APPENDIX 13A
Restoration Timeframe

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APPENDIX 13A
RESTORATION TIMEFRAME

The purpose of this appendix is to evaluate the restoration timeframe for the eight cleanup action alternatives identified for the sediment portion of the Gas Works Park Site (GWPS), which is referred to in the FS as the sediment cleanup unit (SCU). The cleanup action alternatives are described in Section 12 of the FS. A reasonable restoration timeframe for cleanup actions is i defined in the Sediment Cleanup User's Manual (SCUM) as 10 years following completion of construction (Ecology 2021).

The eight cleanup action alternatives include a combination of capping, enhanced natural recovery (ENR), and monitored natural recovery (MNR). Section 1.0 of this appendix discusses the approach used to estimate surface sediment concentrations at the completion of the cleanup action construction in the sediment management areas (SMAs) where MNR or ENR are applied as part of the cleanup action (SMA-13 and SMA-14). The remainder of the SCU will be capped and the surface sediment concentrations in the SMAs where capping is applied are the chemical concentration of the sand used for the caps. Capping materials will be tested prior to placement to ensure that they meet the cleanup criteria.

Compliance with preliminary cleanup levels and screening levels is evaluated differently depending on the exposure mechanism and receptor. Protection of the sediment benthic invertebrate community is evaluated on a point-by-point basis whereas, protection of human health and organisms that may be exposed to sediment contaminants via ingestion of food (bioaccumulation) is evaluated on a surface-area-weighted average concentration (SWAC) basis.

The MNR and ENR approaches presented in Section 1.0 are used in Sections 2.0 and 3.0 to evaluate the restoration timeframe for meeting cleanup and screening levels for benthic and bioaccumulative contaminants of concern (COCs) throughout the SCU.

This appendix uses the following terms (see Figure 13A-1):

- SCU – the sediment portion of the AOI.
- Lake Shore – the relatively shallow nearshore zone of the SCU.
- Lake Slope – the steep sloped portion of the SCU adjacent to the Lake Shore zone.
- Lake Bottom – the slightly sloping bottom portion of the SCU that extends towards the center of the lake from the lake slope zone.
- SMA-13 – a SMA delineated within the SCU. SMA-13 is a subset of the lake bottom zone.
- SMA-14 – a SMA delineated within the SCU. SMA--14 is a subset of the lake bottom zone and is same area as the natural recovery area identified in Section 6.6 of the RI.

The SCU is comprised of 12 SMAs (SMA-3 through SMA-14). These SMA's are included in the restoration timeframe evaluation. A groundwater management area (GWMA-1) and two upland areas (SMA-1 and SMA-2) are not included in the evaluation because they are not part of the SCU. Figure 13A-2 shows the SMAs, included in the restoration timeframe evaluation and the sediment remediation technology considered in the FS for each SMA.

1.0 NATURAL RECOVERY EVALUATION

The natural recovery of sediment refers to processes such as chemical and biological degradation, sedimentation (i.e., burial beneath clean sediment) and bioturbation (e.g., mixing, oxidation) that result in reduced contaminant concentrations in surface sediment and increased isolation of contaminated sediment over time.

MNR relies entirely on natural recovery processes to ensure compliance with the cleanup objectives. ENR includes the placement of a thin layer of sand to accelerate natural recovery processes to comply with cleanup objectives. For both MNR and ENR, monitoring is performed to verify that the cleanup levels are met within an acceptable time period.

1.1. Monitored Natural Recovery

Cleanup action Alternatives 1 through 7 use MNR in SMA-14 as part of the comprehensive cleanup strategy. ENR rather than MNR is used in SMA-14 in cleanup action Alternative 8 (see FS Section 12). MNR is only applicable to the restoration timeframe evaluation for bioaccumulative COCs (carcinogenic polycyclic aromatic hydrocarbons (cPAHs), arsenic, and chromium) in SMA-14. It is not applicable to the evaluation of restoration timeframe for benthic COCs in SMA-14 because, as discussed in Section 2.0, no benthic toxicity was observed in SMA-14.

Values used to calculate surface sediment concentrations in SMA-14 are as follows:

- **cPAHs**: the cPAH SWAC was calculated using data from surface sediment samples collected in 2005, then the natural recovery model presented in Section 1.3 was used to estimate the cPAH SWAC in 2029, the estimated time of remedy construction completion.
- **Arsenic**: the arsenic SWAC was calculated using surface sediment data from samples collected in 2005. The preliminary arsenic cleanup level (CUL) was achieved at the time of remedy construction completion (see Section 3.1), while conservatively using 2005 data and not accounting for any additional recovery between 2005 and 2029.
- **Chromium**: the chromium SWAC was calculated using the maximum detected surface sediment concentration in SMA-14 from samples collected in 2005. The chromium screening level was achieved at the time of remedy construction completion (see Section 3.2), while conservatively using 2005 data and not accounting for additional recovery between 2005 and 2029.

1.2. Enhanced Natural Recovery

The eight cleanup action alternatives evaluated in the FS use ENR as part of the comprehensive cleanup strategy. Alternatives 1 through 7 use ENR in SMA-13, while Alternative 8 uses capping in SMA-13 and ENR in SMA-14. FENR is assumed to include placement of a 6-inch equivalent layer of sand onto the contaminated sediment surface that will mix with the existing sediment and accelerate natural recovery processes (biological degradation, sedimentation, and bioturbation) to reduce contaminant concentrations over time.

To evaluate the restoration timeframe of the eight cleanup action alternatives, the concentrations of the GWPS and co-located ambient Lake Union (ALU) COCs within SMA-13 and SMA-14 following placement of a 6-inch sand layer were estimated using the equation and values below. The sand layer was assumed to completely mix with the existing surface sediments. Because the existing surface sediment is markedly

finer (mostly silts) and less dense than the placed sand layer, the difference in densities needed to be accounted for when estimating the post-placement concentration within the biologically active zone (upper 10 centimeters of sediment) in each SMA.

ENR-adjusted concentration (see below of a description of the parameters in this equation) =

$$\frac{[40.9\ kg/cf\ *\ (COC\ surface\ sediment\ mg/kg)\ +\ 6.04\ kg/cf\ *\ (COC\ sand\ mg/kg)]/2}{40.9\ kg/cf\ divided\ by\ 2\ +\ 6.04\ kg/cf\ divided\ by\ 2}$$

Parameters used to estimate surface sediment concentrations following placement of the sand layer area (ENR-adjusted concentrations) are as follows:

- Surface sediment concentrations: maximum detected concentrations in SMA-13 for benthic COCs (Table 13A-1) and SWACs in SMA-13 and SMA-14 for bioaccumulative COCs (Table 13A-2) were used. The approaches used in Section 1.1 to calculate SWACs for cPAHs, arsenic, and chromium in SMA-14 were also used to calculate SWACs for the same COCs in SMA-13 prior to accounting for the placement of the 6-inch sand layer.
- Sand concentrations: reporting limits for organic COCs and median soil concentrations from samples collected at quarries and pits in the Puget Sound area for metals (Papadopulos and Associates, Inc. 2002) were used (Tables 13A-1 and 13A-2).
- Density of sand and lake bottom sediment: 90 pounds per cubic foot (pcf) for sand and 13.3 pcf for lake bottom sediment were assumed. For the ENR-adjusted concentration calculations, these values were converted to 40.9 kilograms per cubic feet (kg/cf) for sand and 6.04 kg/cf for lake bottom sediment.

The ENR-adjusted maximum detected concentrations for benthic COCs are presented in Table 13A-1, and the restoration timeframe evaluation is presented in Section 2.0. The ENR-adjusted SWAC concentrations for bioaccumulation COCs are presented in Table 13A-2, and the restoration timeframe evaluation is presented in Section 3.0.

1.3. Natural Recovery Model: SMA-14

Available data show that natural recovery has been occurring in SMA-14 (Figure 13A-1)[1] since the MGP stopped operating in 1956 as evidenced by the changes in surface sediment concentrations of COCs and burial of historical contamination over time. The rate of change based on empirical data for cPAHs is depicted in Figure 13A-3. Based on the existing data, natural recovery is expected to continue after the sediment remedy is completed due to the removal and capping of contaminated sediment and as other lake-wide source controls continue to reduce point source discharges of solids to the lake.

Reductions in cPAH concentrations following implementation of the remedy were estimated for SMA-14. It was anticipated that the post-construction inputs of cPAHs to SMA-14 would decrease due to the benefit of active remediation in the lake shore and lake slope zones and additional source control activities in Lake

[1] Figure 13A-1 shows the lakeshore, lake slope and lake bottom zones of the SCU.

Union[2]. A reduction in cPAH concentrations in sediment outside the SCU would improve the ability to achieve preliminary cleanup levels within the SCU.

Future cPAH TEQ concentrations were predicted using the 2004/2005 area-weighted average of SMA-14 as the initial sediment concentration (i.e., 3.3 mg/kg). The initial suspended solids cPAH TEQ concentration was estimated based on suspended solids samples collected in catch basins in the Wallingford and University District neighborhoods over the last decade[3]. cPAH TEQ concentrations reported in suspended solids in catch basins sampled between 2009 and 2015 ranged from 0.5 to 1.4 mg/kg, with a median concentration of 1.0 mg/kg. These catch basin solids concentrations were adjusted to represent 65 percent of the sediment input to address the different sources of suspended particles in the lake. According to the petrology analysis conducted as part of the Stanford University study (Appendix 2D of the RI), about 35 percent of the solids that settle to the lake bottom zone originate as biological material (e.g., plants, plankton, diatoms, etc.) in the water column. It was assumed that this fraction of suspended sediment is not contaminated with cPAHs because cPAHs are not readily bioavailable and are not expected to accumulate in the biogenic fraction. The median concentration of 1.0 mg/kg cPAH TEQ, adjusted to 0.65 mg/kg cPAH to account for the biogenic fraction, was used as the initial input concentration for mineral fraction of suspended sediment in the natural recovery estimate.

It is further assumed that suspended solids cPAH concentrations would decline at a rate of 6 percent per year, the lowest annual rate of change measured in SMA-14, until completion of remedy construction in 2029 and implementation of additional source controls in 2025. Following remediation, natural recovery will potentially be accelerated due to the elimination of lake shore and lake slope sources of contamination to the lake bottom zone; a single 20 percent reduction is, therefore, assumed to occur in 2029. Additional source controls are scheduled to be completed around 2025 for the Lake Washington Ship Canal, which will further support the natural recovery of the lake bottom zone. Another 10 percent reduction is assumed to occur in 2026 because of this additional source control project, followed by a 6 percent reduction per year through the period of interest.

Future (post-2005) surface sediment cPAH SWACs in SMA-14 were calculated as follows:

- Each year, starting in 2006, 1 cm of sediment is assumed to be deposited in SMA-14. This assumption is based on the sediment deposition evaluation presented in Section 3.2.4 of Appendix 11C.
- The newly deposited 1 cm of sediment is assumed to mix with the 4 cm of sediment below (that is, what used to be the top 4 cm of sediment).
- The remaining 5 cm of sediment within the surface sediment interval (aka, the biologically active zone) are unaffected.
- The surface sediment cPAH SWAC is the average cPAH concentration in the top 10 cm of sediment.

To address the uncertainties associated with predicting future natural recovery, inputs were varied to represent a range of natural recovery rates. The inputs that were varied included initial suspended solids concentration, the rate of annual reduction in suspended solids concentrations each year due to ongoing

[2] Potential releases of suspended sediment during dredging or capping will be subject to engineering controls to minimize short-term impacts of in-water work; redistribution of suspended sediment is anticipated to be localized.

[3] This approach likely represents a worst-case estimate of concentrations of suspended solids because there are other sources of cleaner sediment to Lake Union that are not accounted for.

source controls, and the effect of the cleanup and the City of Seattle/King County Ship Canal Water Quality project on suspended solids concentrations. The range of values used are summarized in the table below, along with an estimate of the year that the cleanup level would be achieved.

A sensitivity analysis was conducted by varying each of these four input parameters, one at a time, by using input values associated with the slower and faster recovery scenarios shown below. The purpose of the sensitivity analysis was to see which input parameters have the most significant effect on the year the preliminary cleanup level is achieved in SMA-14. The sensitivity analysis results are shown in Figure 13A-4 and indicate that the year the preliminary cleanup level is achieved is most affected by the initial suspend solids concentration and the rate of annual reduction in suspended solids concentrations. This is because 20 to 24 years of natural recovery will have occurred between 2005 and completion of City of Seattle/King County Ship Canal Water Quality project and the GWPS cleanup.

Model Input Parameter[a] (all refer to cPAH TEQ concentrations)	Slower Rate of Recovery Scenario	Moderate Rate of Recovery Scenario	Faster Rate of Recovery Scenario
Initial SWAC in SMA-14 (mg/kg)	3.3	3.3	3.3
Sediment Deposition Rate (cm/year)	1.0	1.0	1.0
Initial Suspended Solids Concentration (SSC) (mg/kg)	1.0	0.65	0.5
Annual SSC Reduction (percent)	3	6	17
SSC Reduction Due to Cleanup (percent)	10	20	30
SSC Reduction Due to Water Quality Project (percent)	5	10	20
Year Preliminary Cleanup Level Is Predicted to be Achieved within SMA-14	2059	2030	2022

[a] Estimated rates of recovery for model parameters are based on available data or best professional judgement. The basis for the initial SWAC , initial suspended solids concentrations, and reductions in suspended solids concentrations are described in previous paragraphs in Section 1.3.

The natural recovery model results are shown in Figure 13A-5. The Moderate Rate of Recovery Scenario shows that the preliminary cleanup level for cPAHs is likely to be achieved in SMA-14 within 1 year following implementation of the cleanup action. In accordance with the SCUM, a restoration timeframe of 10 years is considered reasonable. The Moderate Rate of Recovery Scenario is appropriate for use in evaluating restoration timeframe because the initial suspended solids cPAH concentration of 0.65 mg/kg and the rate of annual reduction in suspended solids concentrations each year of 6 percent are reasonably conservative values. The initial suspended solids cPAH concentration is based on the median suspended solids concentration detected in in catch basins in the Wallingford and University District neighborhoods over the last decade and the annual reduction in suspended solids concentrations is set at the lowest annual rate of change measured in samples collected from SMA-14 between 1984 and 2005.

Note that this evaluation was only for SMA-14. The preliminary cleanup levels and restoration timeframe requirements apply to the entire SCU (SMA-3 through SMA-14). Restoration timeframes for cleanup action Alternatives 1 through 8 across the entire SCU are discussed in Sections 3.1.3 and 3.1.4.

1.4. Applicability of Natural Recovery Model to SMA-13

The natural recovery model discussed above was developed for SMA-14 to show that MNR is a viable sediment remediation technology for SMA-14. Both SMA-13 and SMA-14 are within depositional portions of the lake bottom (see Sections 6 and 8 of the RI details) and, as discussed in Section 12 of the FS, SMA-13 and SMA-14 are natural recovery areas. ENR was selected as a sediment remediation technology for SMA-13 because, while existing data indicate that natural recovery is occurring in SMA-13, the concentrations are higher than in SMA-14 and, natural recovery processes will be accelerated by placing a thin (6-inch) layer of sand.

The following sections discuss the natural recovery model parameters and their applicability to SMA-13 and the temporal trends in cPAH TEQ concentrations within SMA-13.

1.4.1. Model Input Parameters

The natural recovery model is applicable to SMA-13 based on the following evaluation of the model input parameters:

- The sediment deposition rate of 1 cm/year used in the model was derived from studies completed in the lake bottom zone of the SCU and SMA-13 is in the lake bottom zone.
- The initial suspended solids cPAH TEQ concentration was based on suspended solids samples collected in catch basins in the Wallingford and University District neighborhoods. These samples are as applicable to SMA-13 as they are to SMA-14.
- The annual reduction in suspended solids concentration assumed in the model is 6 percent, based on the annual rate of change in SMA-14 surface sediment samples between 1995 and 1999. As discussed below (Section 1.4.2), the annual rates of change in SMA-13 between 1999 and 2002 and between 2002 and 2005 are greater than 6 percent and greater than corresponding reductions in SMA-14.
- The reduction in suspended solids concentrations due to the cleanup and the City of Seattle/King County Ship Canal Water Quality project are expected to have similar effects on SMA-13 and SMA-14 cPAH TEQ surface sediment concentrations.

1.4.2. Temporal Trends in cPAH TEQ Concentrations in SMA-13

The temporal trends in cPAH TEQ concentrations were evaluated within SMA-13 area using GIS interpolation and averaging methods (samples and area evaluated are depicted in Figure 13A-6). The cPAH TEQ data from samples obtained primarily in 1999, 2002, and 2004/2005 were used to calculate cPAH TEQ SWACs for each sampling period to estimate the percent reduction in cPAH TEQ concentrations in surface sediment in SMA-13. The GIS interpolation of cPAH TEQ surface sediment concentrations for these three periods is shown on Figure 13A-6.

For comparison purposes, the cPAH TEQ concentrations in SMA-14 for the same sampling periods are included the table below.

Period	cPAH TEQ SWAC (mg/kg) SMA-13 [SMA-14]	Percent Reduction Since Previous Period SMA-13 [SMA-14]	Average Annual Reduction Percent SMA-13 [SMA-14]
1999	106 [23]		
2002	27 [10]	74 [57]	27 [24]
2004/2005	7.3 [3.3]	73 [67]	35 [31]
Overall reduction between 1999 and 2004/2005		93 [86]	36 [18]

[a] Based on limited data points.

As shown in the table above, the percent reductions in cPAH TEQ concentrations between 1999 and 2002 and between 2002 and 2004/2005 are greater in SMA-13 than in SMA-14. However, the 2004/2005 cPAH TEQ SWAC in SMA-13 (7.3 mg/kg) is over twice the SWAC in SMA-14 (3.3 mg/kg).

1.4.3. Summary

Based on the information above, the natural recovery model is appropriate for use in estimating future cPAH TEQ concentrations in SMA-13. In Alternatives 1 through 7, ongoing natural recovery processes will be accelerated by placing a thin (6-inch) layer of sand (see Section 3.1).

2.0 BENTHIC COCS

GWPS and co-located ALU COCs with preliminary CULs or screening levels based on protection of benthic organisms are presented in Table 13A-1.

The remedial investigation (RI) identified areas of benthic toxicity based on bioassay data (see Appendix 5D for the evaluation). Areas of benthic toxicity were found in portions of SMAs 3 through 9 and SMAs 11 through 13 (Figure 13A-1). As shown on Figure 13A-1, SMAs 3 through 12 will be capped by a combination of sand caps, thick sand caps, or enhanced (low permeability or amended) caps. ENR will be applied to SMA-13 in Alternatives 1 through 7 and SMA-13 will be capped in Alternative 8. Compliance with benthic-based preliminary CULs and screening levels in SMA-13 for Alternatives 1 through 7 after placement of the sand layer is the focus of this section.

MNR is only applied to SMA-14 in Alternatives 1 through 7 and, therefore, is not applicable to the restoration timeframe evaluation of benthic COCs because benthic toxicity is not observed in SMA-14.

The restoration timeframe evaluation for GWPS and co-located ALU COCs in SMA-13 (for Alternatives 1 through 7) is presented in Table 13A-1. As shown in Table 13A-1, GWPS COC preliminary CULs will be achieved at the completion of remedy construction. Co-located ALU COC screening levels will also be achieved at the time of completion of construction, with the exception of sulfide, tributyltin, and silver. However, it is reasonable to assume that screening levels will be achieved for these COCs within 10 years following completion of construction as outlined below:

- **Sulfide**: The restoration timeframe evaluation did not account for natural recovery. In addition, sulfide concentrations under ENR technologies will be lower than predicted due to mixing and oxygenation of the sediment following placement of the sand material. Lastly, the highest sulfide concentrations within the SCU are in SMA-14, however, no benthic toxicity was associated with this SMA, indicating that

sulfides may not be contributing to benthic impacts. Sulfides will be further evaluated during future design investigation efforts and the ENR approach may need to be altered in order to meet screening levels within 10 years following completion of construction.

- **Tributyltin**: The restoration timeframe evaluation did not account for natural recovery. In addition, the use of tributyltin was restricted in the late 1990s and was banned outright in 2008; and dredging was completed at the Northlake Shipyard in 2013 and 2014, which removed source material adjacent to the SCU. Tributyltin will be further evaluated during future design investigation efforts and the ENR approach may need to be altered in order to meet screening levels within 10 years following completion of construction.
- **Silver**: The evaluation did not account for natural recovery. Silver will be further evaluated during future design investigation efforts and the ENR approach may need to be altered in order to meet screening levels within 10 years following completion of construction.

3.0 BIOACCUMULATION COCS

Compliance with bioaccumulation cleanup levels and screening levels is based on SWACs. Accordingly, post-construction surface sediment concentrations in each SMA were estimated to calculate an SCU-wide SWAC.

This restoration timeframe evaluation is discussed separately for GWPS (arsenic and cPAHs) and co-located ALU (chromium) COCs in the sections below.

ENR-adjusted surface sediment concentrations are used in Sections 3.1 and 3.2 to estimate SCU-wide surface sediment SWACs. The equation and parameters used to estimate the ENR-adjusted concentrations is presented in Section 1.2 and the unadjusted surface sediment SWACs, and concentrations, and ENR-adjusted surface sediment SWACs for SMA-13 and SMA-14 are presented in Table 13A-2.

3.1. GWPS COCs

Arsenic and cPAHs are the only GWPS COCs with preliminary CULs based on bioaccumulation. The approach for evaluating these two COCs is described below.

