FINAL DRAFT

KING COUNTY DEPARTMENT OF NATURAL RESOURCES
YEAR 2000 CSO PLAN UPDATE PROJECT
SEDIMENT MANAGEMENT PROGRAM

Sediment Remediation Alternative Evaluation

Task 1200
Technical Memorandum

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EXECUTIVE SUMMARY

This technical memorandum develops and evaluates programmatic long-range remediation alternatives for consideration at seven identified combined sewer overflow (CSO) sediment cleanup sites. Using available sediment quality data, the general nature and extent of sediment contamination in the vicinity of each site was summarized, and used as input to the Sediment Management Plan's (SMP's) initial site ranking model (Task 1100 work product). This effort resulted in preliminary cleanup priorities from among the seven identified King County CSO sediment cleanup sites. The sediment cleanup site priority identified from this initial assessment is:

CSO	Priority
• Duwamish/Diagonal	High
• King Street	High
• Hanford Street	Medium/High
• Lander Street	Medium/High
• Denny Way	Medium
• Chelan Avenue	Low/Medium
• Brandon Street	Low

Next, the available site characterization data were reviewed in the context of potential cleanup options, in order to determine the general scope of practicable sediment remediation alternatives that could be applied to some or all of the seven sites. The initial development of sediment remediation options focused on the more practicable technologies identified from a preliminary review of technical feasibility, implementability, and cost (Task 1000 work product). The primary sediment remedial technologies considered in this preliminary assessment included source control/natural recovery (potentially including detailed risk assessment); capping; and dredging with confined disposal. For the latter option, low and high-range removal alternatives were developed that represent different cleanup strategies given the limited number of potentially available disposal facilities. In making this determination, a "short list" of representative disposal sites, particularly aquatic facilities, that have previously been considered in other regional cleanup evaluations were included in this initial programmatic assessment. A preliminary cost estimate was developed that considered the full range of prospective costs associated with each cleanup option, including studies (e.g., filling data gaps), engineering, construction, monitoring, land easements/encumbrances, and mitigation. For in-water options (i.e., excluding upland landfill disposal), the estimated total costs for the various cleanup alternatives ranged from approximately $26 to $36 million. If upland disposal was determined to be necessary, the upper-bound cost estimate could approach $75 million.

Cooperative project opportunities and potential funding mechanisms were identified that may be available to reduce potential cleanup costs. These opportunities include integration of multiple stakeholders into cooperative projects that address a range of regional sediment cleanup, disposal, redevelopment, and habitat restoration actions. Depending on the alternative selected, and the specific funding arrangement, 50 percent

or more of the cost of cleanup could be shared with other cooperative parties. Partnership arrangements with the Port of Seattle and other entities will likely be required to accomplish such a "win-win" outcome. The scope of this and other SMP strategies will be developed in more detail over the next several months.

INTRODUCTION

King County recently contracted (Contract #E83034E) with Brown & Caldwell and it's subconsultants (Anchor Environmental and Herrera Environmental Consultants) to develop a Sediment Management Plan (SMP) for King County's Combined Sewer Overflow (CSO) Program. One of the tasks (Task 1200) of this effort was to develop and evaluate programmatic long-range remediation alternatives for consideration at seven identified CSO sediment cleanup sites. This technical memorandum presents a review of readily available information on the seven sites, compiles the information in a manner that allows for comparison of remediation alternatives, costs, and other considerations, and outlines the elements of a recommended sediment cleanup strategy that is consistent with the requirements of the State Sediment Management Standards (SMS; Chapter 173-204 WAC) and which also attempts to further King County's interests. A generalized flow chart depicting the SMP development process is provided on Figure 1.

As set forth in the SMS regulation, the Washington State Department of Ecology (Ecology) has developed a sediment site prioritization scheme to identify and prioritize agency resources to implement the SMS. The general ecological and human health risk reduction objectives of sediment cleanup, as defined by the SMS, have been transformed by Ecology into a set of sediment site scoring guidelines, which are periodically applied to prioritize agency resources from among the total list of Contaminated Sediment Sites Ecology has identified. The most recent Ecology ranking results were released in May 1996. Based on these data, the seven sediment sites currently identified for consideration in the King County SMP were ranked as follows (ecological score only; out of a possible 100 points):

- Hanford Street CSO (EB8) - 42;
- Lander Street CSO (EB7) - 13;
- Duwamish Pump Station/Diagonal CSO (DR31) - 12;
- Brandon Street CSO (DR32) - 10;
- King Street CSO (EB27) - 10;
- Denny Way CSO (EB26) - 6; and
- Chelan Avenue CSO (EB13) - Not Scored [within general Superfund Site boundary]

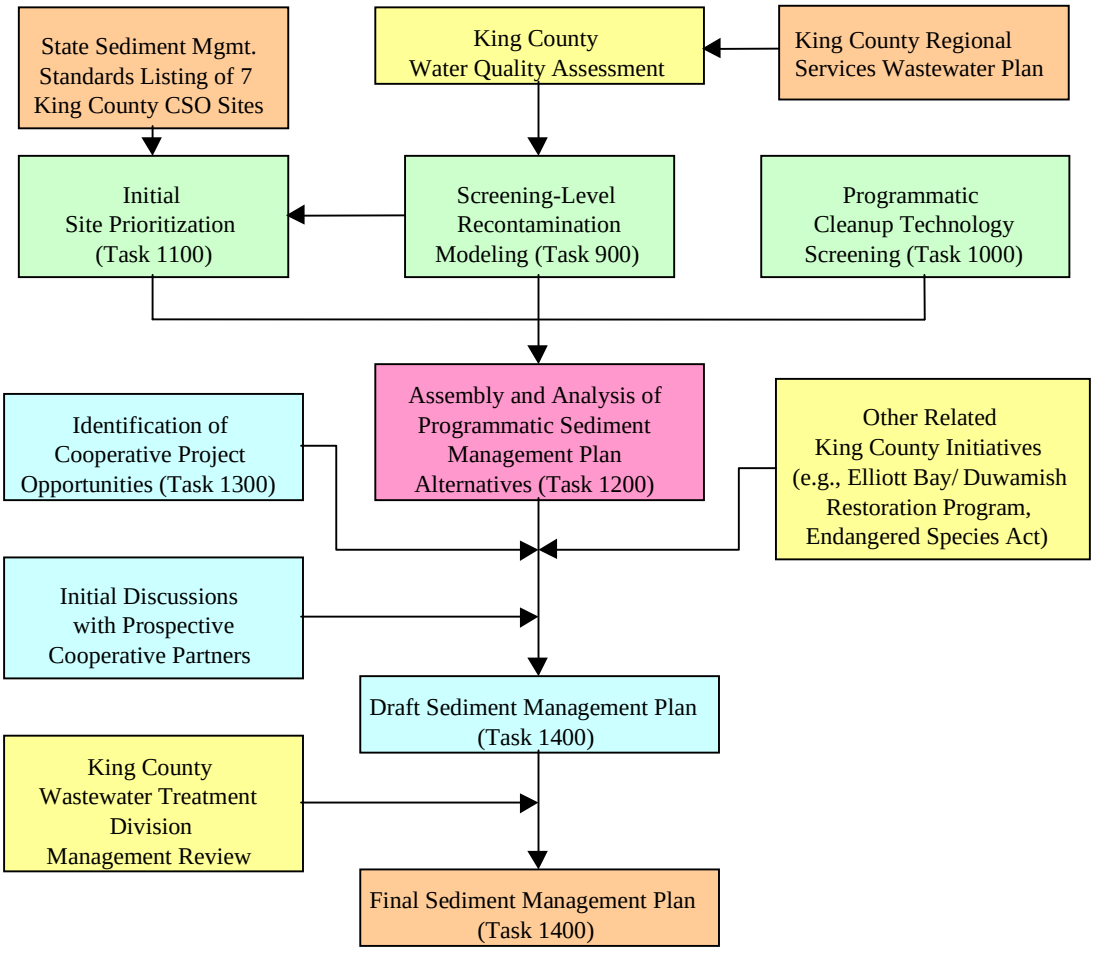
Since publication of the most recent Ecology site prioritization, considerable additional data have become available that provide a more accurate characterization and ranking of each of the prospective sediment cleanup sites listed above. In addition, King County's SMP has recently developed an improved sediment prioritization scheme that builds upon Ecology's ranking model, but also addresses some of the important roadblocks that have complicated cleanup of contaminated sediments throughout Puget Sound. Typically, these roadblocks have included high costs, limited disposal site options, concerns about environmental liability, source control issues, habitat alterations, and complex regulatory and land owner constraints. The improved site prioritization model, which is described in more detail in the Task 1100 Technical Memorandum, is applied to the SMP sites in the following section.

