-day turnaround produces 300 to 500 rail cars needed each year.

(5) Assumes 230,000 cy/season and 1.5 tons/cy weight conversion.

(6) Assumes 15-acre stockpile receiving 37 inches/year of rain over the 6-month stockpile time.

(7) Assumes for transload volume per year:
- 85 to 105 days of dredging (5 to 6 days/week) in a 120-day construction window
- 700 cy/day/site and 2 to 3 cleanup sites being dredged at one time
- 10 to 15 acres of 5-foot stockpiles can hold between 70,000 and 120,000 cy for shipping to the landfill after the dredging season is complete.

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Table 25. Upland Subtitle C Landfill Disposal Cost Buildup

Task	Unit	Quantity	Unit Cost	Total Cost	Basis/Notes
Transload Facility Development					
Transload facility permitting	LS	1	$40,000	$0	(1); Based on past experience normalized over total landfill disposal volume
Transload facility development	LS	1	$7,500,000	$86,000	(1,2); One time cost normalized over total estimated landfill disposal volume
Yearly property lease rate	ACRE	0	$23,500	$0	(3); Lease rate based on Port of Portland T6 public records.
Yearly gondola mobilization	Cars	0	$4,000	$0	(4); Car mobilization price from Waste Management
Materials Handling and Stabilization					
Materials handling from barge to upland stockpile	TON	34,500	$6	$207,000	(5); Offloading rate based on crane on dock and off-road trucks hauling to stockpile
Purchase Diatomaceous Earth (DE)	TON	5,175	$94	$486,000	Assumed 15% by weight mixing rate. DE price from Waste Management
Mix DE with dredged material to improve handling	TON	5,175	$2	$10,000	Cost based on end loader mixing DE and dredge material
Materials handling from stockpile to rail cars	TON	39,675	$5	$198,000	Cost assumes end loaders loading to rail cars on each side of stockpiles
Water treatment	1,000 gal	0	$10	$0	(6); Water treatment cost based on recent construction project.
Transportation and Disposal					
Rail transportation and tipping fee at Subtitle D landfill	TON	39,675	$170	$6,758,000	Price from Waste Management for truck transport and coverted to unit train service.
Inspection and Monitoring of Transload Facility					
Labor inspections during operations	FTE	0.6	$75,000	$44,000	Assumes 7 people during roughly 1 month of offloading throughout the projec
Environmental monitoring direct costs during offloading	MONTH	1	$15,000	$15,000	Cost for boat, monitoring equipment and chemistry analysis
Reporting	Year	0.25	$40,000	$10,000	Only a quarter of costs allocated to Subtitle C work
Total Estimated Cost				**$7,814,000**	
Total Cubic Yards Handled Per Season				**23,000**	(7)
Total Tons Handled Per Season				**34,500**	Assumes 1.5 tons/cy unit weight
Estimated Cost Per Cubic Yard				**$340**	
Estimated Cost Per Ton				**$226**	

Notes:

(1) Assumed total dredge volume taken to upland landfill through life of facility: 2,000,000 cy

(2) Assumption for site development:

- Pier/dock structure development/upgrade (~$1.5M)
- Addition of ~10,000 feet of new rail line & ~5 switches (~$3.5M)
- Creation of 12 to 15 acres of bermed stockpile areas holding up to 100,000 cy of sediment (~$1M)
- Mobilization of offloading equipment, off-road trucks, end loaders and other equipment (~$0.5M)
- Miscellaneous site improvements (utilities, water treatment, offices, etc.) (~$1M)

(3) Assumed another ~5 acres for support activities for total site need of 20 acres. Lease rate is yearly. Assumes lease paid by the Subtitle D disposal work since the Subtitle C is a fraction of the D volume.

(4) Assuming 3,000 to 5,000 tons/day loaded out, 100 tons/gondola, and 10-day turnaround produces 300 to 500 rail cars needed each year. Assumes cars mobilized as part of Subtitle D disposal work.