3.1.1. Arsenic

Arsenic is conservatively evaluated using surface sediment data from samples collected in 2005 without assuming additional recovery between 2005 and 2029. Arsenic concentrations used to calculate an SCU-wide surface sediment SWAC at the time of completion of construction are as follows:

- SMAs with capping: 2.9 mg/kg is the assumed arsenic concentration of the sand used for capping and is the median soil concentrations from quarries and pits in the Puget Sound area for arsenic (Papadopulos and Associates, Inc. 2002).
- SMAs with ENR: the surface sediment arsenic post-construction SWAC is the surface sediment SWAC calculated using data from samples collected in 2005 adjusted for placement of a 6-inch sand layer as described in Section 1.0 (see Table 13A-2).

- SMAs with MNR: the surface sediment arsenic post-construction SWAC is the surface sediment SWAC calculated using 2005 sample data (i.e., 2005 data are used to represent 2029 post-construction conditions without accounting for further recovery since 2005).

3.1.2. cPAHs

cPAHs were evaluated using surface sediment data from samples collected in 2005. cPAH SWACs for SMAs 13 and 14 were calculated using the 2005 data, then the natural recovery model presented in Section 1.3 was used to estimate the cPAH SWACs for 2029. The applicability of the model to SMA13 is discussed in Section 1.4. The 2029 SWAC results, along with assumed cPAH sand concentrations, were used to calculate an SCU-wide surface sediment SWAC at the completion of construction. Details for the cPAH concentrations are as follows:

- SMAs with capping: 0.009 mg/kg, which is the programmatic sediment practical quantitation limit (PQL) from Ecology's Sediment Cleanup User's Manual (SCUM) guidance. This is the assumed sand concentration used for the cap areas.
- SMAs with ENR: surface sediment cPAH post-construction concentration is the estimated 2029 surface sediment SWAC adjusted for placement of a 6-inch sand layer as described in Section 1.0.
- SMAs with MNR: 2029 surface sediment cPAH post-construction concentration is the estimated 2029 surface sediment SWAC.

3.1.3. Arsenic and cPAH Restoration Timeframe Evaluation for Cleanup Action Alternatives 1 through 7

Cleanup action Alternatives 1 through 7 include capping in SMAs 3 through 12, ENR in SMA-13, and MNR in SMA-14. The table below shows that the SCU-wide SWAC immediately following construction will be less than the preliminary CULs for arsenic and cPAHs for these alternatives. Accordingly, an evaluation of 10 years post-construction was not completed.

GWPS COCs	Preliminary CUL	Post-Construction SWACs			
		SMAs 3 – 12 (Cap)	SMA-13 (ENR)	SMA-14 (MNR)	SCU
		23 Acres	10 Acres	23 Acres	56 Acres
Arsenic (mg/kg)	24	2.9	17	28	15
cPAHs (mg/kg TEQ)	0.21	0.009	0.046	0.26	0.12

3.1.4. Arsenic and cPAH Restoration Timeframe Evaluation for Cleanup Action Alternative 8

Alternative 8 includes capping in SMAs 3 through 13 and ENR in SMA-14. The table below shows that the SCU-wide SWAC immediately following construction will be less than the preliminary CULs for arsenic and cPAHs for Alternative 8.

GWPS COCs	Preliminary CUL	Post-Construction SWACs			
		SMAs 3 – 12 (Cap)	SMA-13 (CAP)	SMA-14 (ENR)	SCU
		23 Acres	10 Acres	23 Acres	56 Acres
Arsenic (mg/kg)	24	2.9	2.9	6.1	4.2
cPAHs (mg/kg)	0.21	0.009	0.009	0.041	0.022

3.2. CO-LOCATED ALU COCs

Chromium, hexachlorobenzene, methylmercury, pentachlorophenol, chlordane, and polychlorinated biphenyls (PCBs) are co-located with GWPS COCs and were identified as ALU COCs based on bioaccumulation. A restoration timeframe evaluation was completed for chromium. However, the factors discussed in Section 3.2.4, prevent a restoration timeframe evaluation for hexachlorobenzene, methylmercury, pentachlorophenol, chlordane, and PCBs.

3.2.1. Chromium

Chromium is conservatively evaluated using the maximum detected surface sediment concentrations from SMA-13 and SMA-14 without assuming additional recovery between sample collection (2005 or earlier) and 2029. Chromium concentrations used to calculate an SCU-wide surface sediment SWAC at the time of completion of construction are as follows:

- SMAs with capping: 25 mg/kg is the assumed chromium concentration of the sand used for capping and is the median soil concentrations from quarries and pits in the Puget Sound area for chromium (Papadopulos and Associates, Inc. 2002).
- SMAs with ENR: the surface sediment chromium post-construction SWAC is the maximum detected surface sediment concentration adjusted for placement of a 6-inch sand layer as described in Section 1.0.
- SMAs with MNR: the surface sediment chromium post-construction SWAC is the maximum detected surface sediment concentration in the SMA (i.e., the maximum detected concentration is used to represent 2029 post-construction conditions without accounting for further recovery since sample collection [2005 or earlier]).

3.2.2. Chromium Restoration Timeframe Evaluation for Cleanup Action Alternatives 1 through 7

The table below shows that the SCU-wide SWAC immediately following construction will be less than the screening level (SL) for chromium for Alternatives 1 through 7. Accordingly, an evaluation for 10 years post-construction was not completed.

		Post-Construction SWACs			
		SMAs 3 – 12 (Cap)	SMA-13 (ENR)	SMA-14 (MNR)	SCU
ALU COC	SL	23 Acres	10 Acres	23 Acres	56 Acres
Chromium (mg/kg)	62	25	34	70	45

3.2.3. Chromium Restoration Timeframe Evaluation for Cleanup Action Alternative 8

The table below shows that the SCU-wide SWAC immediately following construction will be less than the SL for chromium for Alternative 8.

		Post-Construction SWACs			
		SMAs 3 – 12 (Cap)	SMA-13 (CAP)	SMA-14 (ENR)	SCU
ALU COC	CUL	23 Acres	10 Acres	23 Acres	56 Acres
Chromium (mg/kg)	62	25	25	31	27

3.2.4. No Restoration Timeframe Evaluation was Completed for Hexachlorobenzene, Methylmercury, Pentachlorophenol, Chlordane, and PCBs

Restoration timeframes were not evaluated for Hexachlorobenzene, chlordane, methylmercury, pentachlorophenol, and PCBs because there are limited available surface sediment sample data or detections within the SCU. The details for each analyte are as follows:

- **Hexachlorobenzene**: As noted in Appendix 4E, there is uncertainty as to whether hexachlorobenzene qualifies as an ALU COC. Hexachlorobenzene was not analyzed for in crayfish tissue and was not included in the risk assessment that was used to help identify bioaccumulation COCs (see Appendix 4C). In addition, hexachlorobenzene was only detected in 2 out of 87 surface sediment samples collected in the SCU (NLU-130-SS and NLU-53-SS). NLU-130-SS was collected within SMA-6, which will be capped. NLU-53-SS was collected in SMA-14, which will undergo monitored or enhanced natural recovery. Hexachlorobenzene was detected at a concentration of 0.0022 mg/kg in NLU-53-SS, which is less than the screening level of 0.005 mg/kg. Hexachlorobenzene will be evaluated further during future remedial design efforts to verify that it is a co-located ALU COC and to evaluate restoration timeframe, if necessary.
- **Methylmercury**: As noted in Appendix 4E, there is uncertainty as to whether methylmercury qualifies as an ALU COC. Methylmercury was detected in the one surface sediment sample collected in the SCU. In addition, methylmercury was not analyzed for in crayfish tissue and was not included in the risk assessment that was used to help identify bioaccumulation COCs (see Appendix 4C). The limited number of surface sediment samples collected for methylmercury prevents the completion of a restoration timeframe evaluation for methylmercury. This analyte will be evaluated further during future remedial design efforts to verify that it is a co-located ALU COC and to evaluate restoration timeframe, if necessary.
- **Pentachlorophenol and Chlordane**: Both of these analytes were identified as bioaccumulative ALU COCs based on the risk assessment that was used to help identify bioaccumulation COCs (see Appendix 4C). However, neither analyte was detected in crayfish tissue samples that were used in the risk assessment. The unacceptable risk estimates were based on one-half of the maximum method detection limit for each analyte. Pentachlorophenol and chlordane were detected in 8 out of 79 and 8 out of 29 surface sediment samples collected within the SCU, respectively. The limited number of surface sediment samples collected for chlordane and the limited number of detections for both analytes prevent the completion of a restoration timeframe evaluation for pentachlorophenol and chlordane. These analytes will be evaluated further during future remedial design efforts to verify that they are co-located ALU COCs and to evaluate restoration timeframes, if necessary.
- **PCBs**: Insufficient time series data are available to perform a restoration timeframe evaluation for PCBs. This analyte will be evaluated further during future remedial design efforts to verify that it is a co-located ALU COC and to evaluate restoration timeframe, if necessary.

For the FS, it is assumed that these five co-located ALU COCs will meet their respective screening levels within 10 years following completion of construction (currently scheduled for completion in 2029). This will be verified during future remedial design activities.

4.0 SUMMARY

As discussed above, the GWPS COCs will achieve preliminary cleanup levels, and co-located ALU chromium concentrations will achieve screening levels, immediately following completion of construction.

Based on the rationale presented in previous sections, co-located ALU benthic COCs (sulfide, tributyl tin and silver) and co-located ALU bioaccumulation COCs (hexachlorobenzene, methylmercury, pentachlorophenol, chlordane, and PCBs) are assumed to achieve screening levels within 10 years following completion of construction. These assumptions will be verified through further evaluation during future remedial design efforts, and a restoration timeframe evaluation will be completed if necessary.

5.0 REFERENCES

Papadopulos and Associates, Inc. 2002. Seattle-Tacoma International Airport Third Runway Embankment Fill Water-Quality and Transport Analysis. Final. February 15, 2002.

Washington Department of Ecology (Ecology). 2021. Sediment Cleanup User's Manual; Guidance for Implementing the Provisions of the Sediment Management Standards, Chapter 173-204 WAC. Publication No. 12-09-057. Third Revision December 2021.

Table 13A-1

Benthic COCs: Enhanced Natural Recovery Evaluation (SMA-13)

Gas Works Park Site

Seattle, Washington

Analyte Group	Contaminants of Concern[a]	Unit	Preliminary Cleanup/Screening Level[b]	Number of Surface Sediment Samples Collected within SMA-13	Frequency of Detection (%)	SMA-13 Enhanced Natural Recovery Evaluation			
						Maximum Detected Surface Sediment Concentration[c]	Sand Concentration[d]	ENR-Adjusted Maximum Detected Surface Sediment Concentration[e]	ENR-Adjusted Maximum > CUL/SL
Conventionals	Sulfide	mg/kg	39	12	100	1,200	20	172	**Yes**
PAHs	Total PAH (GWPS COC)	mg/kg	30	12	100	172	0.02	22	No
TPH	Diesel Range Hydrocarbons[f]	mg/kg	340	1	100	2,420	5	320	No
SVOCs	4-Methylphenol	mg/kg	0.26	12	0	all ND	not applicable	all ND	No
	Benzoic Acid	mg/kg	2.9	12	0	all ND	not applicable	all ND	No
	bis(2-Ethylhexyl)phthalate	mg/kg	0.50	12	100	2.2	0.025	0.30	No
	Carbazole (GWPS COC)	mg/kg	0.90	12	25	0.25	0.02	0.050	No
	Dibenzofuran (GWPS COC)	mg/kg	0.20	12	8	0.073	0.02	0.027	No
	Di-n-Butyl phthalate	mg/kg	0.38	12	0	all ND	not applicable	all ND	No
	Di-n-Octyl phthalate	mg/kg	0.039	12	0	all ND	not applicable	all ND	No
	Phenol	mg/kg	0.12	12	0	all ND	not applicable	all ND	No
Pesticides	4,4'-DDE[g]	mg/kg	0.021	3	33	0.035	0.002	0.0062	No
Butyltins	Tributyl Tin	mg/kg	0.047	12	100	2.3	0.004	0.30	**Yes**
	Cadmium	mg/kg	2.1	12	75	3.0	0.2	0.56	No
	Copper	mg/kg	400	12	100	690	23	110	No
	Lead	mg/kg	360	12	100	810	3.2	110	No
	Mercury	mg/kg	0.66	12	100	2.5	0.1	0.41	No
	Nickel (GWPS COC)	mg/kg	50	10	100	90	27	35	No
	Silver	mg/kg	0.57	12	42	4	0.2	0.69	**Yes**

Notes:

[a] Analytes are ALU COCs co-located with GWPS COCs, except where noted.

[b] Values are cleanup levels for GWPS COCs (RI Table 9-2) or screening levels (sediment cleanup objectives) for ALU COCs (RI Table 9-3)

[c] Values are the maximum detected surface sediment concentration in SMA 13, expect where noted.

[d] Values are reporting limits for organic COCs and median soil concentrations from samples collected at quarries and pits in the Puget Sound area for metals (Papadopulos and Associates, Inc. 2002).

[e] Maximum detected concentrations adjusted to account for placement of 6-inches of sand (see text for details on calculation).

[f] Diesel range hydrocarbons were not tested for in surface sediment samples collected in SMA-13. Only one sample was collected within the SCU, but outside SMA-13, and tested for diesel range hydrocarbons.

[g] Only three surface sediment were collected within SMA-13 and tested for 4,4'-DDD. However, 26 other surface sediment samples collected within the SCU, but outside SMA-13, were tested for 4,4'-DDE. The maximum detectedd 4,4'-DDE concentration within the SCU was from a sample collected within SMA-13.

CUL/SL = cleanup level or screening level

GWPS COC = Gas Works Park Site Contaminant of Concern

mg/kg = milligrams per kilogram

ND = not detected

PAH = polycyclic aromatic hydrocarbon

SVOCs = semivolatile organic compounds

TPH = total petroleum hydrocarbons

Table 13A-2

Bioaccumulation COCs: Estimation of ENR-Adjusted Surface Sediment Concentrations (SMA-13 and SMA-14)

Gas Works Park Site

Seattle, Washington

Analyte Group	Contaminants of Concern[a]	Unit	Preliminary Cleanup/Screening Level[b]	Surface Sediment SWAC[c]	Sand Concentration[d]	ENR-Adjusted Surface Sediment SWAC[e]
SMA-13						
Metals	Arsenic (GWPS COC)	mg/kg	24	113	2.9	17
	Chromium (ALU COC)	mg/kg	62	93	25	34
PAHs	cPAHs (GWPS COC)	mg/kg	0.21	0.294	0.009	0.046
SMA-14						
Metals	Arsenic (GWPS COC)	mg/kg	24	28	2.9	6.1
	Chromium (ALU COC)	mg/kg	62	70	25	31
PAHs	cPAHs (GWPS COC)	mg/kg	0.21	0.261	0.009	0.041

Notes:

[a] ALU COCs are co-located with GWPS COCs.

[b] Preliminary cleanup and screening levels are applicable to the sediment cleanup unit, not to individual SMAs.

[c] The basis of each SWAC is discussed in Section 3 of the text.

[d] Values are Ecology's programatic sediment practical quantitation limit for cPAHs and and median soil concentrations from samples collected at quarries and pits in the Puget Sound area for arsenic and chromium (Papadopulos and Associates, Inc. 2002).

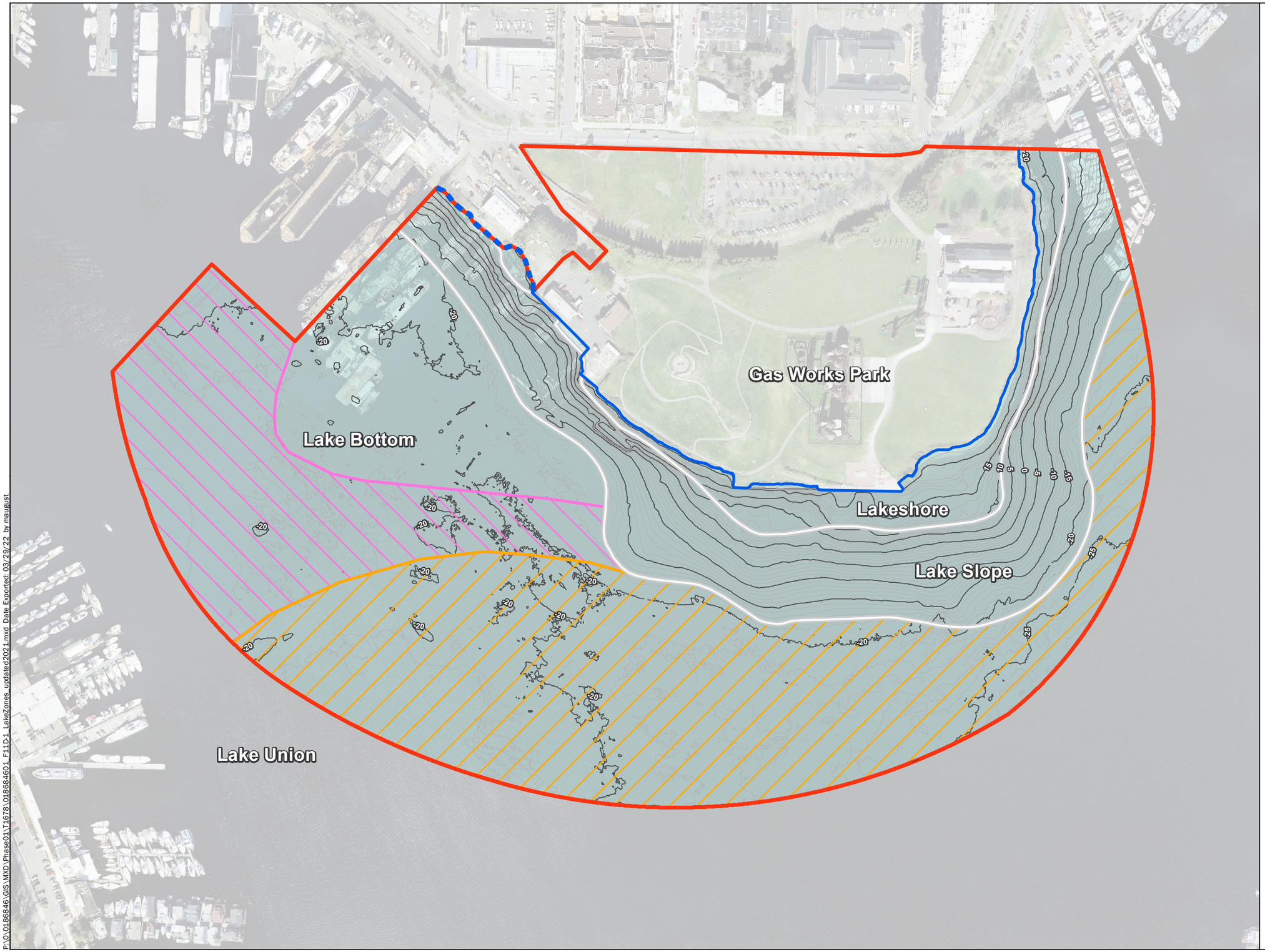
[e] Surface sediment SWAC values adjusted to account for placement of 6-inches of sand (see text for details on calculation).