A related SMP Technical Memorandum (Task 1000) presented a draft compilation of sediment remediation technologies for consideration, based on a review of information and projects located primarily within the Puget Sound region. Sediment remedial technologies considered in the Task 1000 document included source control/natural recovery, containment (i.e., capping), removal (e.g., dredging), upland and aquatic disposal, and treatment. Each technology was evaluated relative to technical feasibility, implementability, and cost. Among the range of potential technologies considered, only treatment was considered impracticable to address relatively large volumes of sediment (i.e., greater than 100,000 cubic yards; CY) containing relatively low contaminant levels (e.g., part-per-million chemical concentrations). However, the remaining three technologies (natural recovery, containment, and removal/disposal) varied widely with respect to potential application within the SMP area. The Task 1000 information was used in this memorandum to develop a preliminary (programmatic) range of remedial alternatives for the seven identified King County CSO sediment cleanup sites (Figure 1).

In addition to potential SMS sediment site cleanup requirements, King County and the City of Seattle must also meet existing Washington State CSO regulations that require CSO discharges be limited to no more than one occurrence per year on average, at each CSO location. King County has had a CSO control program in place since 1988 and has completed several projects. However, CSO control is expensive - it will cost King County approximately $566 million (1998 dollars) to control CSOs to one discharge per year over the life of the program - $255 million of this total has been spent or committed to be spent to achieve the initial volume reductions (Parametrix and King County, 1998). As outlined in King County's Executive's Preferred Plan for Regional Wastewater Services released in May 1998, another $325 million is expected to be spent over the next 30 years, when the program will be complete.

As part of this larger planning effort, King County has completed a separate CSO Water Quality Assessment (WQA) for the Duwamish River and Elliott Bay to better understand the risk to aquatic life, wildlife, and people who use the resources of this estuary (Parametrix and King County, 1998). Among other tasks, the WQA developed a model of the River and Bay to describe how water and sediment-bound pollutants from CSOs and "other" sources move throughout the system. (In the case of at least one CSO, i.e., Duwamish/Diagonal, City of Seattle stormdrain discharges are also implicated in sediment contamination). By combining the modeling with detailed risk assessments, the WQA model provided an improved understanding of the CSO contribution (in relation to other sources) to the overall risk to the estuarine ecosystem and to people who recreate or work in or on these water bodies. With this information, King County can develop an overall CSO control program that targets the areas and causes of greatest risk and achieves a level of benefit reflective of the cost. The WQA model can also be used to provide more accurate assessments of source control and sediment recontamination in the immediate vicinity of each of the 7 CSO sediment sites (see Task 900 Technical Memorandum). This information is important input to the overall remedial alternative assessment (Figure 1).

Figure 1. King County Sediment Management Plan Development and Review Process



SEDIMENT SITE PRIORITIZATION

As discussed in the Task 1100 Technical Memorandum, the SMP has developed a sediment site prioritization scheme, based largely on the successful Bellingham Bay Pilot Project model, to initially prioritize sediment cleanup sites for the SMP. The ranking model was applied to the SMP area to identify preliminary cleanup priorities from among the seven identified King County CSO sediment cleanup sites. The SMP's prioritization model integrated available information on toxicity potential, extent, source control, natural recovery potential, habitat attributes, fisheries utilization, and other factors to derive a total score for each sediment site. Inputs to the ranking model included the following:

- **Maximum "cluster" concentration of individual contaminants.** The SMP ranking model used as input the maximum "station cluster", which is defined as a group of geographically and chemically similar stations that together define the highest average chemical concentrations or biological effects. The station cluster concept addresses to some extent the characteristic variability of environmental measurements, and also is being used in Ecology's SMS program to define sediment "hotspots". In the ranking model, the station cluster concentration was compared with conservative Puget Sound sediment quality standards (SQS) chemical criteria and other applicable toxicity benchmarks (e.g., verified cancer potency factors for human health risk assessment).

  The determination of maximum cluster concentrations at each CSO sediment site was based on an initial review of readily available data sources for surface (0 to 10 cm) sediment samples collected over the past 10 years. The data considered in this preliminary analysis included:

  - King County Laboratory Information Management System (LIMS) data provided as spreadsheet files (see King County Task 5 SMP Report);
  - Ecology's most recent update of the SEDQUAL database (updated August, 1998);
  - Duwamish/Diagonal CSO sediment site characterization reports (e.g., KC-DNR, 1997);
  - Denny Way CSO sediment site characterization reports (e.g., Striplin, 1998);
  - King Street CSO sediment site characterization reports (e.g., Hart Crowser, 1994 and Aura Nova and Ecology, 1995); and
  - Other readily available information on file at Anchor Environmental.

  If more than one set of data was associated with a sampling station, the most recent data set was used. When there were discrepancies in station coordinates between SEDQUAL and King County, the King County coordinates were used.

Some of the SMS chemical criteria are expressed as organic carbon normalized (e.g., mg/kg-OC) values for non-polar organic compounds, because the toxicity of these compounds in sediments have been observed to correlate well with the organic content of the sediments. To normalize for total organic carbon content, the dry weight concentration for each parameter was divided by the decimal fraction representing the percent total organic carbon in the sediment sample. To simplify the calculations and to allow for carbon normalization of those samples without corresponding organic carbon data, the organic carbon values used for normalization were approximated based on the average concentrations of total organic carbon obtained throughout the CSO footprint (see below), using only King County total organic carbon data.

A station cluster analysis was performed per SMS guidelines at each site to determine whether the site could be identified as an area of potential concern for any given analyte/compound in exceedance of the SQS chemical criteria. The station cluster analysis involved identifying the highest concentration of the analyte/compound, calculating the average concentration of the analyte/compound at three contiguous stations (including the one identified with the highest concentration), provided that the distance between stations did not exceed 500 feet. Station cluster results are presented in Table 1.