(5) Assumes 400,000 cy/season and 1.5 tons/cy weight conversion.

(6) Assumes 15-acre stockpile receiving 37 inches/year of rain over the 6-month stockpile time. Assumes water treatment costs covered by the Subtitle D disposal work since the Subtitle C is a fraction of the D volume.

(7) Only a limited amount of potential Subtitle C material is currently estimated (say 10% of total amount)

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Table 26. In Situ Treatment Cost Buildups

Assumption: Material placed as pellet directly on the mudline using similar techniques as Enhanced EMNR placement.

Open water placement rate calculation:
Assume that the same placement method as EMNR which is:
1,200 tons/day or 21,600 sf/day

Confined water placement rate calculation:
Assume that the same placement method as EMNR which is:
400 tons/day or 7,200 sf/day

Unit weight of Sedimite:

Pounds per acre of Sedimite:	58,080
CY per acre of Sedimite:	48
Tons/cy of Sedimite:	0.61

Assumes carbon is Sedimite placed at a AC concentration of 6 pounds per square yard. Costs from Upal Ghosh

Material costs per acre:	$145,200

Assumes material placed with same method for EMNR

Tons per acre of material:	29 6 pounds/SY carbon, with Sedimite at 50% carbon by weight or 58,080 pounds/acre
Open water placement	
Daily placement costs:	$26,000
Placement costs per sf:	$1.2
Confined area placement:	
Daily placement costs:	$18,000
Placement costs per sf:	$2.5

Material and placement cost per acre - open water:	$198,000
Material and placement cost per acre - confined area:	$254,000

Material and placement cost per square foot - open water:	$4.50
Material and placement cost per square foot - confined area:	$5.80

Table 27. Equipment Rates

Equipment	Rate (Hourly)	Notes
150 Ton Crane	$111.00	Rental rate Blue Book for construction equipment - 181.40 MT lift capacity
100 Ton Crane	$87.00	Rental rate Blue Book for construction equipment - 99.80 MT lift capacity
Crane w/Barge	$225.00	Rental rate Blue Book for construction equipment
Derrick Rig 100 Ton Capacity	$776.00	Local contractor known equipment rate
Tug 250 HP	$16.00	Rental rate Blue Book for construction equipment
Tug 700 HP	$60.00	Rental rate Blue Book for construction equipment
Barge	$54.00	Rental rate Blue Book for construction equipment
Barge 200x60	$107.00	Rental rate Blue Book for construction equipment
Debris Barge	$54.00	Rental rate Blue Book for construction equipment
Pile Barge	$54.00	Rental rate Blue Book for construction equipment
Material Barge	$54.00	Rental rate Blue Book for construction equipment
Transfer Barge	$54.00	Rental rate Blue Book for construction equipment
Lash Barges	$143.00	Local contractor known equipment rate
Barge (50')	$31.00	Rental rate Blue Book for construction equipment - 50-foot length, 9-foot draft
Diffuser Barge	$107.00	Rental rate Blue Book for construction equipment
Work Boat	$56.00	Local contractor known equipment rate
Push Boat	$40.00	Rental rate Blue Book for construction equipment - 45-foot length, 435 HP
Scows	$68.00	National contractor known equipment rate
Material Scow	$85.00	National contractor known equipment rate
PC 600 LC-7	$82.00	Rental rate Blue Book for construction equipment
PC 300 LC-7	$50.00	Rental rate Blue Book for construction equipment
Telebelt	$65.00	National contractor known equipment rate
MOXY 31 Ton	$32.00	Rental rate Blue Book for construction equipment
Dump Truck	$32.00	Rental rate Blue Book for construction equipment
450 Loader	$33.00	Rental rate Blue Book for construction equipment - 5.50 cubic yard
Clam Bucket (10 cy) - Debris	$39.00	National contractor known equipment rate
Clam Bucket - Dredge and Cap	$48.00	National contractor known equipment rate
Hydraulic Clam Bucket - Shoreline Dredging	$60.00	National contractor known equipment rate
High Solids Pump	$47.00	National contractor known equipment rate
Air compressor	$5.00	Rental rate Blue Book for construction equipment
Welder/ Torch	$22.00	Local contractor known equipment rate
ICE Vibratory	$22.00	Rental rate Blue Book for construction equipment
Forklift	$16.00	National contractor known equipment rate
Spuds	$2.00	National contractor known equipment rate
Spud wells	$1.00	National contractor known equipment rate
Pipe Welder	$30.00	National contractor known equipment rate
Pug Mill	$65.00	National contractor known equipment rate