ALU COC = Ambient Lake Union Contaminant of Concern

GWPS COC = Gas Works Park Site Contaminant of Concern

mg/kg = milligrams per kilogram

PAH = polycyclic aromatic hydrocarbon



Legend

- Area of Investigation
- Shoreline (OHWM)

Bathymetric Contour in Feet (USACE Locks Datum)

- 1' Contour Interval
- 5' Contour Interval
- SMA-13
- SMA-14
- Sediment Cleanup Unit (SCU)

Notes:

1. Data Source: Upland topography is based on AECOM 2010 topographic base map supplemented with True North Land Surveying, Inc., Gas Works Park, Kite Hill Soil Cover Project, drawing J14-80.00, August 20, 2015; and Northwest Corner topography from City of Seattle (2005). Northeast Corner topography does not reflect 2012 capping. Bathymetry generated from side-scan sonar surveys (RETEC, September 1999; City of Seattle November 2002), nearshore singlebeam bathymetry survey (RETEC, October 2002), multibeam bathymetry surveys (Parametrix, December 2002; Tetra Tech, October 2006), leadline survey (RETEC, 2005).
2. Basemap 2005 USGS aerial photograph. Does not show current conditions.
3. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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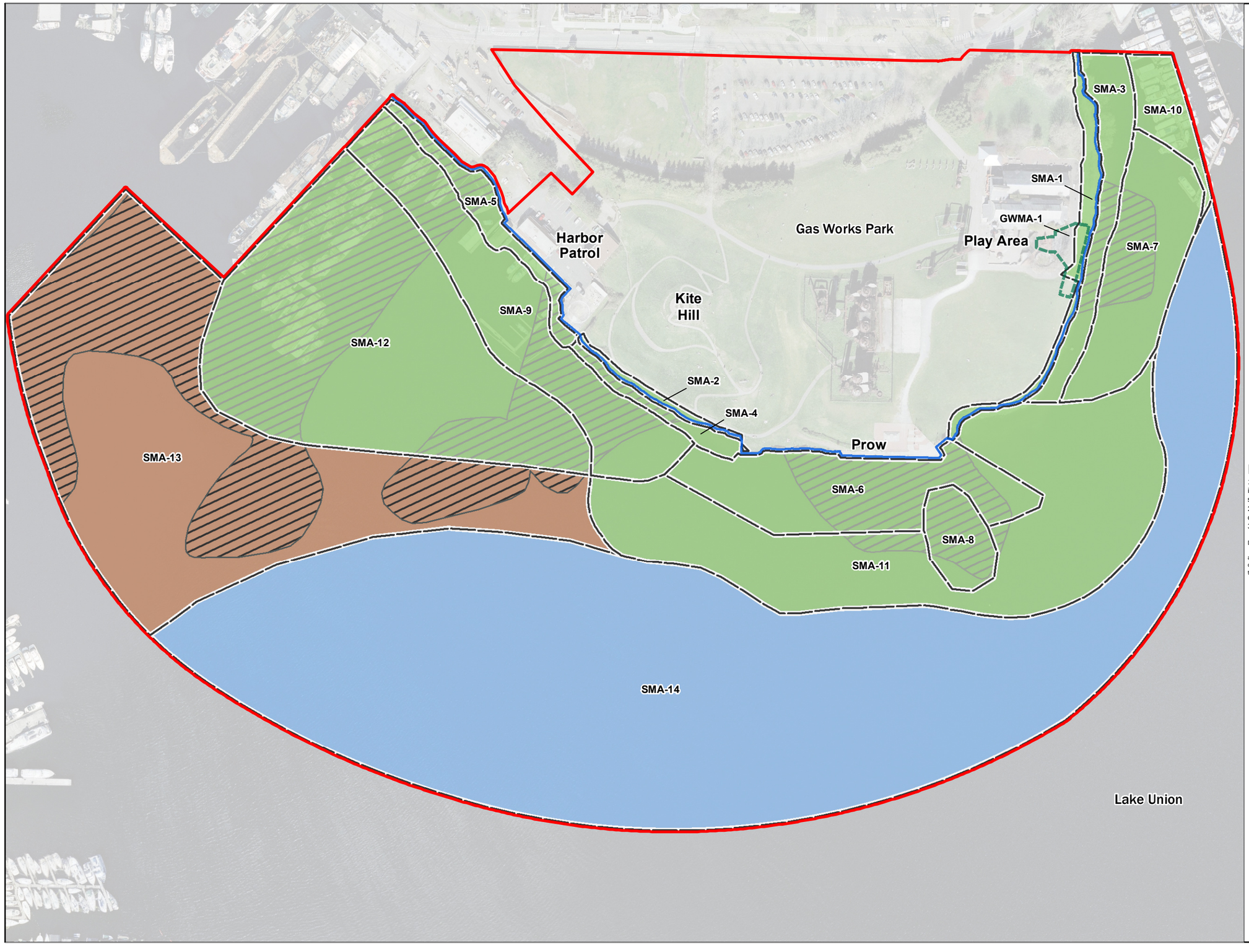
Feet

Lake Zones

Gas Works Park Site
Seattle, Washington

GeoEngineers **Figure 13A-1**



Legend

- Area of Investigation
- Shoreline (OHWM)
- Sediment Management Area (SMA) Boundary
- Groundwater Management Area (GWMA) Boundary
- Vegetated or Sediment Cap
- Enhanced Natural Recovery or Sediment Cap
- Monitored or Enhanced Natural Recovery
- Benthic Toxicity Area

Notes:

1. GWMA-1, SMA-1, and SMA-2 are upland areas and are not included in the restoration timeframe evaluation, which only applies to sediment areas (SMA-3 through SMA-14).
2. Basemap 2005 USGS aerial photograph. Does not show current conditions.
3. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

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Areas Included in Restoration Timeframe Evaluation

Gas Works Park Site
Seattle, Washington

GeoEngineers **Figure 13A-2**

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Observed Reduction in cPAH TEQ Concentration in SMA-14 Surface Sediment over Time

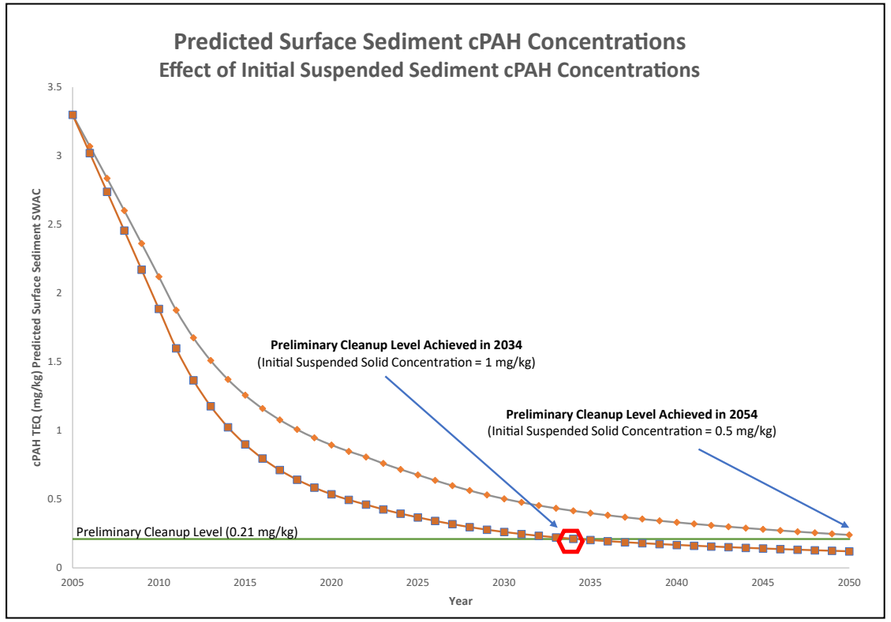
Gas Works Park Site
Seattle, Washington

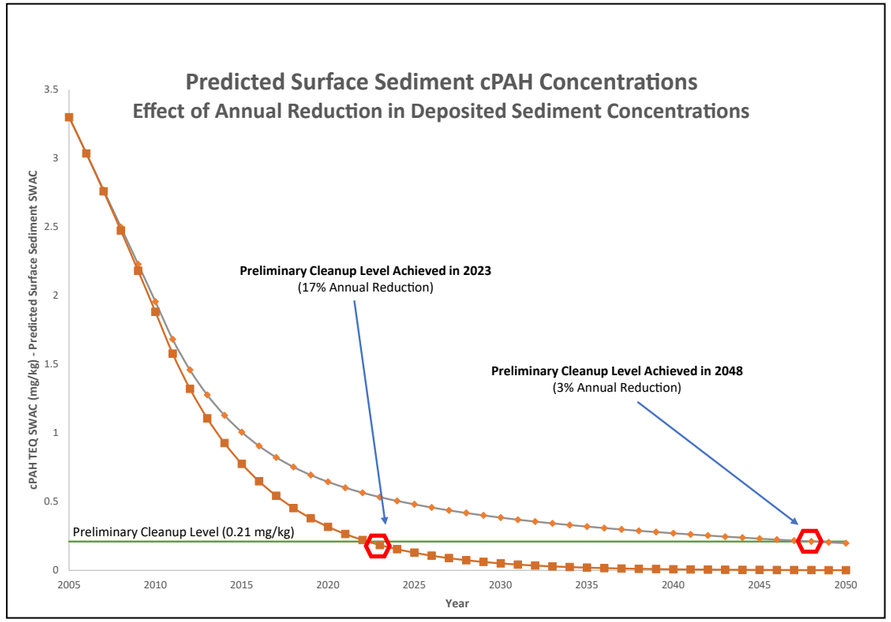
Legend

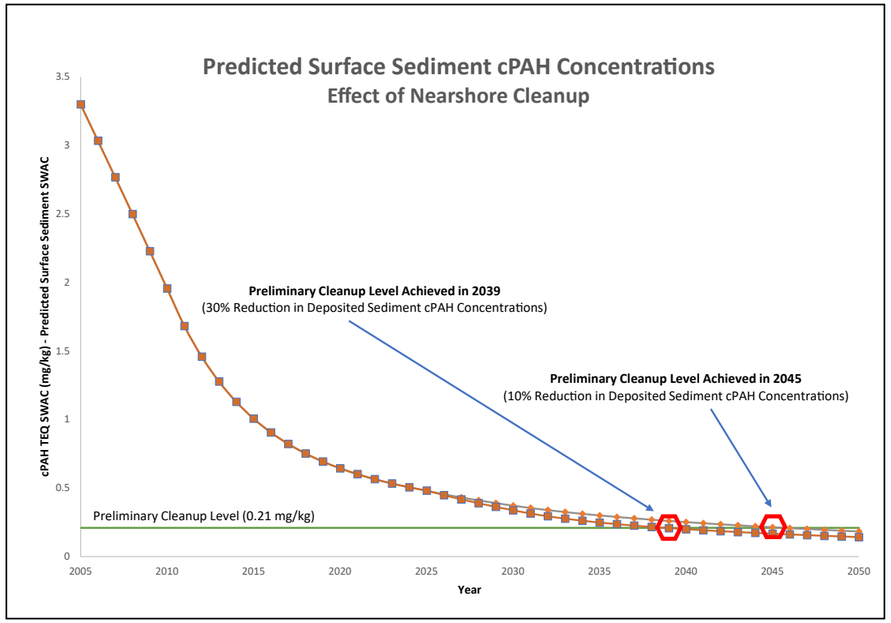
Surface sediment sampling event in the natural recovery area (SMA-14)

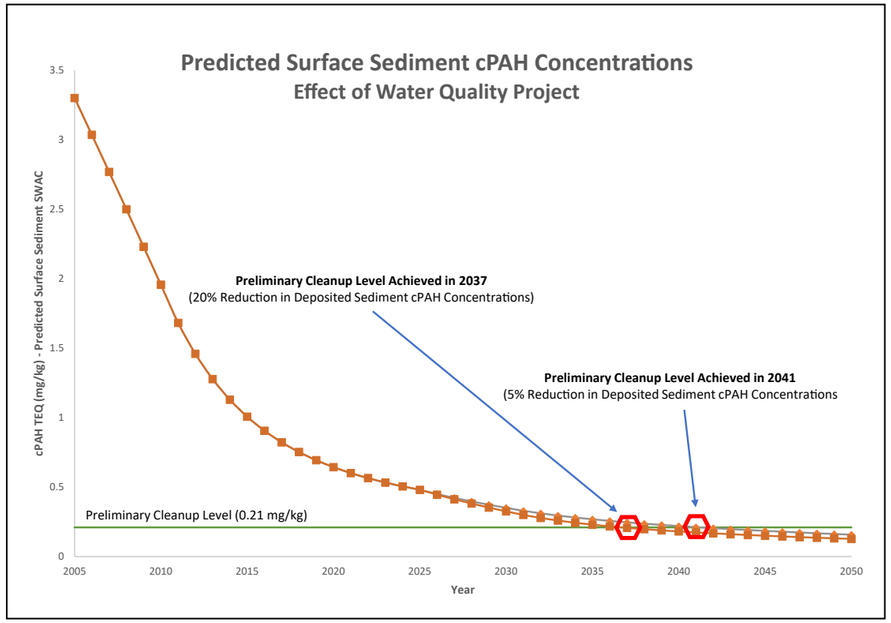
GeoEngineers

Figure 13A-3









Notes:
1. Information on how predicted cPAH surface sediment SWACs are calculated is included in the text (Section 1.3).

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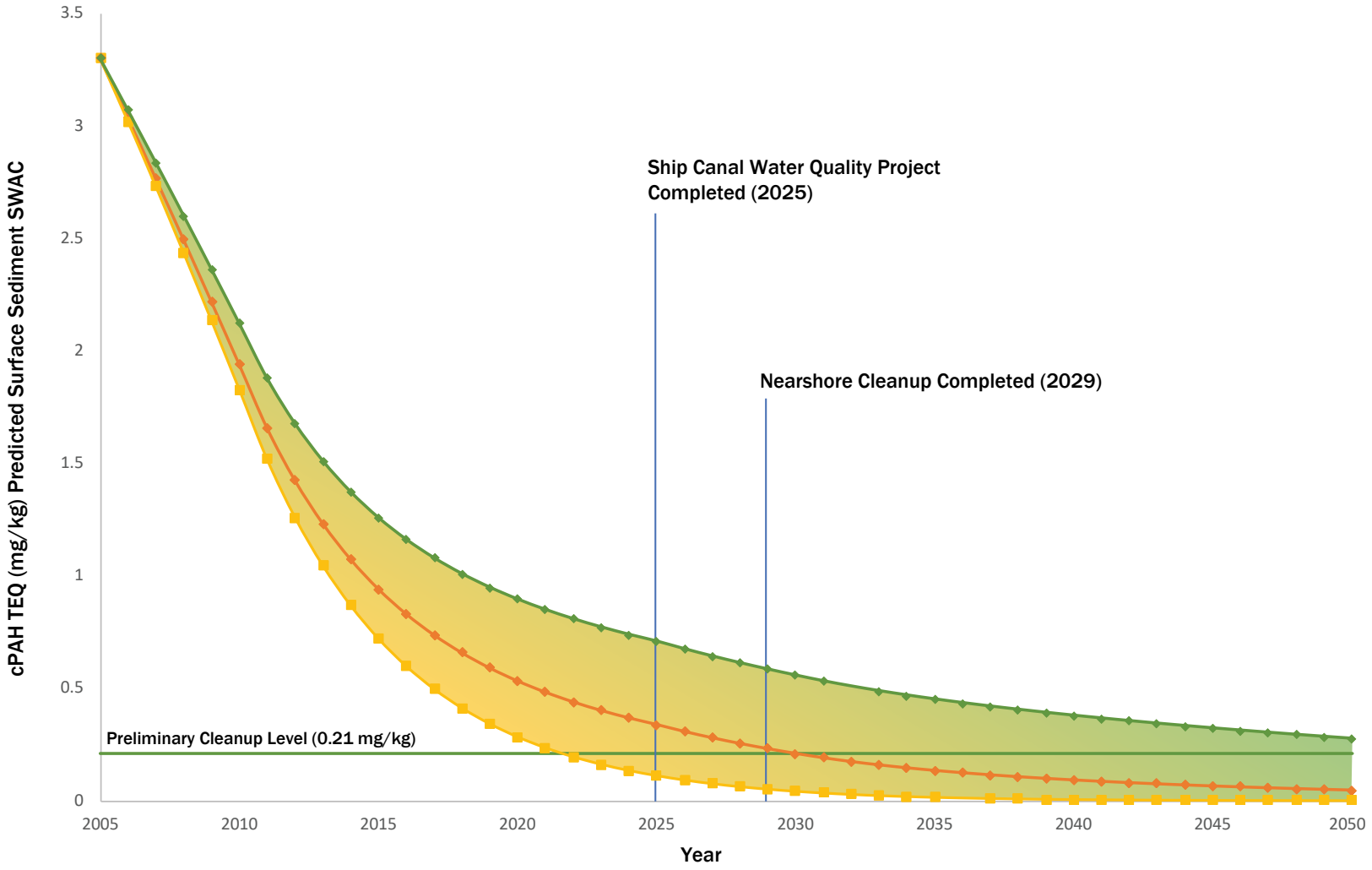
Future Natural Recover in Natural Recover Area
Surface Sediment, Sensitivity Analysis

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 13A-4



Legend

- Moderate Rate of Recovery
- Slower Rate of Recovery
- Faster Rate of Recovery

Notes:

1. Information on how predicted cPAH surface sediment SWACs are calculated is included in the text (Section 1.3).

Future Natural Recovery Surface Sediment in the Natural Recovery Area

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 13A-5

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Legend

cPAH TEQ (mg/kg)

- ≤0.21 CSL
- >0.21 ≤ 2
- >2 ≤ 20
- >20 ≤ 50
- >50

- Area of Investigation
- Shoreline (OHWM)
- SMA-13
- SMA-14
- Sample Location

N W E S

500 0 500

Feet

Notes:

1. cPAH sediment screening level = 0.21 mg/kg (CSL).
2. For mappng purposes surface sediment is defined as the top 6 inches of sediment.
3. ArcGIS Inverse Distance Weighted (IDW) interpolation settings: Power = 6, Neighbors = 8, Radius = 1,000 feet.
4. Where cPAH was not detected, 1/2 the reporting limit was used in the interpolation.
5. Basemap 2005 USGS aerial photograph. Does not show current conditions.
6. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet.

Temporal cPAH TEQ Trends in Surface Sediment 1999-2005

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 13A-6

APPENDIX 13B
Alternative Cost Assumptions and Tables

Table of Contents

TABLES

APPENDIX 13B
REMEDIAL ALTERNATIVE COSTS

This appendix provides the detailed cost estimates for alternatives evaluated in the Gas Works Park Site (GWPS) Feasibility Study (FS). Cost estimates have been developed for the seven remedial alternatives described in Section 12 of the FS document. The following information is provided in this appendix:

- Major cost assumptions
- Alternatives cost estimation summary (Table 13B-1)
- Unit costs and basis for detailed cost estimates (Table 13B-2)
- Detailed cost estimates for the seven remedial alternatives (Tables 13B-3 through Table 13B-9)
- Estimated quantity, material volume and area for the seven remedial alternatives (Table 13B-10)

The costs for each alternative include capital (direct and indirect) costs required to complete the cleanup action construction, long-term operation, maintenance, and monitoring (direct and indirect) for the assumed monitoring period following completion of the cleanup action. An overall project contingency is also applied to address unforeseen conditions at the conceptual design stage typical of an FS. For the purpose of FS cost estimating, a conceptual approach for construction, compliance and long-term monitoring was developed.

Reference information for calculating quantities to support the development of the cost estimate include scaled drawings and boring logs from the Remedial Investigation (RI) report showing lateral and vertical extent of contamination for the area of investigation (AOI). Geographic information system (GIS) and AutoCAD were the primary tools used to calculate areas and volumes and generate material quantities for the cost estimate.

The cost estimates were developed in accordance with the U.S. Environmental Protection Agency's (EPA) guidance document *Guide to Developing and Documenting Cost Estimates during Feasibility Study* (EPA 2000).

Major Cost Assumptions

1. The cost estimates for each alternative, minus the applied contingency are order-of-magnitude costs within a range of -30 percent to +50 percent consistent with EPA's feasibility study cost estimating guidance (EPA 2000).
2. The cost estimates are based on professional judgment, literature reference, published construction cost resources (i.e., RS Means), vendor quotes, and experience on similar projects. The basis for unit costs is listed in the "Source/Assumptions" column in Table 13B-2.
3. The total cost includes capital costs (direct and indirect), operation and maintenance (O&M) costs (direct and indirect) and contingency.
4. Indirect capital costs include mobilization/demobilization, project management, permitting, remedial design, construction management and Ecology oversight. These elements are estimated based on a percentage of the direct capital costs, using consistent percentages across the seven alternatives. The

total indirect capital costs are estimated as 50 percent of the total Direct Capital costs for each alternative.

5. Indirect O&M costs are developed and applied in a similar manner to the indirect capital cost and include project management, construction management and Ecology oversight. The total indirect O&M costs are estimated as 17 percent of the total Direct O&M costs.
6. Sales tax is not included in the cost estimate.
7. For the upland bank permeable vegetated cap composition 0.5 feet of drain rock overlaid by 1.5 feet of topsoil with a geotextile layer below the drain rock is assumed.
8. Material thickness assumptions for the various capping and Enhanced Natural Recovery (ENR) scenarios include:
    a. Conventional sand cap thickness is assumed to be 2 feet of sand, plus 25 percent overage allowance.
    b. Thick sand cap thickness is assumed to be 4 feet of sand, plus 25 percent overage allowance.
    c. ENR sand thickness is assumed to be 0.5 feet, plus 50 percent overage allowance.
    d. Heavy cap armoring is assumed to be a 2-foot thickness of rock applied over 50 percent of Sediment Management Areas (SMAs)-3 to -6 and 25 percent of SMA-11. Habitat mix thickness is assumed to be 0.5 feet and applied over rock armor areas.
    e. For offshore cap areas where a thin layer of lighter armoring is needed, a 0.5 feet thick layer of gravel erosion protection material is assumed to be placed over the cap area.
9. For dredging to facilitate placement of cap material, an average removal depth of 3 feet is assumed. For dredging to facilitate placement of cap material and mass reduction, an average removal depth of 6 feet is assumed. It is assumed that the dredge volume is split equally between land-based excavation and mechanical dredging for SMAs-3 and -4. For SMAs-5 and -10 it is assumed that 90 percent of the removal is by mechanical dredging and 10 percent of the removal is by hydraulic dredging.
10. For low-permeability cap areas, it is assumed that an impermeable liner will be placed on 12 inches of bedding sand, overlaid by geotextile layer and 12 inches of sand cover. Gas collection strips are assumed to be placed in the bedding sand with passive treatment in the bank area. It is assumed that the low-permeability cap will be covered with same armor/habitat mix listed in Item 7.
11. Zero-valent iron (ZVI) is assumed to be placed by mixing in 12 inches of sand and placing an additional 12 inches of sand on top following installation. Activated carbon (AC) and Organoclay (OC) is assumed to be placed on 12-inch sand bedding layer as mats (Aquagate+ or similar) and covered with 12 inches of sand. Amended cap areas are assumed to be covered with same armor/habitat mix listed in Item 7.
12. The following materials contingencies are applied:
    a. ENR Volume = 50 percent;
    b. Sand Cap and Amended Cap Volume = 25 percent; and
    c. Off-Site Disposal Volume = 10 percent.
13. Production rate for sediment removal and cap placement is assumed to be 1,000 cubic yards per day.
14. Local or regional quarries are assumed for sourcing bank material.