- **Footprint of contaminated sediments.** The SMP ranking model differentiated the footprint of sediment contamination into various categories, with the cutoffs for ranking adjusted to represent the logarithmic range of areas observed in the study area. The footprint of a CSO is an area of deposition of chemicals adsorbed to sediment particles that settle to the bottom at varying distances from the end of the pipe depending on particle size and hydrographic conditions. The estimated areal extent of contaminated sediments within each CSO footprint was defined for the purpose of ranking as exceedance of SQS criteria, though the footprint of cleanup screening level (CSL) exceedances was also delineated (see below). The more conservative SQS provides a regulatory goal by identifying surface sediments that are predicted to have no adverse effects (chronic or acute) on biological resources and do not pose a significant risk to humans. The higher CSL identifies sediments that may represent minor adverse effects to some sensitive species, and is sometimes used by Ecology as the enforceable sediment cleanup standard when the cost of achieving the SQS is substantial and disproportionate to the degree of additional protection provided. Within the Puget Sound region, Ecology has used both SQS and CSL criteria to derive enforceable cleanup standards, depending upon site-specific considerations.

Table 1. Maximum Station Cluster Concentrations of Analytes of Potential Concern at the Seven SMP Sites, King County

Analytes of Potential Concern [a]	SQS Chemical Criterion	CSL Chemical Criterion	Maximum Detected Station Cluster Concentration (3 contiguous surface samples)						
			Brandon Street CSO (DR32)	Duwamish/ Diagonal SD/CSO (DR31)	Chelan Avenue CSO (EB13)	Hanford Street CSO (EB8)	Lander Street CSO [b] (EB7)	King Street CSO (EB27)	Denny Way CSO (EB26)
METALS (mg/kg dry):									
Arsenic	57	93		37		14			
Cadmium	5.1	6.7				2.2			
Copper	390	390						180	
Mercury	0.41	0.59	0.18	1.50		0.48	0.63	1.45	0.54
Lead	450	530						190	
Silver	6.1	6.1						6.7	
Zinc	410	960						477	
POLAR ORGANICS (mg/kg dry):									
4-Methylphenol	0.67	0.67		1.54					
NON-POLAR ORGANICS (mg/kg organic carbon):									
1,4 Dichlorobenzene	3.1	9	0.4	8.9	12	3.8			
Bis(2-ethylhexyl)phthalate	47	78	57	275	42	71	58	98	83
Butylbenzylphthalate	4.9	64							14
Total PAHs	~ 1,300	~ 6,100			1,424	320		1,864	862
Total PCBs	12	65		564		81	44		48

Notes:

[a] For the purpose of sediment site ranking, only those analytes that exceeded SQS criteria in at least one surface sample were included in this summary.

[b] Based on sediment core sample intervals ranging from 0 - 86 to 0 - 169 cm depth intervals; no surface (0 to 10 cm) sediment samples available.

Missing Figure 2

Approximate Extent of Sediment Contamination in
the Vicinity of the Seven King County CSO Sediment Sites.

In addition, the footprint determinations focused only on those chemicals that are at least partially attributable to CSO discharges, based on a review of the findings of related King County investigations. For example, the WQA and other King County documents have concluded that the cumulative sediment quality effects of the Duwamish/Diagonal CSO and storm drain discharges have led to a distinct benthic infaunal community grading from impacted at the CSO and storm drain station nearest the outfall to relatively unimpacted at the station furthest from shore (Parametrix and King County, 1998). The areal extent of these impacts appears to be limited to the footprint of elevated sediment concentrations of bis(2-ethylhexyl)phthalate and 1,4 dichlorobenzene that exceed SQS and/or CSL criteria, even though elevated concentrations of other chemicals such as polychlorinated biphenyls (PCBs) are also present in the area. In consideration of these findings, and since bis(2-ethylhexyl)phthalate and 1,4 dichlorobenzene are commonly detected in CSO discharges (while chemicals such as PCBs typically are not), the footprint of contaminated sediments associated with each CSO outfall was determined solely on the basis of these marker chemicals. The results of the footprint analysis are presented in Figure 2. Stations where CSO chemical markers were not detected are denoted with an "X" on Figure 2. When available, confirmatory bioassay data were used to supplement and refine the spatial distributions, consistent with the SMS regulations.

- **Potential for natural recovery and/or sediment recontamination.** Because the seven SMP sites are all located in the immediate vicinity of CSO and storm drain outfalls, the determination of natural recovery and/or sediment recontamination potential can be difficult, potentially requiring the aid of sophisticated mathematical modeling (see Task 900 Technical Memorandum). For the purposes of the SMP site prioritization, the potential for recontamination at each of the seven sites was assessed using a combination of near-field (PLUMES) and far-field (WQA) screening-level model runs. Both model runs used current source level inputs from CSOs and storm drains. Although future source inputs will be reduced as initial volume reduction projects are completed and as King County's Preferred Plan for Regional Wastewater Services is implemented over the next 30 years (see above), these future reductions have not been factored in to the conservative PLUMES and WQA modeling performed for this SMP. Future CSO treatment options in the Duwamish will reduce recontamination by removing particles that settle near the outfalls.

  The near-field modeling determined the (approximate) probability distribution that sediment recontamination above SQS and/or CSL criteria could occur within a distance of approximately 20 to 50 feet from the CSO outfall, based on a statistical analysis of PLUMES output. The far-field modeling assessed the potential for recontamination approximately 100 to 400 feet from the CSO outfall (within the closest WQA model grid), incorporating other regional sources including storm drain discharges and local sediment resuspension. Modeling results were presented in the Task 900 Technical Memorandum. The near-field and far-field model output were then combined to estimate the areal-weighted sediment input concentration of marker chemicals throughout the CSO footprint defined above.

Except for the Brandon Street CSO site, the areal-weighted input concentrations of bis(2-ethylhexyl)phthalate and 1,4 dichlorobenzene calculated in this manner were all below conservative SQS criteria. These data suggest that source controls achieved to date should be sufficient to allow future natural recovery to achieve SQS criteria throughout most of the CSO footprint area, with a low probability of future sediment recontamination. Although the PLUMES model results reveal that a localized zone immediately adjacent to the each outfall (representing an area of less than 1 acre) has a significantly higher probability of sediment recontamination, the extent of these potential sediment impact zones is small in comparison to the existing CSO footprints. In the case of the Brandon Street CSO site, the total existing footprint is already small (less than 1 acre; see Figure 2), and not likely to change significantly at current source levels. Thus, all information considered, sediment contamination at the CSO sites appears to be the result of historical inputs and not ongoing sources. This preliminary result may have important ramifications to the SMP strategy (see below).