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Table 28. Labor Rates

Labor Classification	Hourly Rate	Burden Rate	Sub Total	Total Rate	Bid Rate
Health and Safety Officer	$30.60	$9.18	$39.78	$39.78	$40.00
Office Clerk	$0.00	$0.00	$0.00	$0.00	$0.00
Project Engineer	$28.98	$5.80	$34.78	$34.78	$40.00
Project Manager	$44.94	$8.99	$53.93	$53.93	$65.00
QA/QC Manager	$30.06	$6.01	$36.07	$36.07	$40.00
Superintendent	$44.94	$13.48	$58.42	$58.42	$65.00
Captain					$54.00
Tug Captain					$54.00
Derrick Captain					$54.00
Foreman					$54.00
Crane Operator					$51.00
Dredge Operator					$54.00
Boat Operator					$50.00
Oiler					$50.00
Operator					$46.00
Laborer					$37.00
Work Boat Laborer					$37.00
Deck Hand					$37.00
Teamster					$37.00

Burden Rates	
Office Personnel	20.00%
Field Personnel	30.00%

Table 29A. Material Costs

Material	Unit	FOB Plant Price	Barge Load Fee	Transport Fee[a]	Contractor Markup[b]	Total Unit Cost	Notes
Base Cap	Ton	$12	$0.5	$0.5	$1.63	$14.6	Knife River quote #7838 8/23/2010 from Gordy Jarman
Armor Material A	Ton	$15	$0.5	$0.5	$2.00	$18.0	Knife River quote #7838 8/23/2010 from Gordy Jarman
Armor Material B	Ton	$15	$0.5	$0.5	$2.00	$18.0	Knife River quote #7838 8/23/2010 from Gordy Jarman
Armor Material C	Ton	$15	$0.5	$0.5	$2.00	$18.0	Knife River quote #7838 8/23/2010 from Gordy Jarman
Armor Material D	Ton	$15	$0.5	$0.5	$2.00	$18.0	Knife River quote #7838 8/23/2010 from Gordy Jarman
ODOT 100	Ton	$27	$0.5	$0.5	$3.50	$31.5	Knife River quote #7838 8/23/2010 from Gordy Jarman
ODOT 200	Ton	$27	$0.5	$0.5	$3.50	$31.5	Knife River quote #7838 8/23/2010 from Gordy Jarman
Organoclay Mat	SF	$2.2	NA	$0.1	$0.29	$3.0	Increased the cost 15% to account for overlaps. Cetco quote 10/4/10 from James Wang

Notes:

[a] Assumes aggregate transported by barge and mat by truck to middle of harbor

[b] Contractor Markup: 12.5%

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Table 29B. Vendor Quote

KNIFE RIVER
AN MDU RESOURCES COMPANY
OR CCB #2101 WA #M0RSEBI169BR

Quote #: 7838

Project Name:
WILLAMETTE RIVER PROJECT

Delivery Address:
T-4 WILLAMETTE RIVER

Customer: *ANCHOR QEA*
Attention: *Micheal Crystal*
P: 206-287-9130
mjcrystal@anchorqea.com