15. Seventy-five percent of material removed from tar mound and bank areas is assumed to be disposed at a Subtitle C landfill and 25 percent at an incineration facility. The remaining sediment removed from the GWPS is assumed to be split between Subtitle D landfill (75 percent of material) and Subtitle C landfill (25 percent of material).
16. Sediment handling cost includes gravity dewatering on barge, treatment and handling of drained water, transport dewatered sediment by barge to rail facility and transfer of material from barge to rail cars.
17. Monitoring for Cap, ENR and Monitored Natural Recovery (MNR) during long-term operation and maintenance is assumed to be at 1, 3, 5, 10, 15, 20, 25 and 30 years from construction.
18. Monitoring elements include sediment, surface water, groundwater, and porewater and construction quality, based on the monitoring objective. Activities and costs associated with remedial design sampling or pilot tests are not included in monitoring costs, rather they are included under indirect capital costs.
19. Costs for significant infrastructure relocation or replacement associated with capping adjacent to the Harbor Patrol facility are not included in the alternative cost estimates. If needed, these costs would be common to all alternatives and not impact the Disproportionate Cost Analysis.
20. Costs associated with additional placement of cap material, including armor and habitat mix replenishment, or repair of impermeable cap or other barriers are included in O&M costs. Major repair costs are assumed for capping and ENR at Year 5 and Year 10 after construction. Repair costs based on 10 percent of capping/ENR remedy capital costs for each event.
21. Discount rate of -0.3 percent applied to long-term O&M costs to evaluate net present value.
22. A contingency of 30 percent is applied to the total cost.

REFERENCES

U.S. Environmental Protection Agency. 2000. A Guide to Development and Documenting Cost Estimates During the Feasibility Study.

Table 13B-1

Alternatives Cost Estimate Summary

Gas Works Park Site

Seattle, Washington

Alternative	Management Area	Capital Costs		O&M Costs		Sum (Capital, O&M, Contingency)
		Capital Costs (Base)	Capital Costs (with 30% Contingency)	O&M Costs (Base NPV)	O&M Costs (with 30% Contingency)	
1	GWMA-1, SMA-1, SMA-2	$ 4,258,500	$ 5,536,000	$ 3,040,000	$ 3,952,000	$ 9,488,000
	SMA-3	$ 3,093,000	$ 4,021,000	$ 13,181,000	$ 17,135,300	$ 50,671,300
	SMA-4	$ 1,041,000	$ 1,353,000			
	SMA-5	$ 1,670,000	$ 2,171,000			
	SMA-6	$ 2,003,000	$ 2,604,000			
	SMA-7	$ 1,671,000	$ 2,172,000			
	SMA-8	$ 614,000	$ 798,000			
	SMA-9	$ 3,123,000	$ 4,060,000			
	SMA-10	$ 709,500	$ 922,000			
	SMA-11	$ 4,919,000	$ 6,395,000			
	SMA-12	$ 5,568,000	$ 7,238,000			
	SMA-13	$ 1,386,000	$ 1,802,000			
	SMA-14	$ -	$ -			
Alt 1 Totals =		**$ 30,060,000**	**$ 39,078,000**	**$ 16,220,000**	**$ 21,090,000**	**$ 60,160,000**
2	GWMA-1, SMA-1, SMA-2	$ 4,259,000	$ 5,537,000	$ 3,040,000	$ 3,952,000	$ 9,489,000
	SMA-3	$ 4,512,000	$ 5,866,000	$ 13,630,000	$ 17,719,000	$ 54,908,000
	SMA-4	$ 1,533,000	$ 1,993,000			
	SMA-5	$ 2,637,000	$ 3,428,000			
	SMA-6	$ 2,002,500	$ 2,603,000			
	SMA-7	$ 1,671,000	$ 2,172,000			
	SMA-8	$ 613,500	$ 798,000			
	SMA-9	$ 3,123,000	$ 4,060,000			
	SMA-10	$ 709,500	$ 922,000			
	SMA-11	$ 4,918,500	$ 6,394,000			
	SMA-12	$ 5,500,500	$ 7,151,000			
	SMA-13	$ 1,386,000	$ 1,802,000			
	SMA-14	$ -	$ -			
Alt 2 Totals =		**$ 32,870,000**	**$ 42,731,000**	**$ 16,670,000**	**$ 21,670,000**	**$ 64,400,000**
3	GWMA-1, SMA-1, SMA-2	$ 4,258,500	$ 5,536,000	$ 3,040,000	$ 3,952,000	$ 9,488,000
	SMA-3	$ 2,889,000	$ 3,756,000	$ 14,640,000	$ 19,032,000	$ 64,449,000
	SMA-4	$ 1,095,000	$ 1,424,000			
	SMA-5	$ 1,668,000	$ 2,168,000			
	SMA-6	$ 2,002,500	$ 2,603,000			
	SMA-7	$ 4,564,500	$ 5,934,000			
	SMA-8	$ 1,323,000	$ 1,720,000			
	SMA-9	$ 4,729,500	$ 6,148,000			
	SMA-10	$ 709,500	$ 922,000			
	SMA-11	$ 4,918,500	$ 6,394,000			
	SMA-12	$ 9,651,000	$ 12,546,000			
	SMA-13	$ 1,386,000	$ 1,802,000			
	SMA-14	$ -	$ -			
Alt 3 Totals =		**$ 39,200,000**	**$ 50,960,000**	**$ 17,680,000**	**$ 22,980,000**	**$ 73,940,000**
4	GWMA-1, SMA-1, SMA-2	$ 6,487,500	$ 8,434,000	$ 3,040,000	$ 3,952,000	$ 12,386,000
	SMA-3	$ 6,054,000	$ 7,870,000	$ 13,927,000	$ 18,105,100	$ 57,710,100
	SMA-4	$ 1,522,500	$ 1,979,000			
	SMA-5	$ 1,617,000	$ 2,102,000			
	SMA-6	$ 2,002,500	$ 2,603,000			
	SMA-7	$ 1,671,000	$ 2,172,000			
	SMA-8	$ 613,500	$ 798,000			
	SMA-9	$ 4,398,000	$ 5,717,000			
	SMA-10	$ 715,500	$ 930,000			
	SMA-11	$ 4,918,500	$ 6,394,000			
	SMA-12	$ 5,568,000	$ 7,238,000			
	SMA-13	$ 1,386,000	$ 1,802,000			
	SMA-14	$ -	$ -			
Alt 4 Totals =		**$ 36,950,000**	**$ 48,035,000**	**$ 16,970,000**	**$ 22,060,000**	**$ 70,100,000**

5	GWMA-1, SMA-1, SMA-2	$ 6,487,500	$ 8,434,000	$ 3,040,000	$ 3,952,000	$ 12,386,000
	SMA-3	$ 4,431,000	$ 5,760,000	$ 14,243,000	$ 18,515,900	$ 60,694,900
	SMA-4	$ 1,522,500	$ 1,979,000			
	SMA-5	$ 1,617,000	$ 2,102,000			
	SMA-6	$ 2,002,500	$ 2,603,000			
	SMA-7	$ 4,564,500	$ 5,934,000			
	SMA-8	$ 1,323,000	$ 1,720,000			
	SMA-9	$ 4,398,000	$ 5,717,000			
	SMA-10	$ 715,500	$ 930,000			
	SMA-11	$ 4,918,500	$ 6,394,000			
	SMA-12	$ 5,568,000	$ 7,238,000			
	SMA-13	$ 1,386,000	$ 1,802,000			
	SMA-14	$ -	$ -			
	Alt 5 Totals =	**$ 38,930,000**	**$ 50,609,000**	**$ 17,280,000**	**$ 22,470,000**	**$ 73,080,000**
6	GWMA-1, SMA-1, SMA-2	$ 6,487,500	$ 8,434,000	$ 3,040,000	$ 3,952,000	$ 12,386,000
	SMA-3	$ 4,431,000	$ 5,760,000	$ 14,231,000	$ 18,500,300	$ 60,583,300
	SMA-4	$ 1,770,000	$ 2,301,000			
	SMA-5	$ 1,668,000	$ 2,168,000			
	SMA-6	$ 2,002,500	$ 2,603,000			
	SMA-7	$ 4,564,500	$ 5,934,000			
	SMA-8	$ 619,500	$ 805,000			
	SMA-9	$ 4,729,500	$ 6,148,000			
	SMA-10	$ 715,500	$ 930,000			
	SMA-11	$ 4,918,500	$ 6,394,000			
	SMA-12	$ 5,568,000	$ 7,238,000			
	SMA-13	$ 1,386,000	$ 1,802,000			
	SMA-14	$ -	$ -			
	Alt 6 Totals =	**$ 38,860,000**	**$ 50,518,000**	**$ 17,270,000**	**$ 22,450,000**	**$ 72,970,000**
7	GWMA-1, SMA-1, SMA-2	$ 6,487,500	$ 8,434,000	$ 3,040,000	$ 3,952,000	$ 12,386,000
	SMA-3	$ 4,431,000	$ 5,760,000	$ 15,217,000	$ 19,782,100	$ 69,900,100
	SMA-4	$ 1,555,500	$ 2,022,000			
	SMA-5	$ 1,668,000	$ 2,168,000			
	SMA-6	$ 3,540,000	$ 4,602,000			
	SMA-7	$ 4,564,500	$ 5,934,000			
	SMA-8	$ 1,323,000	$ 1,720,000			
	SMA-9	$ 4,729,500	$ 6,148,000			
	SMA-10	$ 786,000	$ 1,022,000			
	SMA-11	$ 4,918,500	$ 6,394,000			
	SMA-12	$ 9,651,000	$ 12,546,000			
	SMA-13	$ 1,386,000	$ 1,802,000			
	SMA-14	$ -	$ -			
	Alt 7 Totals =	**$ 45,040,000**	**$ 58,552,000**	**$ 18,260,000**	**$ 23,730,000**	**$ 82,290,000**
8	GWMA-1, SMA-1, SMA-2	$ 6,487,500	$ 8,434,000	$ 3,040,000	$ 3,952,000	$ 12,386,000
	SMA-3	$ 4,431,000	$ 5,760,000	$ 17,196,000	$ 22,354,800	$ 81,543,800
	SMA-4	$ 1,555,500	$ 2,022,000			
	SMA-5	$ 1,668,000	$ 2,168,000			
	SMA-6	$ 3,540,000	$ 4,602,000			
	SMA-7	$ 4,564,500	$ 5,934,000			
	SMA-8	$ 1,323,000	$ 1,720,000			
	SMA-9	$ 4,729,500	$ 6,148,000			
	SMA-10	$ 786,000	$ 1,022,000			
	SMA-11	$ 4,918,500	$ 6,394,000			
	SMA-12	$ 9,651,000	$ 12,546,000			
	SMA-13	$ 5,281,500	$ 6,866,000			
	SMA-14	$ 3,082,500	$ 4,007,000			
	Alt 8 Totals =	**$ 52,020,000**	**$ 67,626,000**	**$ 20,240,000**	**$ 26,310,000**	**$ 93,930,000**

Notes

1. Estimates represent order-of-magnitude within a range of -30 percent to +50 percent consistent with USEPA Feasibility Study cost estimating guidance. Costs are in 2021 dollars.
2. All cost values are estimates, and should not be interpreted as final construction costs.
3. NPV = net present value

Table 13B-2

Unit Costs Used for Detailed Cost Estimates

Gas Works Park Site

Seattle, Washington

Item	Unit	Unit Cost	Year	2021 Unit Cost / Conversion[1]	Source/Assumptions
Direct Capital Costs					
General Site Construction Elements					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	ls			$ 100,000	Professional judgment and experience on other similar projects.
Clear and Grub trees up to 12" diameter	acre	$11,761.68	2020	$ 13,546	2020 RS Means Heavy Construction Cost Data. Increased unit cost by 10% to include management of organic waste.
Post-construction upland survey	each	$3,100	2020	$ 3,571	2020 RS Means Heavy Construction Cost Data. Approx. $3,100/acre for topographic survey. Upland area is less than 1 acre.
Air and Dust Monitoring	day			$ 500	Professional judgment and experience on other similar projects. Includes subcontractor and analytical costs for perimeter monitoring.
Excavation (Upland)					
Soil Excavation (upto 15 feet)	cy	$13	2020	$ 14	Vendor quote (Wyser Construction) and experience on other similar projects. Includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	ls			$ 50,000	Professional judgment and experience on other similar projects. Includes dewatering and handling for shallow excavations (less than 15 ft bgs). Assume drainage ditch, sump hole construction with pumping and handling/management of water.
On-site stockpiling and management of excavated material	cy			$ 5	Experience on other similar projects.
Transport/Disposal (Soil/Water)					
Soil unit weight conversion (in-place volume)	ton/cy			1.4	Average unit weight (in-place volume) based on prior testing in arsenic impact area near eastern shoreline; average accounts for differences in unit weights between unsaturated and saturated soil.
Transport (truck/train) and dispose soil to Subtitle D landfill	ton	$60	2018	$ 69	Vendor quote (Waste Management) for permitted facility in Washington. Includes truck liner and
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	ton	$175	2018	$ 201	Considered non-hazardous due to TCLP exemption for MGPs. Disposal at permitted Chem WM Subtitle C in Oregon. Disposal $90/ton, plus rail-transporation and liner cost to Oregon $800/container. Unit cost ~ $175/ton.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	ton	$878	2018	$ 1,008	Vendor quote for permitted facilities in Aragonite, Utah. Basis for quote is $650/ton for incineration and disposal and $228/ton transport by truck.
Upland Backfilling and Capping					
Rough grade for cap surface preparation	ls	3094.03	2020	$ 3,240	Based on 2020 RS Means.
Procure and Install Geotextile	sy	2.85	2020	$ 3	Based on an average contractor bid price on another project (Kite Hill). Assume 10 ounce weight, non-woven needle punched fabric.
Cap drainage layer - import, place, compact	cy	45	2014	$ 63	Vendor quote (Wyser Construction) and project experience from Kite Hill. Assume Type 17 Bank
Procure and Place Topsoil	cy	40	2014	$ 56	Vendor quote (Wyser Construction) and project experience from Kite Hill.
Hydroseeding	sy	2	2014	$ 3	Vendor quote (Wyser Construction) and project experience from Kite Hill.
Shoreline Restoration	ls			$ 100,000	Professional judgment. Assumes revegetation in lake perimeter areas affected by construction; cost includes restoration design and is based on similar effort scope costs.
In-Situ Chemical Fixation					
Mobilization and Demobilization	each	$12,000	2019	$ 13,155	Vendor quote (Isotec).
Bench Scale/Pilot Testing	ls	$40,000	2019	$ 43,849	Vendor quote (Isotec). Bench testing to evalauate treability and design factors.
ISCF Reagent Application	ls			$ 300,000	Based on PA IA costs (2017 to 2019). Includes labor, equipment, injection point drilling and reagent costs. Approx. $300,000 for injection well (~36 wells) and MW drilling and piping infrastructure. Approx. $60,000 per injection event for reagent injection (includes labor and materials). Total cost ~ $500,000. Assume $300,000 for GWMA-1 due to reduced scope.
Process Monitoring	ls			$ 120,000	Professional judgment and experience from PA IA. Assume 2 to 3 new monitoring wells for installation and monitoring/analytical costs (total and dissolved arsenic, iron). Approximate PA IA monitoring cost was $25,000 per event. Assume 4 events. Assume $10,000 for new monitoring wells.
Sediment Removal					
Sediment excavation using land-based excavation equipment	cy	$39	2016	$ 49	Vendor quote (Great Lakes Env and Infrastructure). Excavate using equipment placed in upland; stockpile in upland. Includes silt curtain for in-water BMP. Cost includes a contingency for additional water quality controls in the event NAPL is encountered during removal.
Shoring and/or coffer dam install for excavation in lakeshore area	ls		2021	$ 325,000	Vendor quote (Portadam Inc.). Based on use of Portadam coffer dam system. Cost includes installation, dismantling, and 2-months rental.
Handling and dewatering of sediment from land-based excavation	cy			$ 15	Professional judgment and experience on other smilar projects.
Sediment removal by hydraulic dredging (Suction head)	cy	$47	2016	$ 60	Vendor quote (Great Lakes Env and Infrastructure). Increased the unit cost to account for specialty dredges that may be required to handle site conditions. Assumes 70% removal of water by volume.
Dewatering of hydraulically dredged sediment	cy	$11	2016	$ 14	Vendor quote (Great Lakes Env and Infrastructure) based on previous projects. Sediments to be dried via geotubes in containment area to a degree to allow for transport and disposal.
Sediment removal by mechanical dredging (barge-mounted)	cy	$38	2016	$ 48	Estimate based on vendor quote (Great Lakes Env and Infrastructure) and cost for similar recent completed projects. Includes silt curtain for water quality control. Cost includes a contingency for additional water quality controls in the event NAPL is encountered during removal.
Gravity dewatering on the barge	cy			$ 10	Professional judgment and experience on other similar projects. Assume dewatering of mechanically dredged sediment on material barges.
Handling of water drained from excavated sediment	day			$ 10,000	Professional judgment and experience on other similar projects. Estimate for treatment equipment, collection, treatment, testing, handling, and discharge of water (to the Lake) drained from mechanically dredged sediment.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	day			$ 6,000	Professional judgment and experience on other similar projects. Includes maintenance of BMPs, survey boat, labor and equipment for bathymetric survey and water quality testing during construction.
Sediment unit weight conversion (in-place volume)	ton/cy			1.3	Professional judgment. Average unit weight (in-place volume).
Transload/Transport/Disposal (Sediment)					
Stockpile and dewatering area setup and removal	ls			$ 150,000	Professional judgment and experience on other similar projects.
Barge transport to rail facility	ton			$ 5	Estimate for transporting dewatered sediment on material barge from work area to the WM transload facility in the Duwamish waterway. Estimate based on professional judgment and experience on similar projects.
In-Water Backfilling and Capping					
Sediment debris sweep and disposal	acre			$ 30,000	Professional judgment and experience on other similar projects. Prepares existing surface for cap. Assumes no major obstructions are encountered.
Removal of docks and large obstructions	ls			$ 100,000	Professional judgment and experience on other similar projects. Assumed to cover costs for major obstructions (sunken boats, large debris) in isolated areas.
Procure and place enhanced natural recovery (ENR) layer	cy	$36	2017	$ 44	Vendor quote. Assume placement of sand in two separate thin lifts with 6-inch final thickness (includes 10% increase for thin cap placement in lifts on soft sediment).
Procure and place sand backfill/cap	ton	$37	2017	$ 45	Based on vendor quote and experience on similar projects. Material imported from an upland source.
Procure and place geocomposite gas collection layer	lf	$4	2016	$ 6	Vendor quote (Layfield USA Corp) for Geo-Comp 5-2-6. Includes labor and material costs.
Procure and place Impermeable Liner	sf	$1	2016	$ 2	Vendor quote (Layfield USA Corp) for Enviroliner 7040HD. Incldes labor and material cost for dry installation.
Amended cap media: Organoclay PM-199	lb	$2	2016	$ 2	Vendor quote (AquaBlok). Application rate varies; determined through cap modeling.
Amended cap media: Activated Carbon	lb	$1	2016	$ 2	Vendor quote (AquaBlok). Application rate varies; determined through cap modeling.
Amended cap media: Zero-Valent Iron	lb	$2	2016	$ 3	Vendor quote (AquaBlok). Application rate varies; determined through cap modeling.
Prepare amended cap blend	cy	$5	2016	$ 7	Vendor quote(AquaBlok). Mix sand/organoclay blend in upland location to prepare for placement.
Amended Cap placement	cy	$40	2016	$ 51	Estimate based on previous project costs.
Purchase and Install Reactive Core Mat™ Organoclay	sf	$10	2016	$ 13	Based on vendor quote (Cetco) and previous projects. RCM mat standard dimension 15 feet by 100 feet roll with 1 cm thickness. Material cost ($3/sf) + Installation cost ($7/sf) = $10/sf.
Purchase and Install Reactive Core Mat™ Granular Activated Carbon	sf	$10	2016	$ 13	Based on vendor quote (Cetco) and previous projects. RCM mat standard dimension 15 feet by 100 feet roll with 1 cm thickness. Material cost ($3/sf) + Installation cost ($7/sf) = $10/sf.
Purchase and place Aquagate™ with Powdered Activated Carbon	sf	$10	2021	$ 10	Vendor quote (AquaBlok). Unit cost based on achieving target cap thickness of 3 inches. Assume 5% Powdered Activated Carbon by weight. Material cost ($7.00/sf) + Installation cost ($3.00/sf) = $10/sf.
Purchase and place Aquagate™ with Organoclay	sf	$25	2021	$ 25	Vendor quote (AquaBlok). Unit cost based on achieving target cap thickness of 4 inches. Assume 30% organoclay by weight. Material cost ($22/sf) + Installation cost ($3/sf) = $25/sf.