The rate of natural recovery within the CSO site footprint area, an important site ranking parameter, was estimated for this site prioritization by using the SEDCAM sediment recovery model, an approved method to estimate sediment recovery under the SMS program. SEDCAM incorporates the effects of sedimentation, biodegradation, and diffusion processes (Tetra Tech, 1988), though in this initial application biodegradation rates were conservatively set to zero. The model assumed a well-mixed system and allowed for the continual input of contaminants (at current discharge levels) with sedimentation. Using available estimates of net sedimentation rates at each site (available from several sources; e.g., Patmont et al., 1983; Aura Nova and Ecology, 1995), and assuming a conservative mixed layer thickness of 10 centimeters, an overall 10-year sediment recovery factor (ratio of Year 0 to Year 10 surface sediment concentrations near each CSO) was calculated using the SEDCAM model. The results of this screening-level modeling are summarized in Table 2. Except for the relatively small Brandon Street and Chelan Avenue CSO sites, significant natural recovery is expected to occur within the CSO footprint over the next 10 years. This expected recovery is conservative because it does not account for planned future CSO control.

- **Water depth of contaminated sediments.** In consideration of the well documented preference for many fish and shellfish species to utilize shallow water habitats preferentially over deeper zones, the SMP ranking model assigned a higher score to those sediment sites that are located within relatively shallow water. The scale for this analysis was adjusted to represent the range of depths observed in the study area. Typical water depths for each CSO sediment site are summarized in Table 2.

- **Habitat complexity.** In developing the ecological risk score, the SMP ranking model utilized information on site relief or the areal extent of habitat enhancing materials such as eelgrass, shell hash, or other similar enhancements within the contamination area.

Table 2. Sediment Cleanup Site Scoring Using Modified SEDRANK Model and Other King County Criteria

Parameter	Brandon Street CSO (DR32)	Duwamish/ Diagonal SD/CSO (DR31)	Chelan Avenue CSO (EB13)	Hanford Street CSO (EB8)	Lander Street CSO (EB7)	King Street CSO (EB27)	Denny Way CSO (EB26)
Approximate Area Exceeding SQS Criteria in acres [a]	0.8	8	4	15	6	19	10
Maximum Exceedance Ratio of Cluster Concentration Above SQS [b]	1.2	47.0	3.9	6.7	3.7	3.5	4.0
Max. Ratio of Input/Existing Surface Sediment Concentrations [b,c]	1.0 (d)	0.1	1.0 (d)	0.2	0.3	0.3	0.4
Estimated Sedimentation Rate in cm/year	10	8	4	3	3	1	1
Calculated 10-year Natural Recovery Factor (Year-10/Year-0) [e]	1.0	0.1	1.0	0.2	0.4	0.6	0.6
Typical Water Depth Range in feet MLLW	-15' to 0'	-15' to 0'	-30' to -15'	-30' to -15'	-30' to -15'	-30' to -15'	-30' to -15'
Habitat Complexity (areal extent of high quality habitat)	< 10%	< 10%	< 10%	< 10%	< 10%	< 10%	< 10%
Special Marine Habitats	Near Kellogg Island	Near Kellogg Island	None	None	None	None	None
Wildlife Refuges/Sanctuaries	Near Kellogg Island	Near Kellogg Island	None	None	None	None	None
Commercial Fisheries	Within tribal fisheries	Within tribal fisheries	Within tribal fisheries	Near tribal fisheries	Near tribal fisheries	Near tribal fisheries	Near tribal fisheries
Recreational Fisheries	Fishery near site	Fishery near site	Fishery near site	Fishery near site	Fishery near site	Fishery near site	Fishery near site; shoreline park
Primary Score Based on Modified SEDRANK Model	Low (0)	High (18)	Low (3)	Medium (6)	Medium (6)	Medium/High (11)	Medium (8)
Modifying Criteria: Resource Management	No effect expected	Localized salmonid habitat benefits	No effect expected	No effect expected	No effect expected	No effect expected	No effect expected
Faster, Better, Cheaper	No effect expected	No effect expected	No effect expected	Multiple use opportunities	Multiple use opportunities	Multiple use opportunities	No effect expected
Economic Vitality	No effect expected	Possible future navigation limitations	Possible future navigation limitations	Possible future development limitations	Possible future development limitations	Possible future development limitations	No effect expected
Potential for Cooperative Sediment Cleanup Projects	No cooperative opportunity identified	Potential WRDA Projects (Corps/Port)	Potential WRDA Projects (Corps/Port)	Port of Seattle Redevelopment (Port/Corps)	Port of Seattle Redevelopment (Port/Corps)	Colman Dock Redevelopment (WDSOT/Port)	No cooperative opportunity identified
OVERALL SITE PRIORITIZATION	Low	High	Low/Medium	Medium/High	Medium/High	High	Medium

Notes:
[a] Only those chemicals that are reasonably associated with CSO discharges are included in this evaluation. Exceedance ratio based on SQS chemical criteria.
[b] All chemicals included.
[c] Based on the estimated areal-weighted average of screening-level near-field and far-field recontamination modeling (Task 900).
[d] Input value adjusted downward to reflect relatively low sediment concentrations measured in the CSO discharge area.
[e] 10-year natural recovery factor calculated using SEDCAM, assuming a 10-cm mixed layer depth.

- **Proximity to special resource areas.** The final set of parameters used in the model referred to the location of the sediment site relative to important ecological and human health exposure areas, including special marine habitats, tribal fisheries, and public access points.

Using the input data described above, the model calculated overall ecological and human health scores, which were added together to obtain a subtotal site score. Subsequently, other qualitative criteria including resource management; faster, better, cheaper; economic vitality; and the potential for cooperative projects were used as modifying criteria, and applied to identify priority sites in cases where the initial site scores were equivalent.

The results of the sediment site scoring, as summarized in Table 2, resulted in the following initial site prioritization (presented in order of descending priority; modified from the original Ecology site ranking):

Higher Priority Sites:

- Duwamish Pump Sta./Diagonal CSO (DR31); and
- King Street CSO (EB27).

Medium Priority Sites:

- Hanford Street CSO (EB8);
- Lander Street CSO (EB7); and
- Denny Way CSO (EB26).

Lower Priority Sites:

- Chelan Avenue CSO (EB13); and
- Brandon Street CSO (DR32).

The initial site prioritization may be refined during the SMP development process as alternative cleanup strategies are considered. Additional factors that may influence the site prioritization include estimated cleanup costs, availability of disposal sites, liability considerations, source control refinement, habitat issues, land owner constraints, and the potential for cooperative projects.

SEDIMENT REMEDIATION ALTERNATIVES

The readily available sediment site characterization data discussed above were also reviewed in the context of potential cleanup options, in order to determine the general scope of practicable remediation alternatives that could be applied to some or all of the seven CSO sediment sites. The initial development of sediment remediation options in this case focused on the more practicable technologies identified from a preliminary review of technical feasibility, implementability, and cost (Task 1000 Technical Memorandum). The more practicable sediment remedial technologies identified from this preliminary assessment included source control/natural recovery (potentially including detailed risk assessment); capping; and dredging with confined disposal. The section presents the initial assembly and analysis of programmatic sediment cleanup alternatives that may be applied to some or all of the CSO sediment sites (Figure 1).

For the purposes of this initial programmatic assessment, five sediment remediation alternatives were considered for the SMP sites:

1. No Action;
2. Source Control/ Natural Recovery with Detailed Risk Assessment;
3. Capping of Contaminated Sediments;
4. Low Range Sediment Removal and Confined Disposal with Capping; and
5. High Range Sediment Removal and Confined Disposal.