Source	Product Name	FOB Plant Price		Transfer Delivery		Solo Delivery	
Reichold	4"-3" SMALL COBBLES	$15.00	Ton	$22.00	Ton		
Reichold	2"-1" FINE GRAVEL	$15.00	Ton	$22.00	Ton		
Reichold	¾"-1/4" FINE GRAVEL	$15.00	Ton	$22.00	Ton		
Reichold	3 ½" -2 ½" COURSE GRAVEL	$15.00	Ton	$22.00	Ton		
Reichold	GRAVELLY SAND	$12.00	Ton	$19.00	Ton		
Angell Quarry	CLASS 100 RIP RAP	$20.00	Ton			$27.00	Ton
Angell Quarry	CLASS 200 RIP RAP	$20.00	Ton			$27.00	Ton
Angell Quarry	CLASS 700 RIP RAP	$25.00	Ton			$32.00	Ton
Angell Quarry	CLASS 2000 RIP RAP	$25.00	Ton			$32.00	Ton

The following terms will apply to material purchased at Knife River for this project:

1. Prices include standard ODOT quality control and process control tests at the plant during production of the above quoted product(s). Acceptance of materials supplied by Knife River is at the plant at the time of production.
2. All gradations per ODOT specifications unless otherwise stated. Materials contain natural moisture only.
3. Credit terms net 15th of month following invoice.
4. Prices are for all materials and dump sites quoted inclusive.
5. Per ton pricing is based upon full load deliveries. Short loads are priced at truck time plus materials.
6. Knife River will attempt to secure adequate trucking with a minimum of 48 hours notice.
7. If applicable, dump site agreement must be signed before any export will be accepted.
8. Conversion rates & proctors are for information only & shall not be used to determine pay quantities.
9. No retainage of any material purchased.

Remarks:

1. PRICING IS FOR BUDGET PURPOSES.
2. KNIFE RIVER HAS A BARGE LOAD OUT FACILITY IF BARGING MATERIAL IS AN OPTION.
3. THE PRICE TO RENT KNIFE RIVER'S 6000 TON BARGE, KR-1, IS $500 PER HOUR. THIS DOES NOT INCLUDE A TUGBOAT.
4. WE WILL LOAD THE ABOVE MATERIAL FROM THE REICHOLD SOURCE ONTO THE CUSTOMER'S BARGE FOR A FEE OF $0.50 PER TON.
5. THE RATE AT WHICH WE LOAD KR-1 IS 1500 TONS PER HOUR. IF NEEDED, KNIFE RIVER WILL BACK THAT SPEED DOWN TO 1000 TONS PER HOUR TO ACCOMMODATE THE CUSTOMER'S BARGES LOADING CAPABILITY.

Salesman: Gordy Jarman
Mobile: (503) 572-7236
Office: (503) 944-3500
gordy.jarman@kniferiver.com

Date of Origin: 8/23/2010
Quote Expires: 12/31/2010

Printed: 08/23/2010

Table 30. Indirect Construction Cost Buildup

Daily Oversight and Project Management Including Environmental Monitoring			
Labor			
Task	Hrs/Week	Rate	Weekly Cost
Project manager	60	$180	$10,800
Field manager	60	$125	$7,500
Field technician	60	$100	$6,000
Field technician	60	$80	$4,800
Field technician	60	$80	$4,800
Office support	40	$50	$2,000
Total Labor			$35,900
Weekly Direct Cost (1)			$31,350
Total monthly cost:			$292,000

Engineering Support During Construction			
Labor			
Task	Hrs/Week	Rate	Weekly Cost
Project engineer	20	$180	$3,600
Resident engineer	60	$125	$7,500
Office engineer	40	$80	$3,200
CAD	20	$90	$1,800
Total Labor			$16,100
Weekly Direct Cost (2)			$1,900
Total monthly cost:			$78,000

Notes:
Assumptions for both:
- The field technicians can support both the field manager and the resident engineer

1) Assumptions:
   $3,500 per week for boat, hydrolab, grab sampler, velocity meter, gps, misc equipment
   Six (6) water quality samples per week - 3 at site and 3 at background @ $2,000 per sample
   Four (4) surface grabs per acre of dredge area. Assuming 1,000 cy/day dredge and 6 days/wk that is roughly 4 samples per $3,400 per sample
   Per diem for field crew.
2) Assumption:
   Per diem, monthly site visit by Project Engineer