Item	Unit	Unit Cost	Year	2021 Unit Cost / Conversion[1]	Source/Assumptions
Procure and place armor stone for erosion protection	ton	48	2013	$ 70	Based on an average contractor bid price on a another project. Material imported from an upland source and placed in intertidal zone using upland-based equipment
Procure and place fish mix on armor rock to fill interstitial voids	cy	61.67	2016	$ 78	Based on an average contractor bid price on a another project. Material imported from an upland source, tranloaded onto a barge and placed using marine barge-based equipment.
Procure and place 6-inch layer of pea gravel for armor	cy			$ 27	Estimate based on experience on similar projects.
Stormwater and Stockpile Water Management					
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	ls			$ 100,000	Professional judgment based on recently completed projects. Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Miscellaneous					
Institutional Controls/Restrictive Covenants Preparation	ls			$ 75,000	Professional judgment based on recently completed projects. Initial costs for activities used to establish or setup institutional controls. Assume annual costs applied Year 1 through Year 30.
Institutional Controls - annual cost	ls			$ 25,000	Professional judgment based on recently completed projects. Annual costs for activities performed on a regular basis to monitor and maintain the institutional controls.
Net Present Value Multipliers					
Net Present Value Discount Rate	-0.3%				Based on Real 30-year discount rate published in November 2020 Office of Management and Budget Circular No. A-94.
Net Present Value Multipliers for equal payment series	**Years**			**Equal Annual Payment Multiplier[2]**	**Single Payment Multiplier[3]**
	1			1.00	1.00
	2			2.01	1.01
	3			3.02	1.01
	4			4.03	1.01
	5			5.05	1.02
	6			6.06	1.02
	7			7.08	1.02
	8			8.11	1.02
	9			9.14	1.03
	10			10.17	1.03
	15			15.37	1.05
	20			20.64	1.06
	25			26.00	1.08
	30			31.44	1.09
Annual Groundwater Monitoring					
Groundwater sampling labor	well			$ 500	Professional judgment and experience on other similar projects. Assume 2 field staff for completing the work.
Groundwater Sample Chemical Analysis	well			$ 620	Recent project costs. Includes analysis for BETX, SIM PAHs, Arsenic, Sulfate, Alkalinity, TDS, Chloride, Nitrate, Ions and Total Fe and Ferrous Fe.
Data analysis, management and reporting	ls			$ 100,000	Recent project costs.
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	ls			$ 30,000	Professional judgment and experience on other similar projects.
Sediment Monitoring and O&M					
Sediment cap operation and maintenance monitoring and reporting	acre			$ 20,000	Professional judgment and experience on other similar projects. Includes labor, equipment, sediment sampling, analytical costs and bathymetric survey for long-term operation and maintenance monitoring. Assume monitoring in Year 1,3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes armor and habitat mix replenishment.
ENR operation and maintenance monitoring and reporting	acre			$ 12,500	Professional judgment and experience on other similar projects. Includes labor, equipment, sediment sampling, analytical costs and bathymetric survey for long-term operation and maintenance monitoring. Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event	%			10%	Periodic major repair of cap/ENR areas. Assume repair in Year 5, and 10 after active remedy construction. Based on percent of cap/ENR remedy capital costs.
MNR operation and maintenance monitoring and reporting	acre			$ 10,000	Professional judgment and experience on other similar projects. Includes labor, equipment, sediment sampling, analytical costs and bathymetric survey for long-term operation and maintenance monitoring. Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 years after active remedy construction.
Unit Conversion					
Conversion from CY to Tons for Contaminated Material	TONS/CY			1.3	Professional judgment.
Conversion from CY to Tons for Imported Loose Sand or sand with Gravel	TONS/CY			1.4	Professional judgment.
Conversion from CY to Tons for Imported Gravel/Rock	TONS/CY			1.6	Professional judgment.
Indirect Capital Costs					
Mobilization/demobilization	% of TDC			10%	Indirect percentages based on EPA 2000 guidance (EPA, 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. OSWER 9355.0-75) and recent project experience.
Remedial design	% of TDC			20%	
Project management (PM)	% of TDC			8%	
Construction management (CM)	% of TDC			10%	
Ecology Oversight	% of TDC			2%	
Contingency	% of TDC			30%	
Annual Inflation Rate	%			4.7%	
Total Indirect Capital Costs	% of TDC			50%	Apply mob/demob, remedial design, PM, CM, and ecology oversight to sum of capital direct costs.
Indirect Costs - O&M Expenses					
Project management	% of TDC			10%	Indirect percentages based on EPA 2000 guidance (EPA, 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. OSWER 9355.0-75) and recent project experience.
Construction management	% of TDC			5%	
Ecology Oversight	% of TDC			2%	
Contingency	% of TDC			30%	
Total Indirect O&M Costs	% of TDC			17%	Apply PM, CM and ecology oversight to sum of O&M direct costs.

Notes:

1. Costs shown represent labor, equipment and materials inclusive of overhead and profit.
2. All cost values are estimates, and should not be interpreted as final construction costs.
3. Cost Estimate Guidance: A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. OSWER 9355.0-75, EPA 2000.
4. Estimates represent order-of-magnitude within a range of -30 percent to +50 percent consistent with USEPA Feasibility Study cost estimating guidance. Costs are in 2021 dollars
5. Cost estimates based on professional judgment, literature reference, RS Means Cost Data, vendor quote and experience on similar projects.
6. The estimated costs include direct costs (construction costs), indirect costs (mobilization/demobilization, remedial design, project management, construction management, and ecology oversight), contingency, and operation and maintenance costs.
7. Mobilization/demobilization includes contractor submittals, job adminstration/management, mobilizing labor, equipment and materials, field quality control testing, site preparation, baseline sampling (prior to construction) and demobilization.
8. Remedial design includes sampling plans, work plans, design support studies (geotechnical/seismic, vessel scour) pre-design sampling, engineering survey, permitting, plans and specifications, engineers estimate, bid documents and contracting suppc
9. Project management includes meetings, planning, coordination, cost and performance reporting.
10. Construction management includes field oversight, traffic and vessel navigation control, submittal review, change order review, design modifications, construction schedule tracking and construction completion report.
11. Long-term operation, monitoring, maintenance and inspection (O&M) costs are presented as the Net Present Value (NPV) estimated over a 30 year period using a discount rate of -0.3%. O&M costs include project management and construction management.
12. Contingency applied to the following material volumes: ENR Volume = 50%; Sand Cap Volume = 25%; Upland Backfill Volume = 10%, Off-Site Disposal Volume = 10%.

The following acronyms are used on Tables 13A-3 through 13A-13:

cy = cubic yard
ENR = enhanced natural recovery
lb = pounds
lf = linear feet
ls = lump sum
MNR = monitored natural recovery
NPV = net present value
O&M = operation and maintenance
sf = square foot
ISCF = In-Situ Chemical Fixation
sy = square yard
TDC = total direct capital cost

Table 13B-3

Alternative 1

Gas Works Park Site
Seattle, Washington

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	2,452	cy	$ 14	$ 34,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	2,452	cy	$ 5	$ 12,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	2,832	ton	$ 201	$ 569,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	944	ton	$ 1,008	$ 952,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 2,839,000	
Indirect Capital Cost	% of TDC		50%	$ 1,419,500	
Total Capital Cost				**$ 4,258,500**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	4,889	cy	$ 49	$ 240,000	
Handling and dewatering of sediment from land-based excavation	4,889	cy	$ 15	$ 73,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	1,681	ton	$ 201	$ 338,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	5,042	ton	$ 69	$ 348,000	
Procure and place sand backfill/cap	9,333	ton	$ 45	$ 420,000	Assume 2 ft and 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	18	day	$ 6,000	$ 106,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 2,062,000	
Indirect Capital Cost	% of TDC		50%	$ 1,031,000	
Total Capital Cost				**$ 3,093,000**	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 9,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	1,378	cy	$ 49	$ 68,000	
Handling and dewatering of sediment from land-based excavation	1,378	cy	$ 15	$ 21,000	
Handling of water drained from excavated sediment	5	day	$ 10,000	$ 50,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	474	ton	$ 201	$ 95,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	1,421	ton	$ 69	$ 98,000	
Procure and place sand backfill/cap	2,087	ton	$ 45	$ 94,000	Assume 2 ft and 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 27,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	735	ton	$ 70	$ 51,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	230	cy	$ 78	$ 18,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 694,000	
Indirect Capital Cost	% of TDC		50%	$ 347,000	
Total Capital Cost				**$ 1,041,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 124,800	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	4,356	ton	$ 45	$ 196,000	Assume 2 ft and 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	9	day	$ 6,000	$ 55,600	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 1,113,000	
Indirect Capital Cost		% of TDC	50%	$ 557,000	
Total Capital Cost				**$ 1,670,000**	
SMA-6					
Sediment debris sweep and disposal	2.3	acre	$ 30,000	$ 69,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	12,963	ton	$ 45	$ 583,000	Assume 2 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	21	day	$ 6,000	$ 124,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	5,926	ton	$ 70	$ 415,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	1,852	cy	$ 78	$ 144,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 1,335,000	
Indirect Capital Cost		% of TDC	50%	$ 668,000	
Total Capital Cost				**$ 2,003,000**	
SMA-7					
Sediment debris sweep and disposal	1.95	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	17,241	ton	$ 45	$ 776,000	Assume 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 103,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Direct Capital Cost Subtotal				$ 1,114,000	
Indirect Capital Cost		% of TDC	50%	$ 557,000	
Total Capital Cost				**$ 1,671,000**	
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	6,611	ton	$ 45	$ 298,000	Assume 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 409,000	
Indirect Capital Cost		% of TDC	50%	$ 204,500	
Total Capital Cost				**$ 614,000**	
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	32,148	ton	$ 45	$ 1,447,000	Assume 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	32	day	$ 6,000	$ 193,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot.
Direct Capital Cost Subtotal				$ 2,082,000	
Indirect Capital Cost		% of TDC	50%	$ 1,041,000	
Total Capital Cost				**$ 3,123,000**	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	69	cy	$ 60	$ 4,000	Diver assisted dredging around structures in the Marina
Dewatering of hydraulically dredged sediment	69	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	620	cy	$ 48	$ 30,000	
Gravity dewatering on the barge	620	cy	$ 10	$ 6,000	
Barge transport to rail facility	947	ton	$ 5	$ 5,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	237	ton	$ 201	$ 48,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	710	ton	$ 69	$ 49,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 23,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Direct Capital Cost Subtotal				$ 473,000	
Indirect Capital Cost		% of TDC	50%	$ 236,500	
Total Capital Cost				**$ 709,500**	
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,640,000	
Total Capital Cost				**$ 4,919,000**	

Description	Quantity Number	Unit	Cost Unit Cost	Total Cost	Notes
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	59,759	ton	$ 45	$ 2,689,000	Assume 4 ft thick cap.
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel across 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	67	day	$ 6,000	$ 404,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,712,000	
Indirect Capital Cost		% of TDC	50%	$ 1,856,000	
Total Capital Cost				**$ 5,568,000**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	12,361	cy	$ 44	$ 544,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 74,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 924,000	
Indirect Capital Cost		% of TDC	50%	$ 462,000	
Total Capital Cost				**$ 1,386,000**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 30,056,000**	
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,105,000	
Indirect O&M Costs		% of TDC	17%	$ 358,000	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Sediment - Capping, ENR, MNR and ICs					
Sediment cap operation and maintenance monitoring and reporting	24	acre	$ 20,000	$ 480,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
ENR operation and maintenance monitoring and reporting	10	acre	$ 12,500	$ 125,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 1,719,700	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	23	acre	$ 10,000	$ 230,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Institutional Controls - annual cost	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 10,869,400	
Indirect O&M Costs		% of TDC	17%	$ 1,847,798	
Undiscounted Subtotal (including Indirect Costs)				**$ 12,717,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 13,181,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 15,671,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 16,221,000**	
Contingency (30 Percent of Total Cost)				**$ 13,883,000**	
Total Cost of Alternative (Present Worth)				**$ 60,160,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-4

Alternative 2

Gas Works Park Site
Seattle, Washington

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	2,452	cy	$ 14	$ 34,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	2,452	cy	$ 5	$ 12,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	2,832	ton	$ 201	$ 569,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	944	ton	$ 1,008	$ 952,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 2,839,000	
Indirect Capital Cost		% of TDC	50%	$ 1,420,000	
Total Capital Cost				**$ 4,259,000**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	4,889	cy	$ 49	$ 240,000	
Handling and dewatering of sediment from land-based excavation	4,889	cy	$ 15	$ 73,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	1,681	ton	$ 201	$ 338,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	5,042	ton	$ 69	$ 348,000	
Procure and place sand backfill/cap	3,831	ton	$ 45	$ 172,000	Assume 2 ft and 4 ft thick cap.
Purchase and Install Reactive Core MatTM Organoclay	15,600	sf	$ 26	$ 406,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm. Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Purchase and Install Reactive Core MatTM Granular Activated Carbon	28,300	sf	$ 26	$ 736,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm. Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Amended cap media: Zero-Valent Iron	24,889	lb	$ 3	$ 75,000	Assume application of 5% ZVI.
Prepare amended cap blend	178	cy	$ 7	$ 1,000	Mixing sand with 5% ZVI.
Amended Cap placement	178	cy	$ 51	$ 9,000	Placement of sand blended with 5% ZVI. Assume 12-inch thick amended cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 73,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 3,008,000	
Indirect Capital Cost		% of TDC	50%	$ 1,504,000	
Total Capital Cost				**$ 4,512,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 8,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	1,378	cy	$ 49	$ 68,000	
Handling and dewatering of sediment from land-based excavation	1,378	cy	$ 15	$ 21,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	474	ton	$ 201	$ 95,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	1,421	ton	$ 69	$ 98,000	
Procure and place sand backfill/cap	972	ton	$ 45	$ 44,000	Assume 2 ft and 4 ft thick cap.
Purchase and Install Reactive Core MatTM Organoclay	4,000	sf	$ 26	$ 104,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm (2 cm AC and OC). Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Purchase and Install Reactive Core MatTM Granular Activated Carbon	9,000	sf	$ 26	$ 234,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm (2 cm AC and OC). Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	3	day	$ 6,000	$ 20,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	222	cy	$ 78	$ 17,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 1,022,000	
Indirect Capital Cost		% of TDC	50%	$ 511,000	
Total Capital Cost				**$ 1,533,000**	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 125,000	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	1,685	ton	$ 45	$ 76,000	Assume 2 ft thick cap.
Purchase and Install Reactive Core MatTM Organoclay	4,000	sf	$ 26	$ 104,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm (2 cm AC and OC). Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Purchase and Install Reactive Core MatTM Granular Activated Carbon	26,000	sf	$ 26	$ 676,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm (2 cm AC and OC). Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,758,000	
Indirect Capital Cost		% of TDC	50%	$ 879,000	
Total Capital Cost				**$ 2,637,000**	
SMA-6					
Sediment debris sweep and disposal	2.3	acre	$ 30,000	$ 69,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	12,963	ton	$ 45	$ 583,000	Assume 2 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	21	day	$ 6,000	$ 124,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	5,926	ton	$ 70	$ 415,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	1,852	cy	$ 78	$ 144,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 1,335,000	
Indirect Capital Cost		% of TDC	50%	$ 667,500	
Total Capital Cost				**$ 2,002,500**	
SMA-7					
Sediment debris sweep and disposal	1.95	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	17,241	ton	$ 45	$ 776,000	Assume 2 ft thick cap overall, with 4 ft thick cap in shallow NAPL areas.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 103,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,114,000	
Indirect Capital Cost		% of TDC	50%	$ 557,000	
Total Capital Cost				**$ 1,671,000**	
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	6,611	ton	$ 45	$ 298,000	Assume 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 1 foot
Direct Capital Cost Subtotal				$ 409,000	
Indirect Capital Cost		% of TDC	50%	$ 204,500	
Total Capital Cost				**$ 613,500**	

Description	Quantity Number	Unit	Cost Unit Cost	Total Cost	Notes
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	32,148	ton	$ 45	$ 1,447,000	Assume 4 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	32	day	$ 6,000	$ 193,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot.
Direct Capital Cost Subtotal				$ 2,082,000	
Indirect Capital Cost		% of TDC	50%	$ 1,041,000	
Total Capital Cost				**$ 3,123,000**	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	69	cy	$ 60	$ 4,000	Diver assisted dredging around structures in the Marina
Dewatering of hydraulically dredged sediment	69	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	620	cy	$ 48	$ 30,000	
Gravity dewatering on the barge	620	#REF!	$ 10	$ 6,000	
Barge transport to rail facility	947	ton	$ 5	$ 5,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	237	ton	$ 201	$ 48,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	710	ton	$ 69	$ 49,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 23,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Direct Capital Cost Subtotal				$ 473,000	
Indirect Capital Cost		% of TDC	50%	$ 236,500	
Total Capital Cost				**$ 709,500**	
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,639,500	
Total Capital Cost				**$ 4,918,500**	
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	59,759	ton	$ 45	$ 2,689,000	Assume 4 ft thick cap.
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel over 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	60	day	$ 6,000	$ 359,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,667,000	
Indirect Capital Cost		% of TDC	50%	$ 1,833,500	
Total Capital Cost				**$ 5,500,500**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	12,361	cy	$ 44	$ 544,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 74,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 924,000	
Indirect Capital Cost		% of TDC	50%	$ 462,000	
Total Capital Cost				**$ 1,386,000**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 32,865,500**	

Description	Quantity Number	Unit	Cost Unit Cost	Total Cost	Notes
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,104,800	
Indirect O&M Costs		% of TDC	17%	$ 357,816	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,400**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Sediment - Capping, ENR, MNR and ICs					
Sediment cap operation and maintenance monitoring and reporting	24	acre	$ 20,000	$ 480,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
ENR operation and maintenance monitoring and reporting	10	acre	$ 12,500	$ 125,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 1,907,100	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	23	acre	$ 10,000	$ 230,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Institutional Controls - annual cost	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 11,244,200	
Indirect O&M Costs		% of TDC	17%	$ 1,911,514	
Undiscounted Subtotal (including Indirect Costs)				**$ 13,155,714**	
Net Present Value Subtotal (including Indirect Costs)				**$ 13,630,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 16,110,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 16,670,000**	
Contingency (30 Percent of Total Cost)				**$ 14,861,000**	
Total Cost of Alternative (Present Worth)				**$ 64,400,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-5

Alternative 3

Gas Works Park Site

Seattle, Washington

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	2,452	cy	$ 14	$ 34,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	2,452	cy	$ 5	$ 12,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	2,832	ton	$ 201	$ 569,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	944	ton	$ 1,008	$ 952,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 2,839,000	
Indirect Capital Cost	% of TDC		50%	$ 1,419,500	
Total Capital Cost				**$ 4,258,500**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	4,889	cy	$ 49	$ 240,000	
Handling and dewatering of sediment from land-based excavation	4,889	cy	$ 15	$ 73,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	1,681	ton	$ 201	$ 338,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	5,042	ton	$ 69	$ 348,000	
Procure and place sand backfill/cap	3,831	ton	$ 45	$ 172,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	28,300	sy	$ 2.98	$ 84,000	
Procure and place Impermeable Liner	28,300	sf	$ 2.00	$ 57,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 73,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,926,000	
Indirect Capital Cost	% of TDC		50%	$ 963,000	
Total Capital Cost				**$ 2,889,000**	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 8,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	1,378	cy	$ 49	$ 68,000	
Handling and dewatering of sediment from land-based excavation	1,378	cy	$ 15	$ 21,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	474	ton	$ 201	$ 95,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	1,421	ton	$ 69	$ 98,000	
Procure and place sand backfill/cap	972	ton	$ 45	$ 44,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	9,000	sy	$ 2.98	$ 27,000	
Procure and place Impermeable Liner	9,000	sf	$ 2.00	$ 18,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	200	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	222	cy	$ 78	$ 17,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	3	day	$ 6,000	$ 20,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 730,000	
Indirect Capital Cost	% of TDC		50%	$ 365,000	
Total Capital Cost				**$ 1,095,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 125,000	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	1,685	ton	$ 45	$ 76,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	26,000	sy	$ 2.98	$ 78,000	
Procure and place Impermeable Liner	26,000	sf	$ 2.00	$ 52,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,112,000	
Indirect Capital Cost		% of TDC	50%	$ 556,000	
Total Capital Cost				**$ 1,668,000**	
SMA-6					
Sediment debris sweep and disposal	2.3	acre	$ 30,000	$ 69,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	12,963	ton	$ 45	$ 583,000	Assume 2 ft thick cap
Construction Best Management Practices (BMPs) Maintenance and Monitoring	21	day	$ 6,000	$ 124,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	5,926	ton	$ 70	$ 415,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	1,852	cy	$ 78	$ 144,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 1,335,000	
Indirect Capital Cost		% of TDC	50%	$ 667,500	
Total Capital Cost				**$ 2,002,500**	
SMA-7					
Sediment debris sweep and disposal	2.0	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	11,019	ton	$ 45	$ 496,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Powdered Activated Carbon	20,000	sf	$ 10	$ 200,000	Placement of 4-inch layer of AC cap material (Aquagate-AC)
Purchase and place AquagateTM with Organoclay	46,800	sf	$ 25	$ 1,170,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Amended cap media: Zero-Valent Iron	248,889	lb	$ 3	$ 747,000	Assume application of 5% ZVI.
Prepare amended cap blend	1,778	cy	$ 7	$ 12,000	Mixing sand with 5% ZVI.
Amended Cap placement	1,778	cy	$ 51	$ 91,000	Placement of sand blended with 5% ZVI. Assume 12-inch thick amended cap.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	15	day	$ 6,000	$ 92,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,043,000	
Indirect Capital Cost		% of TDC	50%	$ 1,521,500	
Total Capital Cost				**$ 4,564,500**	
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	3,306	ton	$ 45	$ 149,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	25,500	sf	$ 25	$ 638,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 24,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 882,000	
Indirect Capital Cost		% of TDC	50%	$ 441,000	
Total Capital Cost				**$ 1,323,000**	
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	16,074	ton	$ 45	$ 723,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	60,800	sf	$ 25	$ 1,520,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Purchase and place AquagateTM with Powdered Activated Carbon	45,000	sf	$ 10	$ 450,000	Placement of 4-inch layer of AC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	20	day	$ 6,000	$ 118,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,153,000	
Indirect Capital Cost		% of TDC	50%	$ 1,576,500	
Total Capital Cost				**$ 4,729,500**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	69	cy	$ 60	$ 4,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	69	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	620	cy	$ 48	$ 30,000	
Gravity dewatering on the barge	620	day	$ 10	$ 6,000	
Barge transport to rail facility	947	ton	$ 5	$ 5,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	237	ton	$ 201	$ 48,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	710	ton	$ 69	$ 49,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 23,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 473,000	
Indirect Capital Cost		% of TDC	50%	$ 236,500	
Total Capital Cost				**$ 709,500**	
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,639,500	
Total Capital Cost				**$ 4,918,500**	
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	40,574	ton	$ 45	$ 1,826,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area. 2-foot cap outside amendment areas.
Purchase and place AquagateTM with Organoclay	148,000	sf	$ 25	$ 3,700,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel across 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	48	day	$ 6,000	$ 289,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 6,434,000	
Indirect Capital Cost		% of TDC	50%	$ 3,217,000	
Total Capital Cost				**$ 9,651,000**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	12,361	cy	$ 44	$ 544,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 74,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 924,000	
Indirect Capital Cost		% of TDC	50%	$ 462,000	
Total Capital Cost				**$ 1,386,000**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 39,195,000**	