Each of these alternatives is briefly described below.

Alternative 1 - No Action

Under this option, potentially responsible parties (PRPs) would not actively pursue any further sediment investigation or cleanup actions at the seven CSO sediment sites. Depending on future developments within the SMP area, there may come a time when PRPs would be required to initiate cleanup actions at one or more of these sites as a part of a formal state MTCA/SMS or federal Superfund enforcement order, or is sued by a third party for cost recovery under either of these laws. However, no such enforcement or cost recovery actions have been initiated to date. Under this alternative, PRPs would simply wait until such time as an action may be brought against them to compel further involvement. Options for participation would be evaluated at that time.

Alternative 2 - Source Control/ Natural Recovery with Detailed Risk Assessment

This alternative would focus on defining whether active sediment cleanup is necessary at any of the seven CSO sediment sites, through the use of detailed contaminant transport modeling and ecological and human health risk assessment. Based on the preliminary

SEDCAM modeling presented above, these more detailed technical evaluations may demonstrate that biological effects criteria would be achieved within the next 10 years through a combination of future source controls and natural recovery processes. An explicit objective of pursuing this alternative may be to obtain a formal determination from Ecology (e.g., in the form of a Cleanup Action Plan) that active remediation at one or more of the seven sites is impracticable within the meaning of MTCA/SMS. Long-term monitoring would be required to demonstrate the success of natural recovery. In the event that Ecology may not concur with this determination, or if monitoring data indicate that cleanup standards are not being achieved, options for further PRP involvement would be evaluated at that time.

Alternative 3 - Capping of Contaminated Sediments

This option would focus on near-term construction of sediment caps at one or more of the seven CSO sediment sites to achieve compliance with state cleanup criteria. The caps would be constructed to a thickness of 1 to 3-feet using proven methods, and may require armoring and/or habitat layers in some cases to ensure long-term performance. The potential for sediment recontamination of the caps would be addressed by contaminant transport modeling ranging from relatively simple updates of near-field (PLUMES) modeling to reflect expected future CSO controls, to more complex contaminant transport modeling (see Task 900 Technical Memorandum). Depending on the results of the modeling, there may be a need to delineate a Sediment Impact Zone (SIZ) in the immediate outfall discharge area. An explicit objective of pursuing this alternative may be to obtain a formal determination from Ecology that no further cleanup actions are required under MTCA/SMS. However, landowner concurrence would likely also be required to achieve this objective. If the caps would encumber federal navigation channels or other harbor areas, landowner concurrence may be difficult, potentially requiring the payment of a significant easement fee. Landowner considerations within the SMP project area are discussed in more detail below.

Alternative 4 – Low Range Removal and Confined Disposal with Capping

The overall objective of this alternative is to rapidly achieve state cleanup criteria at one or more of the CSO sediment sites while maintaining existing and prospective navigation channels, minimizing dredging and disposal of contaminated sediment, and maximizing the areal extent and diversity of intertidal aquatic habitat by using caps and potentially available confined disposal facilities. Contaminated sediments (exceeding SQS criteria) that are located within existing federal navigation channels or are otherwise targeted for near-term navigation or development dredging would be removed under this alternative. Although the action level for sediment removal under this alternative could potentially range from SQS to CSL criteria, the available data suggest that sediments within this range (i.e., between SQS and CSL criteria) would not likely be suitable for unconfined open-water disposal. Thus, residual liabilities associated with confined disposal of these navigation dredging materials may remain if the action level is set too high. For these

reasons, the action level assumed for this alternative was conservatively set at the SQS level. Preliminary areas and volumes of sediment contamination at each site are summarized in Figure 2 and Table 3.

Table 3. Summary of CSO Sediment Site Areas and Depths

CSO Sediment Site	Total Site Area in acres		Estimated Sediment Thickness (ft)
	Above SQS	Above MCUL	
Higher Priority Sites:			
Duwamish/Diagonal SD/CSO (DR31)	8	5	6
King Street CSO (EB27)	20	15	8
Medium Priority Sites:			
Hanford Street CSO (EB5)	15	9	8
Lander Street CSO (EB7)	6	1	8
Denny Way CSO (EB26)	5	0	6
Lower Priority Sites:			
Chelan Avenue CSO (EB13)	4	0.3	6
Brandon Street CSO (DR32)	1	0	6
SUBTOTAL	**59**	**30**	

As presented in Figure 3 and Table 4, sediment removal under Alternative 4 would likely occur primarily within the Hanford Street CSO footprint (190,000 CY), and secondarily within the footprints of the Lander Street CSO (50,000 CY), Duwamish/Diagonal CSO (20,000 CY), and Chelan Avenue CSO sites (20,000 CY). All of these removal footprints occur within the Duwamish or East Waterway federal navigation channels, or otherwise within adjacent areas of the forthcoming East Waterway navigation improvement projects (Stage I and II; target removal depth of 51 feet MLLW). The removal volume associated with the Hanford and Lander Street CSO footprints (240,000 CY) already appears to be targeted by the Port of Seattle for Stage II dredging and disposal. This volume is also slightly more than half of the total volume of Stage II sediments estimated to be unsuitable for open-water disposal (460,000 CY), and thus requiring containment. Based on a preliminary review of existing information, capping of all other CSO sediment site areas could be performed in a manner that would be consistent with current site development and land use plans, though easements may be required.

Table 4. Summary of Remedial Alternative Actions

CSO Sediment Site	Sediment Remediation Alternative Actions						
	Alternative 1	Alternative 2	Alternative 3	Alternative 4 Low Removal		Alternative 5 High Removal	
	No Action	Natural Recovery	Capping (acres)	Capping (acres)	Removal (CY)	Capping (acres)	Removal (CY)
Higher-Priority Sites							
Duwamish/Diagonal SD/CSO (DR31)	X	X	5 – 8	5	20,000	0	70,000
King Street CSO (EB27)	X	X	15 – 20	15 – 20	0	7 – 11	110,000
Medium-Priority Sites							
Hanford Street CSO (EB5)	X	X	9 – 15	0	190,000	0	190,000
Lander Street CSO (EB7)	X	X	1 – 6	0	50,000	0	50,000
Denny Way CSO (EB26)	X	X	0 – 4	0 – 4	0	0	40,000
Lower-Priority Sites							
Chelan Avenue CSO (EB13)	X	X	0.3 – 4	0.2 – 2	20,000	0	40,000
Brandon Street CSO (DR32)	X	X	0 – 1	0 – 1	0	0	10,000
SUBTOTAL			**31 – 61**	**20 – 37**	**280,000**	**7 – 11**	**500,000**
Possible Disposal Sites							
Port of Seattle: Slip 27 nearshore fill					260,000		260,000
Option A—Crowley: Slip 4 confined aquatic disposal (& habitat)					20,000		–
Option B—Multi-user disposal site: Elliott Bay confined aquatic disposal					280,000		500,000
Option C—Roosevelt Landfill (or equivalent)					280,000		500,000

Missing Figure 3

Plan View of Alternative 4 Low Range Removal

This initial programmatic assessment considered a "short list" of representative sediment disposal sites that have previously been considered in other regional cleanup evaluations. The following list of reports contain relevant disposal site evaluations that were included as part of this review:

- Technical Appendix B-1: Aquatic Cleanup Feasibility Study, Southwest Harbor Cleanup and Redevelopment Project Draft Environmental Impact Statement, Parametrix, January 1994;

- Final Remedial Design Investigation Data Report for the Lockheed Shipyard No. 1 Sediment Operable Unit, Hartman Consulting, September 1998;

- Puget Sound Confined Disposal Site Study: Programmatic NEPA/SEPA Environmental Impact Statement, Preliminary Draft, U.S. Army Corps of Engineers and Washington Department of Ecology, October 1998; and

- Unpublished design memoranda on file at Anchor Environmental.