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Table 31. Discount Factors for Long Term Monitoring, Maintenance and Operations Costs

Alternative[1]	First Year of Monitoring, Maintenance and Operations (year)	Total Construction Duration[2] (year)	Last Year of Monitoring, Maintenance and Operations
B-r	6	6	36
B-I (treat)	2	2	32
B-i(cap)	2	2	32
C-r	7	7	37
C-i(treat)	3	3	33
C-i(cap)	3	3	33
D-r	8	8	38
D-i(treat)	3	3	33
D-i(cap)	3	3	33
E-r	12	10	42
E-i(treat)	7	7	37
E-i(cap)	7	7	37
F-r	14	24	44
F-i(treat)	8	14	38
F-i(cap)	8	14	38

Notes:

1 = Assumes a 2.3% inflation rate for calculating the discount factor

-r = Removal Focused, incorporates a range of costs (low/high)

-i = in-situ focused, incorporates a range of costs (low/high)

(treat) - assumed in-situ treatment as the primary in-situ technology - used for the lower end cost.

(cap) - assumes engineered cap as the primary in-situ technology. Used for the higher end cost.

2 = The total construction is consistent with the durations presented in Appendix K of the draft FS. This is the final year of remedial construction activity with the final SMA to be constructed.

Table 32. Draft Template Table for EPA Comment: Cost and Quantity Estimates by sub-SMA

		Integrated Focused						Removal Focused					
sub-SMA ID	sub-SMA Area (Acres)	Treatment/ Cap Area (Acres)	Removal Volume (CY)	Low Cost	Cap Area (Acres)	Removal Volume (CY)	High Cost	Cap Area (Acres)	Removal Volume (CY)	Low Cost	Cap Area (Acres)	Removal Volume (CY)	High Cost
B-NC-9607	2.25	-	39,145	$11,743,481.36	-	51,918	$ 20,767,144.00	-	39,145	$ 11,743,481.36	-	51,918	$ 20,767,144.00
B-OW-WZ-9613	1.58	1.58	-	$ 1,584,465.87	2.99	-	$ 2,988,902.85	-	37,606	$ 11,281,803.30	-	44,127	$ 17,650,742.36
B-OW-WZ-9524x	2.02	2.02	-	$ 2,016,437.25	3.92	-	$ 3,920,513.91	-	34,616	$ 10,384,697.02	-	40,909	$ 16,363,460.04
B-OW-9611	0.61	0.61	-	$ 605,429.39	2.84	-	$ 2,838,250.69	-	30,793	$ 9,237,965.40	-	40,077	$ 16,030,973.57
B-FD-6107	2.30	-	28,158	$ 8,447,251.31	-	36,837	$ 14,734,908.73	-	28,158	$ 8,447,251.31	-	36,837	$ 14,734,908.73
B-OW-9509	0.44	0.44	-	$ 444,844.41	2.01	-	$ 2,008,434.48	-	25,801	$ 7,740,280.20	-	31,489	$ 12,595,796.97
B-NC-9615	0.74	-	18,611	$ 5,583,231.08	-	28,882	$ 11,552,705.74	-	18,611	$ 5,583,231.08	-	28,882	$ 11,552,705.74
B-OW-WZ-9614	0.85	0.85	-	$ 854,743.15	1.30	-	$ 1,302,424.66	-	18,427	$ 5,528,054.77	-	23,501	$ 9,400,504.48
B-FD-9601	0.65	-	19,910	$ 5,973,012.00	-	23,109	$ 9,243,480.20	-	19,910	$ 5,973,012.00	-	23,109	$ 9,243,480.20
B-SL-WZ-9529x	1.14	1.14	-	$ 1,135,505.36	2.50	-	$ 2,500,476.55	-	19,182	$ 5,754,731.89	-	22,406	$ 8,962,220.68
B-NC-9001	0.88	-	17,904	$ 5,371,103.08	-	19,011	$ 7,604,519.00	-	17,904	$ 5,371,103.08	-	19,011	$ 7,604,519.00
B-OW-9610	0.11	0.11	-	$ 112,744.13	0.55	-	$ 546,572.27	-	15,872	$ 4,761,735.79	-	18,434	$ 7,373,662.59
B-FD-3102x	0.52	-	14,880	$ 4,463,930.19	-	18,308	$ 7,323,228.92	-	14,880	$ 4,463,930.19	-	18,308	$ 7,323,228.92