Description	Quantity Number	Unit	Cost Unit Cost	Total Cost	Notes
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,104,800	
Indirect O&M Costs		% of TDC	17%	$ 357,816	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,400**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Present worth calculated using equal series present worth analysis where i = 0.4%					
Sediment cap operation and maintenance monitoring and reporting	24	acre	$ 20,000	$ 480,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
ENR operation and maintenance monitoring and reporting	10	acre	$ 12,500	$ 125,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 2,329,100	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	23	acre	$ 10,000	$ 230,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Institutional Controls - annual cost	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 12,088,200	
Indirect O&M Costs		% of TDC	17%	$ 2,054,994	
Undiscounted Subtotal (including Indirect Costs)				**$ 14,143,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 14,640,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 17,097,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 17,680,000**	
Contingency (30 Percent of Total Cost)				**$ 17,063,000**	
Total Cost of Alternative (Present Worth)				**$ 73,940,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-6

Alternative 4

Gas Works Park Site
Seattle, Washington

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	4,775	cy	$ 14	$ 67,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	4,775	cy	$ 5	$ 24,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	5,516	ton	$ 201	$ 1,109,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	1,839	ton	$ 1,008	$ 1,853,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 4,325,000	
Indirect Capital Cost	% of TDC		50%	$ 2,162,500	
Total Capital Cost				**$ 6,487,500**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	9,778	cy	$ 49	$ 479,000	
Handling and dewatering of sediment from land-based excavation	9,778	cy	$ 15	$ 147,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	3,361	ton	$ 201	$ 676,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	10,083	ton	$ 69	$ 696,000	
Procure and place sand backfill/cap	3,831	ton	$ 45	$ 172,000	Assume 2 ft and 4 ft thick cap.
Purchase and Install Reactive Core MatTM Organoclay	15,600	sf	$ 26	$ 406,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm. Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Purchase and Install Reactive Core MatTM Granular Activated Carbon	28,300	sf	$ 26	$ 736,000	Multiplied unit cost by a factor of 2 due to RCM thickness at 2 cm. Assume 1 ft sand bedding and 1 ft sand cover. Sand costs accounted for under capping. Assume placement of 5,000 sf per day.
Amended cap media: Zero-Valent Iron	24,889	lb	$ 3	$ 75,000	Assume application of 5% ZVI.
Prepare amended cap blend	178	cy	$ 7	$ 1,000	Mixing sand with 5% ZVI.
Amended Cap placement	178	cy	$ 51	$ 9,000	Placement of sand blended with 5% ZVI. Assume 12-inch thick amended cap.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 102,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Direct Capital Cost Subtotal				$ 4,036,000	
Indirect Capital Cost	% of TDC		50%	$ 2,018,000	
Total Capital Cost				**$ 6,054,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 9,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	2,756	cy	$ 49	$ 135,000	
Handling and dewatering of sediment from land-based excavation	2,756	cy	$ 15	$ 41,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	947	ton	$ 201	$ 190,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,842	ton	$ 69	$ 196,000	
Procure and place sand backfill/cap	1,368	ton	$ 45	$ 62,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	3,700	sy	$ 2.98	$ 11,000	
Procure and place Impermeable Liner	3,700	sf	$ 2.00	$ 7,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	120	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	735	ton	$ 70	$ 51,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	230	cy	$ 78	$ 18,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 31,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,015,000	
Indirect Capital Cost		% of TDC	50%	$ 507,500	
Total Capital Cost				**$ 1,522,500**	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 125,000	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	2,878	ton	$ 45	$ 130,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	7,600	sy	$ 2.98	$ 23,000	
Procure and place Impermeable Liner	7,600	sf	$ 2.00	$ 15,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	200	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	8	day	$ 6,000	$ 47,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,078,000	
Indirect Capital Cost		% of TDC	50%	$ 539,000	
Total Capital Cost				**$ 1,617,000**	
SMA-6					
Sediment debris sweep and disposal	2.3	acre	$ 30,000	$ 69,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	12,963	ton	$ 45	$ 583,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	5,926	ton	$ 70	$ 415,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	1,852	cy	$ 78	$ 144,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	21	day	$ 6,000	$ 124,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,335,000	
Indirect Capital Cost		% of TDC	50%	$ 667,500	
Total Capital Cost				**$ 2,002,500**	
SMA-7					
Sediment debris sweep and disposal	1.95	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	17,241	ton	$ 45	$ 776,000	Assume 4 ft thick cap.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 103,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,114,000	
Indirect Capital Cost		% of TDC	50%	$ 557,000	
Total Capital Cost				**$ 1,671,000**	
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	6,611	ton	$ 45	$ 298,000	Assume 4 ft thick cap.
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 409,000	
Indirect Capital Cost		% of TDC	50%	$ 204,500	
Total Capital Cost				**$ 613,500**	
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	27,222	ton	$ 45	$ 1,225,000	Assume 4 ft thick cap. Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Powdered Activated Carbon	13,000	sf	$ 10	$ 130,000	Placement of 4-inch layer of AC cap material (Aquagate-AC)
Purchase and place AquagateTM with Organoclay	38,000	sf	$ 25	$ 950,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	31	day	$ 6,000	$ 185,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,932,000	
Indirect Capital Cost		% of TDC	50%	$ 1,466,000	
Total Capital Cost				**$ 4,398,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	69	cy	$ 60	$ 4,000	Diver assisted dredging around structures in the Marina
Dewatering of hydraulically dredged sediment	69	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	620	cy	$ 48	$ 30,000	
Gravity dewatering on the barge	620	#REF!	$ 10	$ 6,000	
Barge transport to rail facility	947	ton	$ 5	$ 5,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	237	ton	$ 201	$ 48,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	710	ton	$ 69	$ 49,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 27,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 477,000	
Indirect Capital Cost		% of TDC	50%	$ 238,500	
Total Capital Cost				**$ 715,500**	
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,639,500	
Total Capital Cost				**$ 4,918,500**	
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	59,759	ton	$ 45	$ 2,689,000	Assume 4 ft thick cap.
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel across 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	67	day	$ 6,000	$ 404,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,712,000	
Indirect Capital Cost		% of TDC	50%	$ 1,856,000	
Total Capital Cost				**$ 5,568,000**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	12,361	cy	$ 44	$ 544,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 74,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 924,000	
Indirect Capital Cost		% of TDC	50%	$ 462,000	
Total Capital Cost				**$ 1,386,000**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 36,954,000**	

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,104,800	
Indirect O&M Costs		% of TDC	17%	$ 357,816	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Sediment - Capping, ENR, MNR and ICs					
Sediment cap operation and maintenance monitoring and reporting	24	acre	$ 20,000	$ 480,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
ENR operation and maintenance monitoring and reporting	10	acre	$ 12,500	$ 125,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 2,031,100	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	23	acre	$ 10,000	$ 230,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Present worth calculated using equal series present worth analysis where i = 0.4%	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 11,492,200	
Indirect O&M Costs		% of TDC	17%	$ 1,953,674	
Undiscounted Subtotal (including Indirect Costs)				**$ 13,446,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 13,927,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 16,400,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 16,967,000**	
Contingency (30 Percent of Total Cost)				**$ 16,176,000**	
Total Cost of Alternative (Present Worth)				**$ 70,100,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-7

Alternative 5

Gas Works Park Site

Seattle, Washington

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	4,775	cy	$ 14	$ 67,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	4,775	cy	$ 5	$ 24,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	5,516	ton	$ 201	$ 1,109,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	1,839	ton	$ 1,008	$ 1,853,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 4,325,000	
Indirect Capital Cost	% of TDC		50%	$ 2,162,500	
Total Capital Cost				**$ 6,487,500**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	9,778	cy	$ 49	$ 479,000	
Handling and dewatering of sediment from land-based excavation	9,778	cy	$ 15	$ 147,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	3,361	ton	$ 201	$ 676,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	10,083	ton	$ 69	$ 696,000	
Procure and place sand backfill/cap	3,831	ton	$ 45	$ 172,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	28,300	sy	$ 2.98	$ 84,000	
Procure and place Impermeable Liner	28,300	sf	$ 2.00	$ 57,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 102,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,954,000	
Indirect Capital Cost	% of TDC		50%	$ 1,477,000	
Total Capital Cost				**$ 4,431,000**	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 9,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	2,756	cy	$ 49	$ 135,000	
Handling and dewatering of sediment from land-based excavation	2,756	cy	$ 15	$ 41,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	947	ton	$ 201	$ 190,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,842	ton	$ 69	$ 196,000	
Procure and place sand backfill/cap	1,368	ton	$ 45	$ 62,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	3,700	sy	$ 2.98	$ 11,000	
Procure and place Impermeable Liner	3,700	sf	$ 2.00	$ 7,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	120	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	735	ton	$ 70	$ 51,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	230	cy	$ 78	$ 18,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 31,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,015,000	
Indirect Capital Cost	% of TDC		50%	$ 507,500	
Total Capital Cost				**$ 1,522,500**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 125,000	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	2,878	ton	$ 45	$ 130,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	7,600	sy	$ 2.98	$ 23,000	
Procure and place Impermeable Liner	7,600	sf	$ 2.00	$ 15,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	200	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	8	day	$ 6,000	$ 47,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,078,000	
Indirect Capital Cost		% of TDC	50%	$ 539,000	
Total Capital Cost				**$ 1,617,000**	
SMA-6					
Sediment debris sweep and disposal	2.3	acre	$ 30,000	$ 69,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	12,963	ton	$ 45	$ 583,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	5,926	ton	$ 70	$ 415,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	1,852	cy	$ 78	$ 144,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	21	day	$ 6,000	$ 124,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,335,000	
Indirect Capital Cost		% of TDC	50%	$ 667,500	
Total Capital Cost				**$ 2,002,500**	
SMA-7					
Sediment debris sweep and disposal	2.0	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	11,019	ton	$ 45	$ 496,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Powdered Activated Carbon	20,000	sf	$ 10	$ 200,000	Placement of 4-inch layer of AC cap material (Aquagate-AC)
Purchase and place AquagateTM with Organoclay	46,800	sf	$ 25	$ 1,170,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Amended cap media: Zero-Valent Iron	248,889	lb	$ 3	$ 747,000	Assume application of 5% ZVI.
Prepare amended cap blend	1,778	cy	$ 7	$ 12,000	Mixing sand with 5% ZVI.
Amended Cap placement	1,778	cy	$ 51	$ 91,000	Placement of sand blended with 5% ZVI. Assume 12-inch thick amended cap.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	15	day	$ 6,000	$ 92,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,043,000	
Indirect Capital Cost		% of TDC	50%	$ 1,521,500	
Total Capital Cost				**$ 4,564,500**	
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	3,306	ton	$ 45	$ 149,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	25,500	sf	$ 25	$ 638,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 24,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 882,000	
Indirect Capital Cost		% of TDC	50%	$ 441,000	
Total Capital Cost				**$ 1,323,000**	
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	27,222	ton	$ 45	$ 1,225,000	Assume 4 ft thick cap. Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Powdered Activated Carbon	13,000	sf	$ 10	$ 130,000	Placement of 4-inch layer of AC cap material (Aquagate-AC)
Purchase and place AquagateTM with Organoclay	38,000	sf	$ 25	$ 950,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	31	day	$ 6,000	$ 185,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,932,000	
Indirect Capital Cost		% of TDC	50%	$ 1,466,000	
Total Capital Cost				**$ 4,398,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	69	cy	$ 60	$ 4,000	Diver assisted dredging around structures in the Marina
Dewatering of hydraulically dredged sediment	69	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	620	cy	$ 48	$ 30,000	
Gravity dewatering on the barge	620	#REF!	$ 10	$ 6,000	
Barge transport to rail facility	947	ton	$ 5	$ 5,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	237	ton	$ 201	$ 48,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	710	ton	$ 69	$ 49,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 27,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 477,000	
Indirect Capital Cost		% of TDC	50%	$ 238,500	
Total Capital Cost				**$ 715,500**	
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,639,500	
Total Capital Cost				**$ 4,918,500**	
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	59,759	ton	$ 45	$ 2,689,000	Assume 4 ft thick cap.
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel across 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	67	day	$ 6,000	$ 404,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,712,000	
Indirect Capital Cost		% of TDC	50%	$ 1,856,000	
Total Capital Cost				**$ 5,568,000**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	12,361	cy	$ 44	$ 544,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 74,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 924,000	
Indirect Capital Cost		% of TDC	50%	$ 462,000	
Total Capital Cost				**$ 1,386,000**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 38,934,000**	

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,104,800	
Indirect O&M Costs		% of TDC	17%	$ 357,816	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,400**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Sediment - Capping, ENR, MNR and ICs					
Present worth calculated using equal series present worth analysis where i = 0.4%	24	acre	$ 20,000	$ 480,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
ENR operation and maintenance monitoring and reporting	10	acre	$ 12,500	$ 125,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 2,163,100	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	23	acre	$ 10,000	$ 230,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Institutional Controls - annual cost	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 11,756,200	
Indirect O&M Costs		% of TDC	17%	$ 1,998,554	
Undiscounted Subtotal (including Indirect Costs)				**$ 13,755,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 14,243,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 16,709,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 17,283,000**	
Contingency (30 Percent of Total Cost)				**$ 16,865,000**	
Total Cost of Alternative (Present Worth)				**$ 73,080,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-8

Alternative 6

Gas Works Park Site
Seattle, Washington

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	4,775	cy	$ 14	$ 67,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	4,775	cy	$ 5	$ 24,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	5,516	ton	$ 201	$ 1,109,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	1,839	ton	$ 1,008	$ 1,853,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 4,325,000	
Indirect Capital Cost		% of TDC	50%	$ 2,162,500	
Total Capital Cost				**$ 6,487,500**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	9,778	cy	$ 49	$ 479,000	
Handling and dewatering of sediment from land-based excavation	9,778	cy	$ 15	$ 147,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	3,361	ton	$ 201	$ 676,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	10,083	ton	$ 69	$ 696,000	
Procure and place sand backfill/cap	3,831	ton	$ 45	$ 172,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	28,300	sy	$ 2.98	$ 84,000	
Procure and place Impermeable Liner	28,300	sf	$ 2.00	$ 57,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 102,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,954,000	
Indirect Capital Cost		% of TDC	50%	$ 1,477,000	
Total Capital Cost				**$ 4,431,000**	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 8,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 325,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	2,756	cy	$ 49	$ 135,000	
Handling and dewatering of sediment from land-based excavation	2,756	cy	$ 15	$ 41,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	947	ton	$ 201	$ 190,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,842	ton	$ 69	$ 196,000	
Procure and place sand backfill/cap	972	ton	$ 45	$ 44,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	9,000	sy	$ 2.98	$ 27,000	
Procure and place Impermeable Liner	9,000	sf	$ 2.00	$ 18,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	200	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	222	cy	$ 78	$ 17,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 28,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,180,000	
Indirect Capital Cost		% of TDC	50%	$ 590,000	
Total Capital Cost				**$ 1,770,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 125,000	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	1,685	ton	$ 45	$ 76,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	26,000	sy	$ 2.98	$ 78,000	
Procure and place Impermeable Liner	26,000	sf	$ 2.00	$ 52,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,112,000	
Indirect Capital Cost		% of TDC	50%	$ 556,000	
Total Capital Cost				**$ 1,668,000**	
SMA-6					
Sediment debris sweep and disposal	2.3	acre	$ 30,000	$ 69,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	12,963	ton	$ 45	$ 583,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	5,926	ton	$ 70	$ 415,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	1,852	cy	$ 78	$ 144,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	21	day	$ 6,000	$ 124,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,335,000	
Indirect Capital Cost		% of TDC	50%	$ 667,500	
Total Capital Cost				**$ 2,002,500**	
SMA-7					
Sediment debris sweep and disposal	2.0	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	11,019	ton	$ 45	$ 496,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Powdered Activated Carbon	20,000	sf	$ 10	$ 200,000	Placement of 4-inch layer of AC cap material (Aquagate-AC)
Purchase and place AquagateTM with Organoclay	46,800	sf	$ 25	$ 1,170,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Amended cap media: Zero-Valent Iron	248,889	lb	$ 3	$ 747,000	Assume application of 5% ZVI.
Prepare amended cap blend	1,778	cy	$ 7	$ 12,000	Mixing sand with 5% ZVI.
Amended Cap placement	1,778	cy	$ 51	$ 91,000	Placement of sand blended with 5% ZVI. Assume 12-inch thick amended cap.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	15	day	$ 6,000	$ 92,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,043,000	
Indirect Capital Cost		% of TDC	50%	$ 1,521,500	
Total Capital Cost				**$ 4,564,500**	
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	6,611	ton	$ 45	$ 298,000	Assume 4 ft thick cap.
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 44,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 413,000	
Indirect Capital Cost		% of TDC	50%	$ 206,500	
Total Capital Cost				**$ 619,500**	
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	16,074	ton	$ 45	$ 723,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	60,800	sf	$ 25	$ 1,520,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Purchase and place AquagateTM with Powdered Activated Carbon	45,000	sf	$ 10	$ 450,000	Placement of 4-inch layer of AC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	20	day	$ 6,000	$ 118,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,153,000	
Indirect Capital Cost		% of TDC	50%	$ 1,576,500	
Total Capital Cost				**$ 4,729,500**	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	69	cy	$ 60	$ 4,000	Diver assisted dredging around structures in the Marina
Dewatering of hydraulically dredged sediment	69	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	620	cy	$ 48	$ 30,000	
Gravity dewatering on the barge	620	ls	$ 10	$ 6,000	
Barge transport to rail facility	947	ton	$ 5	$ 5,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	237	ton	$ 201	$ 48,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	710	ton	$ 69	$ 49,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 27,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 477,000	
Indirect Capital Cost		% of TDC	50%	$ 238,500	
Total Capital Cost				**$ 715,500**	

Description	Quantity Number	Unit	Cost Unit Cost	Total Cost	Notes
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,639,500	
Total Capital Cost				**$ 4,918,500**	
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	59,759	ton	$ 45	$ 2,689,000	Assume 4 ft thick cap.
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel across 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	67	day	$ 6,000	$ 404,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,712,000	
Indirect Capital Cost		% of TDC	50%	$ 1,856,000	
Total Capital Cost				**$ 5,568,000**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	12,361	cy	$ 44	$ 544,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 74,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 924,000	
Indirect Capital Cost		% of TDC	50%	$ 462,000	
Total Capital Cost				**$ 1,386,000**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 38,860,500**	
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,104,800	
Indirect O&M Costs		% of TDC	17%	$ 357,816	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Sediment - Capping, ENR, MNR and ICs					
Sediment cap operation and maintenance monitoring and reporting	24	acre	$ 20,000	$ 480,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
Present worth calculated using equal series present worth analysis where i = 0.4%	10	acre	$ 12,500	$ 125,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 2,158,200	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	23	acre	$ 10,000	$ 230,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Institutional Controls - annual cost	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 11,746,400	
Indirect O&M Costs		% of TDC	17%	$ 1,996,888	
Undiscounted Subtotal (including Indirect Costs)				**$ 13,743,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 14,231,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 16,697,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 17,271,000**	
Contingency (30 Percent of Total Cost)				**$ 16,839,000**	
Total Cost of Alternative (Present Worth)				**$ 72,970,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-9