Based on the available disposal site reviews, one of the most promising sediment disposal facilities for Alternative 4 is the Slip 27 nearshore confined disposal facility (CDF) alterative currently being evaluated in the Corps and Port of Seattle East Waterway Deepening Project EIS. A nearshore CDF constructed at this location in the East Waterway (Figure 3) could convert intertidal and subtidal areas into upland property. Dredged sediments would be transported to the CDF site typically by barge, and placed within a constructed berm to an elevation such that the sediments confined at the site will remain saturated. Keeping the contaminated sediments saturated reduces the contaminants' mobility, thus enhancing the protectiveness of the disposal site. The sediments would then be covered with a layer of clean material, filling in the site to surrounding upland elevations for subsequent use as marine industrial land.

The Slip 27 nearshore CDF alternative has an estimated capacity of approximately 460,000 CY, incorporating prospective disposal site improvements. The Port of Seattle owns the upland and aquatic areas surrounding Slip 27, while the subtidal area consists of City of Seattle right-of-way. The land area created by the CDF has been identified as needed for expansion of a container handling area by connecting Terminals 25 and 30 in the Port of Seattle's Container terminal Development Plan (Port of Seattle, 1991). Creating a nearshore CDF would therefore be consistent with upland development plans. However, a nearshore CDF constructed at this location would require substantial habitat mitigation for the filling of aquatic lands. Other Port properties within the Duwamish Estuary are available to provide habitat restoration opportunities.

Under Alternative 4, the total estimated volume of sediments removed as part of the CSO site remediation (280,000 CY) may be able to be disposed at Slip 27, representing a 10 percent increase in disposal volumes above the Port's current Stage II proposal. The Port is presently working through applicable environmental review processes to evaluate the Slip 27 nearshore fill facility as part of its Stage 2 navigation improvement of the East Waterway. Under this alternative, King County would partner with the Port to achieve multiple objectives within the SMP area including sediment cleanup, disposal,

redevelopment, and habitat mitigation/restoration. However, if the Slip 27 fill alternative is not accepted by the regulatory agencies, there are several additional options (with progressively increasing costs) that may be considered, including:

- **Option A – Slip 4 Supplement.** The first option to consider is a supplement to the Slip 27 nearshore CDF proposal to include additional disposal and habitat mitigation and/or restoration by constructing a confined aquatic disposal facility (CAD) at Slip 4 in the upper Duwamish Estuary (Figure 3). The Slip 4 CAD facility could also provide needed sediment disposal capacity for the local landowner (Crowley), and would concurrently accomplish remediation of some of the most contaminated sediments in the Duwamish Estuary (the regional PCB "hotspot"; NOAA, 1998). Equally important is that the Slip 4 contaminated sediments would be covered with a layer of clean material and the subtidal area raised to intertidal conditions to provide highly productive mudflat habitat. Because of its location, the Slip 4 CAD would provide critical feeding and rearing habitat for important fisheries resources, including endangered juvenile Chinook salmon outmigrants from the Green River.

- **Option B – MUDS Alternative.** A second option is to dispose of the Alternative 4 sediments in a possible regional multi-use disposal site (MUDS) located in Elliott Bay or elsewhere in Puget Sound. The Corps of Engineers and Ecology are currently completing a programmatic SEPA/NEPA EIS, with WDNR and EPA as cooperating agencies, that evaluates the potential environmental impacts from a wide range of regional sediment MUDS alternatives. Once the programmatic EIS is completed, one or more embayments in Puget Sound will be selected for a site-specific EIS. These site-specific EISs will evaluate the environmental impacts of implementing one or more MUDS alternatives at a specific location. At this point in time, there is no guarantee that Elliott Bay will be chosen for one of the initial site-specific EISs. The Draft EIS states that the most logical location for the first MUDS site would be Central Puget Sound because of the proximity of high volumes of contaminated sediment. Potential MUDS locations have been identified within Elliott Bay, including the Lockheed nearshore aquatic area (concurrently creating valuable intertidal and subtidal aquatic habitat), and several deep-water (150 to 200-foot depth) sites in the middle of the bay. All of these lands are owned by the State and managed by WDNR. The MUDS locations may also overlap with the Puget Sound Dredge Disposal Area (PSDDA) boundary and perimeter lines, and may be difficult to construct. Nevertheless, the MUDS program may provide a suitable backup to the disposal alternatives currently being evaluated by the Corps and Port, and/or Slip 4 CAD options discussed above.

- **Option C – Roosevelt Landfill.** Although characterized by higher costs, a final option that could be considered for the disposal of sediments under Alternative 4 is upland landfilling. To dispose of dredged sediments in an upland site, the sediments will generally require dewatering for the facility's acceptance. Because of its approximately 3 million ton per year capacity with 35 years of capacity remaining, the Roosevelt Landfill located approximately 210 miles southeast of Seattle in Goldendale, Washington (Klickitat County) is the upland landfill most often considered for this purpose. The Regional Disposal Company (Rabanco) manages the landfill and operates a rail transport station at Third and Lander Streets in Seattle.

Dewatered sediments can be loaded onto containers and transported by truck to the rail transport station, where the containers can be loaded onto rail cars and transported to the landfill. An option to the Roosevelt Landfill is the Columbia Ridge Landfill and Recycling Center located in Arlington, Oregon, approximately 255 miles south of Seattle and 140 miles east of Portland, Oregon. Both facilities charge similar tipping fees.

The primary elements of the Alternative 4 action, including the various disposal options, are summarized in Table 4. Sediment capping would be used (as generally described in Alternative 3 above) in those areas of the CSO sediment site footprint that are not located within the federal navigation channels, or within adjacent areas of the East Waterway Stage I and II navigation improvement project. Nevertheless, if the caps encumber these harbor areas, landowner concurrence may require the payment of an easement fee (see below). The potential for sediment recontamination of the capping and dredging areas would also need to be addressed through contaminant transport modeling and/or SIZ determinations (see Alternative 3 discussion above).

Alternative 5 – High Range Removal and Confined Disposal

In contrast to the other alternatives, the overall objective of Alternative 5 is to rapidly achieve state cleanup criteria at one or more of the CSO sediment sites, allowing for unencumbered future navigation deepening of the navigation channels. Unlike Alternative 4, minimizing dredging and disposal volumes is not a primary objective of Alternative 5. In this case, all contaminated sediments (exceeding SQS criteria) that are located within designated harbor areas would be removed and disposed in a regional containment facility. Although the action level for sediment removal under this alternative could potentially range from SQS to CSL criteria, the action level assumed for this alternative was conservatively set at the SQS level, consistent with the Alternative 4 discussion above.