Notes:

sub-SMAs are organized fom the highest cost (Removal focused) to the lowest.

Dummy values provided. Pending EPA comment this table will be populated with actual data from the draft FS.

This draft template table only shows 10 sub-SMAs. After EPA approval, the actual table would include all 387 sub-SMAs.

To: Wyatt, Robert[rjw@nwnatural.com]; James McKenna[jim.mckenna@verdantllc.com]
Cc: Jennifer Woronets[jworonets@anchorqea.com]; Koch, Kristine[Koch.Kristine@epa.gov]; Gustavson, Karl[Gustavson.Karl@epa.gov]
From: Humphrey, Chip
Sent: Tue 9/10/2013 8:33:11 PM
Subject: Corps ERDC memos
2013_ERDC_Residuals-Releases.docx
2013_ERDC_Production_FINAL.docx

Bob and Jim

At our project managers meeting discussion on FS issues last month we mentioned that the Corps ERDC reviewed some of the assumptions on dredging production and dredging releases and residuals in the draft FS and prepared recommendations for EPA. We also said we would provide you the information. Two Corps ERDC memos prepared by Karl Gustavson and Paul Schroeder on these subjects are attached.

Chip Humphrey

EPA

To: Gustavson, Karl[Gustavson.Karl@epa.gov]
Cc: Penoyar, Susan[PenoyarSJ@cdmsmith.com]
From: Blischke, Eric
Sent: Tue 9/10/2013 5:00:26 PM
Subject: RE: PH FS Technology and Alternative Development

I will call you. I have a call scheduled to run from 10:30 to 11:00 my time. I will call you then and patch in Susan.

Thanks, Eric

From: Gustavson, Karl [mailto:Gustavson.Karl@epa.gov]
Sent: Tuesday, September 10, 2013 9:40 AM
To: Blischke, Eric
Subject: RE: PH FS Technology and Alternative Development

Eric,

I was kicking around some ideas with him yesterday after I reviewed the Kalamazoo FS and was thinking about what could be a simpler approach for PH. I figured it'd be good to run by you to see what you think.

I'm available at 2. Let's talk then.

Karl

From: Blischke, Eric [mailto:blischkee@cdmsmith.com]
Sent: Tuesday, September 10, 2013 12:00 PM
To: Gustavson, Karl
Subject: PH FS Technology and Alternative Development

Karl, I was speaking with Todd this morning. He mentioned you wanting to talk with me about PH technology assignment and alternative development. Are you available to talk at 2:00 pm today Eastern? Susan would like to listen in. Todd is tied up.

Let me know.

Thanks, Eric

Eric Blischke

CDM Smith

319 SW Washington St, Suite 900

Portland, OR 97204

503-205-7406 direct

503-720-0754 cell

To: Gustavson, Karl[Gustavson.Karl@epa.gov]
From: King, Todd W.
Sent: Wed 8/21/2013 11:42:32 PM
Subject: FW: PDF of tomorrow's meeting
LWG_Meeting_20130821.pdf

For tomorrow's call…

From: King, Todd W.
Sent: Wednesday, August 21, 2013 7:22 PM
To: Kristine Koch
Cc: Chip Humphrey; Penoyar, Susan; Blischke, Eric
Subject: PDF of tomorrow's meeting