Alternative 7

Gas Works Park Site
Seattle, Washington

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	4,775	cy	$ 14	$ 67,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	4,775	cy	$ 5	$ 24,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	5,516	ton	$ 201	$ 1,109,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	1,839	ton	$ 1,008	$ 1,853,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 4,325,000	
Indirect Capital Cost		% of TDC	50%	$ 2,162,500	
Total Capital Cost				**$ 6,487,500**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	9,778	cy	$ 49	$ 479,000	
Handling and dewatering of sediment from land-based excavation	9,778	cy	$ 15	$ 147,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	3,361	ton	$ 201	$ 676,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	10,083	ton	$ 69	$ 696,000	
Procure and place sand backfill/cap	3,831	ton	$ 45	$ 172,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	28,300	sy	$ 2.98	$ 84,000	
Procure and place Impermeable Liner	28,300	sf	$ 2.00	$ 57,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 102,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,954,000	
Indirect Capital Cost		% of TDC	50%	$ 1,477,000	
Total Capital Cost				**$ 4,431,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 8,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	2,756	cy	$ 49	$ 135,000	
Handling and dewatering of sediment from land-based excavation	2,756	cy	$ 15	$ 41,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Sediment removal by mechanical dredging (barge-mounted)	0	cy	$ 48	$ -	
Gravity dewatering on the barge	0	cy	$ 10	$ -	
Barge transport to rail facility	3,789	ton	$ 5	$ 19,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	947	ton	$ 201	$ 190,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,842	ton	$ 69	$ 196,000	
Procure and place sand backfill/cap	972	ton	$ 45	$ 44,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	9,000	sy	$ 2.98	$ 27,000	
Procure and place Impermeable Liner	9,000	sf	$ 2.00	$ 18,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	200	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	222	cy	$ 78	$ 17,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 28,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,037,000	
Indirect Capital Cost		% of TDC	50%	$ 518,500	
Total Capital Cost				**$ 1,555,500**	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 125,000	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	1,685	ton	$ 45	$ 76,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	26,000	sy	$ 2.98	$ 78,000	
Procure and place Impermeable Liner	26,000	sf	$ 2.00	$ 52,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,112,000	
Indirect Capital Cost		% of TDC	50%	$ 556,000	
Total Capital Cost				**$ 1,668,000**	
SMA-6					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Sediment removal by mechanical dredging (barge-mounted)	8,148	cy	$ 48	$ 391,000	
Gravity dewatering on the barge	8,148	ls	$ 10	$ 81,000	
Barge transport to rail facility	11,204	ton	$ 5	$ 56,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	2,801	ton	$ 201	$ 563,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	8,403	ton	$ 69	$ 580,000	
Procure and place sand backfill/cap	5,704	ton	$ 45	$ 257,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	2,607	ton	$ 70	$ 183,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	815	cy	$ 78	$ 64,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	9	day	$ 6,000	$ 55,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,360,000	
Indirect Capital Cost		% of TDC	50%	$ 1,180,000	
Total Capital Cost				**$ 3,540,000**	
SMA-7					
Sediment debris sweep and disposal	2.0	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	11,019	ton	$ 45	$ 496,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Powdered Activated Carbon	20,000	sf	$ 10	$ 200,000	Placement of 4-inch layer of AC cap material (Aquagate-AC)
Purchase and place AquagateTM with Organoclay	46,800	sf	$ 25	$ 1,170,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Amended cap media: Zero-Valent Iron	248,889	lb	$ 3	$ 747,000	Assume application of 5% ZVI.
Prepare amended cap blend	1,778	cy	$ 7	$ 12,000	Mixing sand with 5% ZVI.
Amended Cap placement	1,778	cy	$ 51	$ 91,000	Placement of sand blended with 5% ZVI. Assume 12-inch thick amended cap.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	15	day	$ 6,000	$ 92,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,043,000	
Indirect Capital Cost		% of TDC	50%	$ 1,521,500	
Total Capital Cost				**$ 4,564,500**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	3,306	ton	$ 45	$ 149,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	25,500	sf	$ 25	$ 638,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 24,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 882,000	
Indirect Capital Cost		% of TDC	50%	$ 441,000	
Total Capital Cost				**$ 1,323,000**	
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	16,074	ton	$ 45	$ 723,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	60,800	sf	$ 25	$ 1,520,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Purchase and place AquagateTM with Powdered Activated Carbon	45,000	sf	$ 10	$ 450,000	Placement of 4-inch layer of AC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	20	day	$ 6,000	$ 118,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,153,000	
Indirect Capital Cost		% of TDC	50%	$ 1,576,500	
Total Capital Cost				**$ 4,729,500**	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	92	cy	$ 60	$ 6,000	Diver assisted dredging around structures in the Marina
Dewatering of hydraulically dredged sediment	92	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	827	cy	$ 48	$ 40,000	
Gravity dewatering on the barge	827	ls	$ 10	$ 8,000	
Barge transport to rail facility	1,263	ton	$ 5	$ 6,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	316	ton	$ 201	$ 63,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	947	ton	$ 69	$ 65,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 28,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 524,000	
Indirect Capital Cost		% of TDC	50%	$ 262,000	
Total Capital Cost				**$ 786,000**	
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,639,500	
Total Capital Cost				**$ 4,918,500**	
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	40,574	ton	$ 45	$ 1,826,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area. 2-foot cap outside amendment areas.
Purchase and place AquagateTM with Organoclay	148,000	sf	$ 25	$ 3,700,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel across 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	48	day	$ 6,000	$ 289,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 6,434,000	
Indirect Capital Cost		% of TDC	50%	$ 3,217,000	
Total Capital Cost				**$ 9,651,000**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	12,361	cy	$ 44	$ 544,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	12	day	$ 6,000	$ 74,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 924,000	
Indirect Capital Cost		% of TDC	50%	$ 462,000	
Total Capital Cost				**$ 1,386,000**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 45,040,500**	

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,104,800	
Indirect O&M Costs		% of TDC	17%	$ 357,816	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Sediment - Capping, ENR, MNR and ICs					
Sediment cap operation and maintenance monitoring and reporting	24	acre	$ 20,000	$ 480,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
ENR operation and maintenance monitoring and reporting	10	acre	$ 12,500	$ 125,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 2,570,200	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	23	acre	$ 10,000	$ 230,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Institutional Controls - annual cost	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 12,570,400	
Indirect O&M Costs		% of TDC	17%	$ 2,136,968	
Undiscounted Subtotal (including Indirect Costs)				**$ 14,707,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 15,217,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 17,661,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 18,257,000**	
Contingency (30 Percent of Total Cost)				**$ 18,989,000**	
Total Cost of Alternative (Present Worth)				**$ 82,290,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-10

Alternative 8

Gas Works Park Site

Seattle, Washington

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
Capital Costs (Direct and Indirect)					
GWMA-1, SMA-1 and SMA-2					
Upland earthwork temporary controls (erosion control, temporary facilities, access controls)	1	ls	$ 100,000	$ 100,000	Assumed to apply to all upland work.
Air and Dust Monitoring	60	day	$ 500	$ 30,000	Assume perimeter and work area dust monitoring using hand-held real-time dust monitoring equipment. Assume 3 months of upland construction.
Stockpile and dewatering area setup and removal	1	ls	$ 150,000	$ 150,000	
Stormwater collection, water collection from material stockpile areas (from dewatering), treatment, and discharge system during construction	1	ls	$ 100,000	$ 100,000	Costs include mobilization, setup, rental, demobilization, treatment and discharge.
Clear and Grub trees up to 12" diameter	1	acre	$ 13,546	$ 14,000	
Soil Excavation (upto 15 feet)	4,775	cy	$ 14	$ 67,000	Cost includes screening and handling of oversized debris encountered during excavation.
Dewatering System - Shallow Excavation	1	ls	$ 50,000	$ 50,000	Assumed to apply to tar mound excavation work. Includes water collection and off-site management.
On-site stockpiling and management of excavated material	4,775	cy	$ 5	$ 24,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	5,516	ton	$ 201	$ 1,109,000	Assume 75% soil from tar mound excavation can be disposed at Subtitle C landfill. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Transport (truck), incinerate and dispose soil at hazardous waste facility in (Aragonite, Utah)	1,839	ton	$ 1,008	$ 1,853,000	Assume 25% soil from tar mound excavation is classified as hazardous and requires incineration. Based on soil unit weight conversion (1.4 tons/cy) for the site.
Rough grade for cap surface preparation	1	ls	$ 3,240	$ 3,000	Cap area to be rough graded is less than 1 acre.
Procure and Install Geotextile	3,582	sy	$ 2.98	$ 11,000	
Cap drainage layer - import, place, compact	657	cy	$ 63	$ 41,000	Assume 6 inch thick layer of drainage rock (i.e, Type 17).
Procure and Place Topsoil	1,970	cy	$ 56	$ 110,000	Assume 1.5 ft thick layer of topsoil.
Hydroseeding	3,582	sy	$ 3	$ 11,000	
Post-construction upland survey	1	each	$ 3,571	$ 4,000	Final as-built survey for upland construction.
Shoreline Restoration	1	ls	$ 100,000	$ 100,000	
Mobilization and Demobilization	4	each	$ 13,155	$ 53,000	In-Situ Chemical Fixation (ISCF) mob and demob.
ISCF Reagent Application	1	ls	$ 300,000	$ 300,000	Includes labor, equipment, injection point drilling and reagent costs. Assume 4 events.
Process Monitoring	1	ls	$ 120,000	$ 120,000	ISCF process monitoring, new wells, sample collection and analysis.
Institutional Controls/Restrictive Covenants Preparation	1	ls	$ 75,000	$ 75,000	Assumed cost for initial setup of institutional controls for uplands and in-water work.
Direct Capital Cost Subtotal				$ 4,325,000	
Indirect Capital Cost		% of TDC	50%	$ 2,162,500	
Total Capital Cost				**$ 6,487,500**	
SMA-3					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	9,778	cy	$ 49	$ 479,000	
Handling and dewatering of sediment from land-based excavation	9,778	cy	$ 15	$ 147,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	3,361	ton	$ 201	$ 676,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	10,083	ton	$ 69	$ 696,000	
Procure and place sand backfill/cap	3,831	ton	$ 45	$ 172,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	28,300	sy	$ 2.98	$ 84,000	
Procure and place Impermeable Liner	28,300	sf	$ 2.00	$ 57,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	2,590	ton	$ 70	$ 181,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	809	cy	$ 78	$ 63,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	17	day	$ 6,000	$ 102,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,954,000	
Indirect Capital Cost		% of TDC	50%	$ 1,477,000	
Total Capital Cost				**$ 4,431,000**	

Description	Quantity		Cost		Notes
	Number	Unit	Unit Cost	Total Cost	
SMA-4					
Sediment debris sweep and disposal	0.3	acre	$ 30,000	$ 8,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Shoring and/or coffer dam install for excavation in lakeshore area	1	ls	$ 325,000	$ 163,000	Assume costs are split between SMA-3 and SMA-4
Sediment excavation using land-based excavation equipment	2,756	cy	$ 49	$ 135,000	
Handling and dewatering of sediment from land-based excavation	2,756	cy	$ 15	$ 41,000	
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Sediment removal by mechanical dredging (barge-mounted)	0	cy	$ 48	$ -	
Gravity dewatering on the barge	0	cy	$ 10	$ -	
Barge transport to rail facility	3,789	ton	$ 5	$ 19,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	947	ton	$ 201	$ 190,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,842	ton	$ 69	$ 196,000	
Procure and place sand backfill/cap	972	ton	$ 45	$ 44,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	9,000	sy	$ 2.98	$ 27,000	
Procure and place Impermeable Liner	9,000	sf	$ 2.00	$ 18,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	200	lf	$ 6.00	$ 1,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	222	cy	$ 78	$ 17,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 28,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,037,000	
Indirect Capital Cost		% of TDC	50%	$ 518,500	
Total Capital Cost				**$ 1,555,500**	
SMA-5					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	289	cy	$ 60	$ 17,000	Diver assisted dredging around shoreline structures
Dewatering of hydraulically dredged sediment	289	cy	$ 14	$ 4,000	
Sediment removal by mechanical dredging (barge-mounted)	2,600	cy	$ 48	$ 125,000	
Gravity dewatering on the barge	2,600	cy	$ 10	$ 26,000	
Barge transport to rail facility	3,972	ton	$ 5	$ 20,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	993	ton	$ 201	$ 200,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	2,979	ton	$ 69	$ 206,000	
Procure and place sand backfill/cap	1,685	ton	$ 45	$ 76,000	Assume 2 ft thick cap. Includes sand bedding (6 inches) for low permeability cap.
Procure and Install Geotextile	26,000	sy	$ 2.98	$ 78,000	
Procure and place Impermeable Liner	26,000	sf	$ 2.00	$ 52,000	Assume 6 inches of sand bedding for the impermeable liner. Sand volume included under sand cap line item.
Procure and place geocomposite gas collection layer	600	lf	$ 6.00	$ 4,000	Assume geocomposite gas collection strips embedded in the sand layer with a spacing of 10 feet on center.
Procure and place armor stone for erosion protection	1,541	ton	$ 70	$ 108,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	481	cy	$ 78	$ 38,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	7	day	$ 6,000	$ 40,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 1,112,000	
Indirect Capital Cost		% of TDC	50%	$ 556,000	
Total Capital Cost				**$ 1,668,000**	
SMA-6					
Sediment debris sweep and disposal	1.0	acre	$ 30,000	$ 30,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Handling of water drained from excavated sediment	10	day	$ 10,000	$ 100,000	
Sediment removal by mechanical dredging (barge-mounted)	8,148	cy	$ 48	$ 391,000	
Gravity dewatering on the barge	8,148	ls	$ 10	$ 81,000	
Barge transport to rail facility	11,204	ton	$ 5	$ 56,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	2,801	ton	$ 201	$ 563,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	8,403	ton	$ 69	$ 580,000	
Procure and place sand backfill/cap	5,704	ton	$ 45	$ 257,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	2,607	ton	$ 70	$ 183,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	815	cy	$ 78	$ 64,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	9	day	$ 6,000	$ 55,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,360,000	
Indirect Capital Cost		% of TDC	50%	$ 1,180,000	
Total Capital Cost				**$ 3,540,000**	
SMA-7					
Sediment debris sweep and disposal	2.0	acre	$ 30,000	$ 59,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	11,019	ton	$ 45	$ 496,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Powdered Activated Carbon	20,000	sf	$ 10	$ 200,000	Placement of 4-inch layer of AC cap material (Aquagate-AC)
Purchase and place AquagateTM with Organoclay	46,800	sf	$ 25	$ 1,170,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Amended cap media: Zero-Valent Iron	248,889	lb	$ 3	$ 747,000	Assume application of 5% ZVI.
Prepare amended cap blend	1,778	cy	$ 7	$ 12,000	Mixing sand with 5% ZVI.
Amended Cap placement	1,778	cy	$ 51	$ 91,000	Placement of sand blended with 5% ZVI. Assume 12-inch thick amended cap.
Procure and place armor stone for erosion protection	2,519	ton	$ 70	$ 176,000	Assume a thickness of 1 feet.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	15	day	$ 6,000	$ 92,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,043,000	
Indirect Capital Cost		% of TDC	50%	$ 1,521,500	
Total Capital Cost				**$ 4,564,500**	

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
SMA-8					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 18,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	3,306	ton	$ 45	$ 149,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	25,500	sf	$ 25	$ 638,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	756	ton	$ 70	$ 53,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	4	day	$ 6,000	$ 24,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 882,000	
Indirect Capital Cost		% of TDC	50%	$ 441,000	
Total Capital Cost				**$ 1,323,000**	
SMA-9					
Sediment debris sweep and disposal	2.8	acre	$ 30,000	$ 85,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	16,074	ton	$ 45	$ 723,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area.
Purchase and place AquagateTM with Organoclay	60,800	sf	$ 25	$ 1,520,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Purchase and place AquagateTM with Powdered Activated Carbon	45,000	sf	$ 10	$ 450,000	Placement of 4-inch layer of AC cap material (Aquagate-OC)
Procure and place armor stone for erosion protection	3,674	ton	$ 70	$ 257,000	Assume a thickness of 1 foot
Construction Best Management Practices (BMPs) Maintenance and Monitoring	20	day	$ 6,000	$ 118,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,153,000	
Indirect Capital Cost		% of TDC	50%	$ 1,576,500	
Total Capital Cost				**$ 4,729,500**	
SMA-10					
Sediment debris sweep and disposal	0.6	acre	$ 30,000	$ 17,000	
Removal of docks and large obstructions	1	ls	$ 100,000	$ 100,000	For removal of large obstructions from cap areas.
Sediment removal by hydraulic dredging (Suction head)	92	cy	$ 60	$ 6,000	Diver assisted dredging around structures in the Marina
Dewatering of hydraulically dredged sediment	92	cy	$ 14	$ 1,000	
Sediment removal by mechanical dredging (barge-mounted)	827	cy	$ 48	$ 40,000	
Gravity dewatering on the barge	827	ls	$ 10	$ 8,000	
Barge transport to rail facility	1,263	ton	$ 5	$ 6,000	
Transport (truck/train) and dispose Soil at Subtitle C (hazardous waste) landfill	316	ton	$ 201	$ 63,000	
Transport (truck/train) and dispose soil to Subtitle D landfill	947	ton	$ 69	$ 65,000	
Procure and place sand backfill/cap	3,111	ton	$ 45	$ 140,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	711	ton	$ 70	$ 50,000	Assume a thickness of 1 foot.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	5	day	$ 6,000	$ 28,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 524,000	
Indirect Capital Cost		% of TDC	50%	$ 262,000	
Total Capital Cost				**$ 786,000**	
SMA-11					
Sediment debris sweep and disposal	6.2	acre	$ 30,000	$ 185,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	34,741	ton	$ 45	$ 1,563,000	Assume 2 ft thick cap.
Procure and place armor stone for erosion protection	11,911	ton	$ 70	$ 834,000	Assume a thickness of 2 feet.
Procure and place fish mix on armor rock to fill interstitial voids	4,963	cy	$ 78	$ 387,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	52	day	$ 6,000	$ 310,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,279,000	
Indirect Capital Cost		% of TDC	50%	$ 1,639,500	
Total Capital Cost				**$ 4,918,500**	
SMA-12					
Sediment debris sweep and disposal	7.2	acre	$ 30,000	$ 216,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	40,574	ton	$ 45	$ 1,826,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area. 2-foot cap outside amendment areas.
Purchase and place AquagateTM with Organoclay	148,000	sf	$ 25	$ 3,700,000	Placement of 4-inch layer of OC cap material (Aquagate-OC)
Procure and place 6-inch layer of pea gravel for armor	2,898	cy	$ 27	$ 78,000	Assume thin gravel across 50% of SMA-12
Procure and place armor stone for erosion protection	4,637	ton	$ 70	$ 325,000	Assume 1-foot rock armor layer across 50% of SMA-12.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	48	day	$ 6,000	$ 289,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 6,434,000	
Indirect Capital Cost		% of TDC	50%	$ 3,217,000	
Total Capital Cost				**$ 9,651,000**	
SMA-13					
Sediment debris sweep and disposal	10.2	acre	$ 30,000	$ 306,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place sand backfill/cap	57,685	ton	$ 45	$ 2,596,000	Includes 1 ft of sand bedding and 1 ft sand cover for the amended cap area. 2-foot cap outside amendment areas.
Procure and place 6-inch layer of pea gravel for armor	8,241	cy	$ 27	$ 223,000	Assume thin gravel across 50% of SMA-12
Construction Best Management Practices (BMPs) Maintenance and Monitoring	66	day	$ 6,000	$ 396,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 3,521,000	
Indirect Capital Cost		% of TDC	50%	$ 1,760,500	
Total Capital Cost				**$ 5,281,500**	
SMA-14					
Sediment debris sweep and disposal	22.7	acre	$ 30,000	$ 681,000	
Removal of docks and large obstructions	0	ls	$ 100,000	$ -	For removal of large obstructions from cap areas.
Procure and place enhanced natural recovery (ENR) layer	27,472	cy	$ 44	$ 1,209,000	Assume a thickness of 6 inches.
Construction Best Management Practices (BMPs) Maintenance and Monitoring	27	day	$ 6,000	$ 165,000	Based on an assumed average removal rate and cap production rate of 1,000 cy/day.
Direct Capital Cost Subtotal				$ 2,055,000	
Indirect Capital Cost		% of TDC	50%	$ 1,027,500	
Present worth calculated using equal series present worth analysis where i = 0.4%				**$ 3,082,500**	
TOTAL CAPITAL COSTS (Direct and Indirect)				**$ 52,018,500**	

Description	Quantity Number	Quantity Unit	Cost Unit Cost	Cost Total Cost	Notes
Operation & Maintenance Costs					
Upland Long-term Groundwater Monitoring					
Entire Upland Area - Groundwater Monitoring of shoreline wells quarterly for year 0, annually for 10 years, followed by four 5-year events					
Groundwater sampling labor	30	well	$ 500	$ 15,000	Quantity based on 30 shoreline wells including samples for field QA/QC.
Groundwater sample chemical analysis	30	well	$ 620	$ 18,600	
Annual reporting	1	ls	$ 100,000	$ 100,000	
Direct Subtotal				$ 2,104,800	
Indirect O&M Costs		% of TDC	17%	$ 357,816	
Undiscounted Subtotal (including Indirect Costs)				**$ 2,463,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 2,533,000**	
Upland Cap Monitoring					
Cap monitoring, maintenance, and reporting - annual cost	1	ls	$ 30,000	$ 30,000	Assume annual monitoring for Years 1 to 10 followed by monitoring in Years 15, 20, 25 and 30.
Direct Subtotal				$ 420,000	
Indirect O&M Costs		% of TDC	17.0%	$ 71,400	
Undiscounted Subtotal (including Indirect Costs)				**$ 491,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 507,000**	
Sediment - Capping, ENR, MNR and ICs					
Sediment cap operation and maintenance monitoring and reporting	32	acre	$ 20,000	$ 640,000	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction. Includes monitoring and maintenance costs for amended cap and low-permeability cap.
ENR operation and maintenance monitoring and reporting	23	acre	$ 12,500	$ 283,750	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Periodic cap/ENR repair event		%	10%	$ 3,035,400	Assume repair in Year 5, and 10 after active remedy construction.
MNR operation and maintenance monitoring and reporting	0	acre	$ 10,000	$ -	Assume monitoring in Year 1, 3, 5, 10, 15, 20, 25 and 30 after active remedy construction.
Institutional Controls - annual cost	1	ls	$ 25,000	$ 25,000	Assume annual costs for 30 years.
Direct Subtotal				$ 14,210,800	
Indirect O&M Costs		% of TDC	17%	$ 2,415,836	
Undiscounted Subtotal (including Indirect Costs)				**$ 16,627,000**	
Net Present Value Subtotal (including Indirect Costs)				**$ 17,196,000**	
Total Undiscounted O&M Costs (30 Years)				**$ 19,581,000**	
Total Net Present Value of O&M Costs (30 Years)				**$ 20,236,000**	
Contingency (30 Percent of Total Cost)				**$ 21,676,000**	
Total Cost of Alternative (Present Worth)				**$ 93,930,000**	

Notes:

Present worth calculated using equal series present worth analysis where i = -0.3%