As summarized in Figure 4 and Table 4, sediment removal under Alternative 5 could occur at all CSO sediment sites, including the Hanford Street CSO (190,000 CY), King Street CSO (110,000 CY), Denny Way CSO (90,000 CY), Duwamish/Diagonal CSO (70,000 CY), Lander Street CSO (50,000 CY), Chelan Avenue CSO (40,000 CY), and Brandon Street CSO (10,000 CY). The only area that would be capped would be at those nearshore locations within the King Street CSO footprint that are not located on state-owned aquatic lands (7 to 11 acres). The Port of Seattle currently owns these lands in fee.

As discussed above, this initial programmatic assessment considered a short list of representative sediment disposal sites that have previously been considered in other regional cleanup evaluations. Since one of the most promising sediment disposal facilities is the Port of Seattle's Slip 27 nearshore CDF alternative in the East Waterway, this CDF may also be utilized in Alternative 5. However, the total estimated volume of sediments removed as part of the CSO site remediation (560,000 CY) would exceed the Slip 27

Missing Figure 4

Plan View of Alternative 5 High Range Removal

disposal capacity by approximately 200,000 CY, even when supplemented with Slip 4 (see Option A of Alternative 4 above). Therefore, under this alternative, King County would either need to partner with the MUDS program to obtain the additional disposal capacity, or utilize relatively expensive upland disposal facilities.

The primary elements of the Alternative 5 action, including the various disposal options, are summarized in Table 4. The potential for sediment recontamination of the capping and dredging areas would also need to be addressed through contaminant transport modeling and/or SIZ determinations (see Alternative 3 discussion above).

Preliminary Cost Estimates

A preliminary cost estimate was developed for each of the remedial alternatives described above. The cost estimates considered the full range of prospective costs associated with cleanup, including studies (e.g., filling data gaps), engineering, construction, monitoring, land easements/encumbrances, and mitigation. The following items were included in the preliminary cost estimates:

- Contaminant transport modeling (see Task 900 Technical Memorandum);
- Risk assessments (human health and ecological assessments similar to those performed as a part of the WQA; Parametrix and King County, 1998);
- Remedial investigations/feasibility studies (consistent with MTCA and SMS requirements);
- Cleanup Action Plans and Consent Decrees (including attorneys fees);
- Remedial design and engineering (including detailed engineering studies as may be required, final permitting, and plans and specifications documents);
- Mobilization/demobilization (generally estimated at 5 percent of construction costs);
- Remedial construction (capping, dredging, and disposal, including habitat and property mitigation);
- Construction monitoring/management (generally estimated at 10 percent of construction costs);
- Site acquisition and easement (including encumbrance fees; see below);
- Long-term monitoring;
- Contingency (assumed at 30 percent of the cost subtotal);
- Owner management (legal and administrative; generally estimated at 10-15 percent of construction); and
- Sales tax

The preliminary cost estimates developed for this technical memorandum are summarized in Table 5 and a detailed planning level cost estimate for the preferred alternative is presented in Table 6. All costs were estimated based on Anchor Environmental's review of similar recent remedial design and/or construction projects within the Puget Sound region (e.g., Elliott Bay/Duwamish River; Eagle Harbor; Sitcum Waterway; Thea Foss Waterway; Hylebos Waterway; Bellingham Bay), consistent with relevant agency guidance (e.g., EPA, 1994). For in-water options (i.e., excluding upland landfill disposal), the estimated total costs for the various cleanup alternatives ranged from approximately $26 to $36 million. If upland disposal were determined to be necessary, the upper-bound cost estimate could approach $75 million.

It is apparent from the Table 5 summary that site acquisition and/or easement costs may be a significant component of the overall cleanup costs, particularly for those alternatives that leave contaminated sediments in-place, and also depending on landowner and operator requirements. The long-term costs of property easements for sediment containment (*in situ* and at prospective disposal sites), particularly on state-owned aquatic lands and sediments that occur throughout the SMP area, are difficult to estimate and can vary widely depending on specific circumstances. Property owners and managers, including WDNR and the Port, may charge for long-term easements on their land in those cases where the cleanup or disposal action would reduce the value of the land to the owner.

On a case-by-case basis, the various fees and costs could be reduced or waived if the project(s) meet the interests of the landowners and makes them "whole". In the case of the state, these landowner interests are generally set forth in DNR's land management regulations and Public Trust Doctrine (see below). Other property would likely make similar landowner interest determinations.

Aquatic Land Management Laws and Public Trust Doctrine

Following a finding of the state legislature that: "This (1984) legislature finds that state-owned aquatic land is a finite natural resource of great value and irreplaceable public heritage" (RCW 79.90.450), management of state-owned aquatic lands and sediments must be in accordance with constitutional and statutory requirements. It must also strive to provide a balance of varied public benefits for all citizens of the state, including (RCW 79.90.455):

1. Encouraging direct public use and access;
2. Fostering water-dependent uses;
3. Ensuring environmental protection;
4. Utilizing renewable resources; and
5. Generating revenue in a manner consistent with these benefits (economics).

Consistent with these objectives, WDNR strives to manage state-owned aquatic lands to maximize overall public benefits, also recognizing the finding of the state legislature that

Table 5. Summary of Remedial Alternative Cost Estimates

Cost Item	Sediment Remediation Alternatives				
	Alternative 1 No Action	**Alternative 2 Natural Recovery**	**Alternative 3 Capping**	**Alternative 4 Low Removal**	**Alternative 5 High Removal**
1. Contaminant Transport Modeling	$0	$500,000	$100,000	$100,000	$100,000
2. Detailed Risk Assessments	$0	$1,000,000	$0	$0	$0
3. Remedial Investigation/Feasibility Studies	$0	$1,000,000	$500,000	$1,000,000	$1,000,000
4. Cleanup Action Plans/Consent Decrees	$0	$400,000	$400,000	$200,000	$200,000
5. Remedial Design/Engineering	$0	$0	$400,000	$1,500,000	$2,000,000
6. Mobilization/Demobilization	$0	$0	$200,000	$700,000	$700,000
7. Construction of Sediment Caps	$0	$0	$3,000,000	$2,000,000	$500,000
8. Sediment Dredging	$0	$0	$0	$1,000,000	$2,000,000
9. Confined Disposal and Mitigation:					
a. Slip 27 CDF and/or Slip 4 CAD Option	$0	$0	$0	$9,000,000	$9,000,000
b. MUDS Option (cost increment)	$0	$0	$0	$2,000,000	$10,000,000
c. Upland Landfill Option (cost increment) [(a)]	$0	$0	$0	($20,000,000)[(a)]	($40,000,000)[(a)]
10. Construction Monitoring/Management	$0	$0	$300,000	$1,000,000	$2,000,000
11. Land Encumbrances/Easements [(b)]	$0	$15,000,000	$15,000,000	$6,000,000	$0
12. Long-term Monitoring	$0	$2,000,000	$1,000,000	$500,000	$200,000
13. Contingency (30%)	$0	$6,000,000	$6,000,000	$7,000,000	$8,000,000
TOTAL ESTIMATED COST [(a)]	**$0**	**$26,000,000**	**$27,000,000**	**$32,000,000**	**$36,000,000**
Cost-Sharing Opportunities	none	none	small (0-20%)	large (50%+)	medium (20-50%)

Notes:

[(a)] Incremental costs associated with the unlikely upland landfill disposal option are not included in the total estimated costs.