Table 13B-11

Quantities Used for Detailed Cost Estimates

Gas Works Park Site
Seattle, Washington

	Excavation			Vegetated Cap					Sediment Cap									
Alternative/Area ID	Area ft^2	Exc. Depth ft	Exc. Volume cy	Cap/Geotextile Area ft^2	Drainage Rock Depth ft	Topsoil Depth ft	Drainage Rock Volume + 10% SF cy	Topsoil Volume + 10% SF cy	Sand Cap Area (Conventional) ft^2	Sand Cap Area (Thick) ft^2	ENR Area ft^2	Total Net Amended Cap Area ft^2	AC-Amended Cap Area ft^2	OC-Amended Cap Area ft^2	ZVI-Amended Cap Area ft^2	Low-Permeability Cap Area ft^2	Sand Cap Thickness (Conventional) ft	Sand Cap Thickness (Thick) ft
Alternative 1																		
GWMA-1, SMA-1, SMA-2	32,234	2 to 3	2,452	32,234	0.5	1.5	657	1,970	0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	28,300	0	0	0	0	0	0	2	4
SMA-4	0	0	0	0	0	0	0	0	8,700	3,700	0	0	0	0	0	0	2	4
SMA-5	0	0	0	0	0	0	0	0	18,400	7,600	0	0	0	0	0	0	2	4
SMA-6	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	37,000	48,000	0	0	0	0	0	0	2	4
SMA-8	0	0	0	0	0	0	0	0	0	25,500	0	0	0	0	0	0	2	4
SMA-9	0	0	0	0	0	0	0	0	0	124,000	0	0	0	0	0	0	2	4
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	148,000	0	0	0	0	0	0	2	4
SMA-13	0	0	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	0	0
Alternative 2																		
GWMA-1, SMA-1, SMA-2	32,234	2 to 3	2,452	32,234	0.5	1.5	657	1,970	0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	0	0	28,300	28,300	15,600	9,600	0	2	0
SMA-4	0	0	0	0	0	0	0	0	3,000	0	0	9,000	9,000	4,000	0	0	2	0
SMA-5	0	0	0	0	0	0	0	0	0	0	0	26,000	26,000	4,000	0	0	0	0
SMA-6	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	37,000	48,000	0	0	0	0	0	0	2	4
SMA-8	0	0	0	0	0	0	0	0	0	25,500	0	0	0	0	0	0	0	4
SMA-9	0	0	0	0	0	0	0	0	0	124,000	0	0	0	0	0	0	0	4
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	148,000	0	0	0	0	0	0	2	4
SMA-13	0	0	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	0	0
Alternative 3																		
GWMA-1, SMA-1, SMA-2	32,234	2 to 3	2,452	32,234	0.5	1.5	657	1,970	0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	0	0	0	0	0	0	28,300	2	0
SMA-4	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	9,000	2	0
SMA-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,000	1	0
SMA-6	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	13,000	0	0	72,000	20,000	46,800	48,000	0	2	0
SMA-8	0	0	0	0	0	0	0	0	0	0	0	25,500	0	25,500	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0	37,000	0	0	87,000	45,000	60,800	0	0	2	0
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	0	0	148,000	0	148,000	0	0	2	0
SMA-13	0	0	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	0	0
Alternative 4																		
GWMA-1, SMA-1, SMA-2	32,234	4	4,775	32,234	0.5	1.5	657	1,970	0	0	0	0				0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	0	0	28,300	28,300	15,600	9,600	0	2	0
SMA-4	0	0	0	0	0	0	0	0	8,700	0	0	0	0	0	0	3,700	2	0
SMA-5	0	0	0	0	0	0	0	0	18,400	0	0	0	0	0	0	7,600	2	0
SMA-6	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	37,000	48,000	0	0	0	0	0	0	2	4
SMA-8	0	0	0	0	0	0	0	0	0	25,500	0	0	0	0	0	0	0	4
SMA-9	0	0	0	0	0	0	0	0	0	86,000	0	38,000	13,000	38,000	0	0	0	4
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0

	Excavation			Vegetated Cap					Sediment Cap									
Alternative/Area ID	Area ft^2	Exc. Depth ft	Exc. Volume cy	Cap/Geotextile Area ft^2	Drainage Rock Depth ft	Topsoil Depth ft	Drainage Rock Volume + 10% SF cy	Topsoil Volume + 10% SF cy	Sand Cap Area (Conventional) ft^2	Sand Cap Area (Thick) ft^2	ENR Area ft^2	Total Net Amended Cap Area ft^2	AC-Amended Cap Area ft^2	OC-Amended Cap Area ft^2	ZVI-Amended Cap Area ft^2	Low-Permeability Cap Area ft^2	Sand Cap Thickness (Conventional) ft	Sand Cap Thickness (Thick) ft
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	148,000	0	0	0	0	0	0	2	4
SMA-13	0	0	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	0	0
Alternative 5																		
GWMA-1, SMA-1, SMA-2	32,234	4	4,775	32,234	0.5	1.5	657	1,970	0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	0	0	0	0	0	0	28,300	2	0
SMA-4	0	0	0	0	0	0	0	0	8,700	0	0	0	0	0	0	3,700	2	0
SMA-5	0	0	0	0	0	0	0	0	18,400	0	0	0	0	0	0	7,600	2	0
SMA-6	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	13,000	0	0	72,000	20,000	46,800	48,000	0	2	0
SMA-8	0	0	0	0	0	0	0	0	0	0	0	25,500	0	25,500	0	0	2	0
SMA-9	0	0	0	0	0	0	0	0	0	86,000	0	38,000	13,000	38,000	0	0	0	4
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	148,000	0	0	0	0	0	0	2	4
SMA-13	0	0	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	0	0
Alternative 6																		
GWMA-1, SMA-1, SMA-2	32,234	4	4,775	32,234	0.5	1.5	657	1,970	0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	0	0	0	0	0	0	28,300	2	0
SMA-4	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	9,000	2	0
SMA-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,000	2	0
SMA-6	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	13,000	0	0	72,000	20,000	46,800	48,000	0	2	0
SMA-8	0	0	0	0	0	0	0	0	0	25,500	0	0	0	0	0	0	0	4
SMA-9	0	0	0	0	0	0	0	0	37,000	0	0	87,000	45,000	60,800	0	0	2	0
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	148,000	0	0	0	0	0	0	2	4
SMA-13	0	0	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	0	0
Alternative 7																		
GWMA-1, SMA-1, SMA-2	32,234	4	4,775	32,234	0.5	1.5	657	1,970	0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	0	0	0	0	0	0	28,300	2	0
SMA-4	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	9,000	2	0
SMA-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,000	2	0
SMA-6	0	0	0	0	0	0	0	0	44,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	13,000	0	0	72,000	20,000	46,800	48,000	0	2	0
SMA-8	0	0	0	0	0	0	0	0	0	0	0	25,500	0	25,500	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0	37,000	0	0	87,000	45,000	60,800	0	0	2	0
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	0	0	148,000	0	148,000	0	0	2	0
SMA-13	0	0	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	2	0
SMA-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative 8																		
GWMA-1, SMA-1, SMA-2	32,234	4	4,775	32,234	0.5	1.5	657	1,970	0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0	0	0	0	0	0	15,400	0	0	0	0	0	0	28,300	2	0
SMA-4	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	9,000	2	0
SMA-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,000	2	0
SMA-6	0	0	0	0	0	0	0	0	44,000	0	0	0	0	0	0	0	2	0
SMA-7	0	0	0	0	0	0	0	0	13,000	0	0	72,000	20,000	46,800	48,000	0	2	0
SMA-8	0	0	0	0	0	0	0	0	0	0	0	25,500	0	25,500	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0	37,000	0	0	87,000	45,000	60,800	0	0	2	0
SMA-10	0	0	0	0	0	0	0	0	24,000	0	0	0	0	0	0	0	2	0
SMA-11	0	0	0	0	0	0	0	0	268,000	0	0	0	0	0	0	0	2	0
SMA-12	0	0	0	0	0	0	0	0	165,000	0	0	148,000	0	148,000	0	0	2	0

	Excavation			Vegetated Cap					Sediment Cap									
Alternative/Area ID	Area	Exc. Depth	Exc. Volume	Cap/Geotextile Area	Drainage Rock Depth	Topsoil Depth	Drainage Rock Volume + 10% SF	Topsoil Volume + 10% SF	Sand Cap Area (Conventional)	Sand Cap Area (Thick)	ENR Area	Total Net Amended Cap Area	AC-Amended Cap Area	OC-Amended Cap Area	ZVI-Amended Cap Area	Low-Permeability Cap Area	Sand Cap Thickness (Conventional)	Sand Cap Thickness (Thick)
	ft^2	ft	cy	ft^2	ft	ft	cy	cy	ft^2	ft^2	ft^2	ft^2	ft^2	ft^2	ft^2	ft^2	ft	ft
SMA-13	0	0	0	0	0	0	0	0	445,000	0	0	0	0	0	0	0	2	0
SMA-14	0	0	0	0	0	0	0	0	0	0	989,000	0	0	0	0	0	0	0

Notes

1. Areas and volumes for alternatives based on polygons and cross sections developed in GIS.

	Sediment Cap									Sediment Excavation/Dredge			
	ENR Thickness	Amended Cap Thickness	Fish Mix/Erosion Protection Layer Thickness	Rock Armor Thickness	Sand Cap Volume (Conventional) +25% Volume Cont	Sand Cap Volume (Thick) +25% Volume Cont	ENR Material Volume +50% Volume Cont	Fish Mix/Erosion Protection Volume	Rock Armor Tonnage	Land-based Excavation Area	Mechanical Dredge Area	Hydraulic Dredge Area	Land-based Excavation Depth
Alternative/Area ID	ft	ft	ft	ft	cy	cy	cy	cy	ton	ft^2	ft^2	ft^2	ft
Alternative 1													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0.5	2.0	1,426	5,241	0	809	2,590	44,000	0	0	3.0
SMA-4	0	0	0.5	2.0	806	685	0	230	735	12,400	0	0	3.0
SMA-5	0	0	0.5	2.0	1,704	1,407	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	9,259	0	0	1,852	5,926	0	0	0	0
SMA-7	0	0	0.0	1.0	3,426	8,889	0	0	2,519	0	0	0	0
SMA-8	0	0	0.0	1.0	0	4,722	0	0	756	0	0	0	0
SMA-9	0	0	0.0	1.0	0	22,963	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	0	0.5	1.0	15,278	27,407	0	2,898	4,637	0	0	0	0
SMA-13	0.5	0	0.0	0.0	0	0	12,361	0	0	0	0	0	0
Alternative 2													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	1	0.5	2.0	2,736	0	0	809	2,590	44,000	0	0	3.0
SMA-4	0	1	0.5	2.0	694	0	0	222	711	12,400	0	0	3.0
SMA-5	0	1	0.5	2.0	1,204	0	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	9,259	0	0	1,852	5,926	0	0	0	0
SMA-7	0	0	0.0	1.0	3,426	8,889	0	0	2,519	0	0	0	0
SMA-8	0	0	0.0	1.0	0	4,722	0	0	756	0	0	0	0
SMA-9	0	0	0.0	1.0	0	22,963	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	0	0.5	1.0	15,278	27,407	0	2,898	4,637	0	0	0	0
SMA-13	0.5	0	0.0	0.0	0	0	12,361	0	0	0	0	0	0
Alternative 3													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0.5	2.0	2,736	0	0	809	2,590	44,000	0	0	3.0
SMA-4	0	0	0.5	2.0	694	0	0	222	711	12,400	0	0	3.0
SMA-5	0	0	0.5	2.0	1,204	0	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	9,259	0	0	1,852	5,926	0	0	0	0
SMA-7	0	2	0.0	1.0	7,870	0	0	0	2,519	0	0	0	0
SMA-8	0	2	0.0	1.0	2,361	0	0	0	756	0	0	0	0
SMA-9	0	2	0.0	1.0	11,481	0	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	2	0.5	1.0	28,981	0	0	2,898	4,637	0	0	0	0
SMA-13	0.5	0	0.0	0.0	0	0	12,361	0	0	0	0	0	0
Alternative 4													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	1	0.5	2.0	2,736	0	0	809	2,590	44,000	0	0	6.0
SMA-4	0	0	0.5	2.0	977	0	0	230	735	12,400	0	0	6.0
SMA-5	0	0	0.5	2.0	2,056	0	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	9,259	0	0	1,852	5,926	0	0	0	0
SMA-7	0	0	0.5	1.0	3,426	8,889	0	1,574	2,519	0	0	0	0
SMA-8	0	0	0.0	1.0	0	4,722	0	0	756	0	0	0	0
SMA-9	0	2	0.0	1.0	3,519	15,926	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0

	Sediment Cap									Sediment Excavation/Dredge			
Alternative/Area ID	ENR Thickness ft	Amended Cap Thickness ft	Fish Mix/Erosion Protection Layer Thickness ft	Rock Armor Thickness ft	Sand Cap Volume (Conventional) +25% Volume Cont cy	Sand Cap Volume (Thick) +25% Volume Cont cy	ENR Material Volume +50% Volume Cont cy	Fish Mix/Erosion Protection Volume cy	Rock Armor Tonnage ton	Land-based Excavation Area ft^2	Mechanical Dredge Area ft^2	Hydraulic Dredge Area ft^2	Land-based Excavation Depth ft
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	0	0.5	1.0	15,278	27,407	0	2,898	4,637	0	0	0	0
SMA-13	0.5	0	0.0	0.0	0	0	12,361	0	0	0	0	0	0
Alternative 5													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0.5	2.0	2,736	0	0	809	2,590	44,000	0	0	6.0
SMA-4	0	0	0.5	2.0	977	0	0	230	735	12,400	0	0	6.0
SMA-5	0	0	0.5	2.0	2,056	0	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	9,259	0	0	1,852	5,926	0	0	0	0
SMA-7	0	2	0.0	1.0	7,870	0	0	0	2,519	0	0	0	0
SMA-8	0	2	0.0	1.0	2,361	0	0	0	756	0	0	0	0
SMA-9	0	2	0.0	1.0	3,519	15,926	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	0	0.5	1.0	15,278	27,407	0	2,898	4,637	0	0	0	0
SMA-13	0.5	0	0.0	0.0	0	0	12,361	0	0	0	0	0	0
Alternative 6													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0.5	2.0	2,736	0	0	809	2,590	44,000	0	0	6.0
SMA-4	0	0	0.5	2.0	694	0	0	222	711	12,400	0	0	6.0
SMA-5	0	0	0.5	2.0	1,204	0	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	9,259	0	0	1,852	5,926	0	0	0	0
SMA-7	0	2	0.0	1.0	7,870	0	0	0	2,519	0	0	0	0
SMA-8	0	0	0.0	1.0	0	4,722	0	0	756	0	0	0	0
SMA-9	0	2	0.0	1.0	11,481	0	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	0	0.5	1.0	15,278	27,407	0	2,898	4,637	0	0	0	0
SMA-13	0.5	0	0.0	0.0	0	0	12,361	0	0	0	0	0	0
Alternative 7													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0.5	2.0	2,736	0	0	809	2,590	44,000	0	0	6.0
SMA-4	0	0	0.5	2.0	694	0	0	222	711	12,400	0	0	6.0
SMA-5	0	0	0.5	2.0	1,204	0	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	4,074	0	0	815	2,607	0	44,000	0	0.0
SMA-7	0	2	0.0	1.0	7,870	0	0	0	2,519	0	0	0	0
SMA-8	0	2	0.0	1.0	2,361	0	0	0	756	0	0	0	0
SMA-9	0	2	0.0	1.0	11,481	0	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	2	0.5	1.0	28,981	0	0	2,898	4,637	0	0	0	0
SMA-13	1	0	0.5	0.0	0	0	12,361	8,241	0	0	0	0	0
SMA-14	0.0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
Alternative 8													
GWMA-1, SMA-1, SMA-2	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0
SMA-3	0	0	0.5	2.0	2,736	0	0	809	2,590	44,000	0	0	6.0
SMA-4	0	0	0.5	2.0	694	0	0	222	711	12,400	0	0	6.0
SMA-5	0	0	0.5	2.0	1,204	0	0	481	1,541	0	23,400	2,600	0
SMA-6	0	0	0.5	2.0	4,074	0	0	815	2,607	0	44,000	0	0.0
SMA-7	0	2	0.0	1.0	7,870	0	0	0	2,519	0	0	0	0
SMA-8	0	2	0.0	1.0	2,361	0	0	0	756	0	0	0	0
SMA-9	0	2	0.0	1.0	11,481	0	0	0	3,674	0	0	0	0
SMA-10	0	0	0.0	1.0	2,222	0	0	0	711	0	5,580	620	0
SMA-11	0	0	0.5	1.5	24,815	0	0	4,963	11,911	0	0	0	0
SMA-12	0	2	0.5	1.0	28,981	0	0	2,898	4,637	0	0	0	0

	Sediment Cap									Sediment Excavation/Dredge			
Alternative/Area ID	ENR Thickness	Amended Cap Thickness	Fish Mix/Erosion Protection Layer Thickness	Rock Armor Thickness	Sand Cap Volume (Conventional) +25% Volume Cont	Sand Cap Volume (Thick) +25% Volume Cont	ENR Material Volume +50% Volume Cont	Fish Mix/Erosion Protection Volume	Rock Armor Tonnage	Land-based Excavation Area	Mechanical Dredge Area	Hydraulic Dredge Area	Land-based Excavation Depth
	ft	ft	ft	ft	cy	cy	cy	cy	ton	ft^2	ft^2	ft^2	ft
SMA-13	0	0	0.5	0.0	41,204	0	0	8,241	0	0	0	0	0
SMA-14	0.5	0	0.0	0.0	0	0	27,472	0	0	0	0	0	0

	Sediment Excavation/Dredge					Off-site Transportation and Disposal		ISCF
Alternative/Area ID	Mechanical Dredge Depth ft	Hydraulic Dredge Depth ft	Land-based Excavation Volume cy	Hydraulic Dredge Volume cy	Mechanical Dredge Volume cy	Subtitle C Landfill +10% BF tons	Subtitle D Landfill +10% BF tons	Area ft^2
Alternative 1								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	3,776	0	7,500
SMA-3	0.0	0	4,889	0	0	1,681	5,042	0
SMA-4	0.0	0	1,378	0	0	474	1,421	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	0	0	0	0	0	0	0	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	3.0	3.0	0	69	620	237	710	0
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0
SMA-13	0	0	0	0	0	0	0	0
Alternative 2								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	3,776	0	7,500
SMA-3	0.0	0	4,889	0	0	1,681	5,042	0
SMA-4	0.0	0	1,378	0	0	474	1,421	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	0	0	0	0	0	0	0	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	3.0	3.0	0	69	620	237	710	0
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0
SMA-13	0	0	0	0	0	0	0	0
Alternative 3								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	3,776	0	7,500
SMA-3	0.0	0	4,889	0	0	1,681	5,042	0
SMA-4	0.0	0	1,378	0	0	474	1,421	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	0	0	0	0	0	0	0	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	3.0	3.0	0	69	620	237	710	0
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0
SMA-13	0	0	0	0	0	0	0	0
Alternative 4								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	7,354	0	7,500
SMA-3	0.0	0	9,778	0	0	3,361	10,083	0
SMA-4	0.0	0	2,756	0	0	947	2,842	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	0	0	0	0	0	0	0	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	3.0	3.0	0	69	620	237	710	0

	Sediment Excavation/Dredge					Off-site Transportation and Disposal		ISCF
Alternative/Area ID	Mechanical Dredge Depth ft	Hydraulic Dredge Depth ft	Land-based Excavation Volume cy	Hydraulic Dredge Volume cy	Mechanical Dredge Volume cy	Subtitle C Landfill +10% BF tons	Subtitle D Landfill +10% BF tons	Area ft^2
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0
SMA-13	0	0	0	0	0	0	0	0
Alternative 5								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	7,354	0	7,500
SMA-3	0.0	0	9,778	0	0	3,361	10,083	0
SMA-4	0.0	0	2,756	0	0	947	2,842	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	0	0	0	0	0	0	0	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	3.0	3.0	0	69	620	237	710	0
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0
SMA-13	0	0	0	0	0	0	0	0
Alternative 6								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	7,354	0	7,500
SMA-3	0.0	0	9,778	0	0	3,361	10,083	0
SMA-4	0.0	0	2,756	0	0	947	2,842	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	0	0	0	0	0	0	0	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	3.0	3.0	0	69	620	237	710	0
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0
SMA-13	0	0	0	0	0	0	0	0
Alternative 7								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	7,354	0	7,500
SMA-3	0.0	0	9,778	0	0	3,361	10,083	0
SMA-4	0.0	0	2,756	0	0	947	2,842	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	5.0	0	0	0	8,148	2,801	8,403	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	4.0	4.0	0	92	827	316	947	0
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0
SMA-13	0	0	0	0	0	0	0	0
SMA-14	0	0	0	0	0	0	0	0
Alternative 8								
GWMA-1, SMA-1, SMA-2	0	0	0	0	0	7,354	0	7,500
SMA-3	0.0	0	9,778	0	0	3,361	10,083	0
SMA-4	0.0	0	2,756	0	0	947	2,842	0
SMA-5	3.0	3.0	0	289	2,600	993	2,979	0
SMA-6	5.0	0	0	0	8,148	2,801	8,403	0
SMA-7	0	0	0	0	0	0	0	0
SMA-8	0	0	0	0	0	0	0	0
SMA-9	0	0	0	0	0	0	0	0
SMA-10	4.0	4.0	0	92	827	316	947	0
SMA-11	0	0	0	0	0	0	0	0
SMA-12	0	0	0	0	0	0	0	0

Alternative/Area ID	Sediment Excavation/Dredge					Off-site Transportation and Disposal		ISCF
	Mechanical Dredge Depth	Hydraulic Dredge Depth	Land-based Excavation Volume	Hydraulic Dredge Volume	Mechanical Dredge Volume	Subtitle C Landfill +10% BF	Subtitle D Landfill +10% BF	Area
	ft	ft	cy	cy	cy	tons	tons	ft^2
SMA-13	0	0	0	0	0	0	0	0
SMA-14	0	0	0	0	0	0	0	0