[(b)] Estimated based on preliminary land valuation concepts (see text).

Table 6. Summary of Planning-Level Costs Associated with the Recommended Remedial Alternative

Cost Item	Alternative 4 - Limited Removal with Cost-Effective In-Water Disposal							
	Duw/Diag	King	Hanford	Lander	Denny	Chelan	Brandon	**TOTAL**
1. Transport Modeling/Phthtalate Studies	$150,000	$150,000	$100,000	$50,000	$50,000	$50,000	$50,000	$600,000
2. Detailed Risk Assessments	$0	$0	$0	$0	$0	$0	$0	$0
3. Remedial Investigation/Feasibility Studies	$0	$100,000	$100,000	$100,000	$0	$100,000	$50,000	$450,000
4. General Planning, CAPs & Consent Decrees	$250,000	$100,000	$250,000	$150,000	$50,000	$150,000	$50,000	$1,000,000
5. Remedial Design/Engineering	$80,000	$80,000	$580,000	$150,000	$20,000	$70,000	$5,000	$1,000,000
6. Mobilization/Demobilization	$50,000	$0	$480,000	$120,000	$0	$50,000	$0	$700,000
7. Construction of Sediment Caps	$300,000	$1,100,000	$0	$0	$310,000	$100,000	$60,000	$1,900,000
8. Sediment Dredging	$70,000	$0	$680,000	$180,000	$0	$70,000	$0	$1,000,000
9. Confined Disposal and Mitigation:	$0	$0	$0	$0	$0	$0	$0	$0
a. Slip 27 CDF and/or Slip 4 CAD Option	$600,000	$0	$6,500,000	$1,700,000	$0	$700,000	$0	$9,500,000
b. MUDS Option (cost increment)	$100,000	$0	$1,400,000	$400,000	$0	$100,000	$0	$600,000
c. Upland Landfill Option (cost increment) [(a)]	$0	$0	$0	$0	$0	$0	$0	$0
10. Construction Monitoring/Management	$70,000	$0	$700,000	$200,000	$0	$70,000	$0	$1,000,000
11. Land Encumbrances/Easements [(b)]	$0	$0	$0	$0	$0	$0	$0	$0
12. Long-term Monitoring	$100,000	$150,000	$100,000	$100,000	$100,000	$100,000	$50,000	$700,000
13. Contingency (30%)	$530,000	$520,000	$3,100,000	$850,000	$160,000	$460,000	$60,000	$5,700,000
TOTAL ESTIMATED COST [(a)]	$2,300,000	$2,200,000	$13,000,000	$4,000,000	$700,000	$2,000,000	$300,000	$24,000,000

NOTES:
(a) Incremental costs associated with the unlikely upland landfill disposal option are not included in the total estimated costs.
(b) Estimated based on preliminary land valuation concepts (see text).

dredged material "disposal sites are essential to the commerce and well being of the citizens of the State of Washington" (RCW 79.90.550). Although specific decision criteria for disposal site selection have not yet been developed for Elliott Bay, in making its public interest determination, WDNR assesses whether the action is clearly in the long-term interest of the public and how the cleanup and/or disposal action fits into the vision for the entire bay. Investments in navigation and commerce along harbor areas and waterways will be maintained to provide for economic growth, and to avoid development elsewhere. Finally, the full costs will be evaluated as part of WDNR's public interest determination, including habitat restoration.

Because of the complexities of landowner interest determinations, the long-term costs of property easements for leaving contaminated sediments in place or contained within disposal facilities, including state-owned aquatic lands and sediments, is difficult to estimate. Nevertheless, since these costs can become very large (e.g., Thea Foss Waterway CAD site), it is important to consider their potential ramifications early in the SMP process. Accordingly, based on application of preliminary land valuation concepts to the SMP area, and considering recent WDNR policy developments and case histories (including Thea Foss Waterway), a preliminary easement cost of $\$15/ft^2$ was assumed if contamination were to be left in federal navigation channels, and a cost of $5/ft^2$ was assumed if contamination were to be left on other state-owned harbor lands.

COOPERATIVE PROJECT OPPORTUNITIES

A variety of cooperative project and funding opportunities exist that may be used by PRPs to defray at least a portion of the cleanup costs. Several of the more important opportunities are summarized below.

Navigation Improvement Projects

Seattle Harbor's chief anchorage is Elliott Bay. The U.S. Army Corps of Engineers (Corps) maintains three waterways at the southern end of Elliott Bay. The East and West Waterways parallel Harbor Island. Both channels are currently authorized to a depth of 34 feet MLLW. The shallower Duwamish Waterway is a continuation of the West Waterway, extending about 5 miles upstream. The Duwamish Waterway was completed in 1931 and has served as a primary commerce pathway ever since.

For the past 20 years, the Corps and the Port of Seattle have been considering deepening the East and West Waterways, and deepening and widening the Duwamish Waterway. The final Feasibility Report and Environmental Impact Statement for these proposed actions were completed in January 1983. Thereafter, navigation improvements of the waterways were recommended to Congress. The Seattle District of the Corps initiated preconstruction engineering and design (PED) studies in October 1984 following receipt of congressional funding. Congress in PL 99-662 authorized construction of the project; however, PED was deferred in 1986 at the request of the Port of Seattle, the local sponsor.

Over the last several years, the Corps and Port have focused their navigation improvement efforts on the East Waterway, which is a critical element of the Port's Container Terminal Development Plan (Port of Seattle, 1991). Stage I of the East Waterway project, resulting in the dredging of key approach channels and berthing areas near Harbor Island to a depth of 51 feet MLLW, is expected to be completed within approximately 1 year (Stage I dredging areas are depicted on Figure 2). Stage II of the project, which will include dredging of most of the rest of the East Waterway (including nearly all of the Hanford and Lander Street CSO footprints), is currently in the design phase. Because of the substantial overlap between these projects, Stage II of the East Waterway navigation improvement project is a significant cooperative project opportunity for the King County SMP. Removal Alternatives 4 and 5 were developed to be consistent with this opportunity.

Water Resources Development Act (WRDA) Funding Opportunities

In addition to direct cooperation with the Port of Seattle for navigation improvement projects, as described above, there is also federal Water Resources Development Act (WRDA) funding authorities that are potentially available to assist in the implementation of the SMP. Consistent with the overall mission of the U.S. Army Corps of Engineers and with the intent of the current WRDA regulation as amended by Congress, federal funding assistance is potentially available for general navigation features (Section 101; e.g., Duwamish Waterway navigation channel maintenance) and for a range of environmental improvement projects (Section 201 through 210). Additional WRDA authorities are potentially available to provide further civil works assistance such as for flood control, though such authorities are likely not applicable to the SMP.

Section 101 - General Navigation Features (O&M)

This is the "traditional" dredging and disposal authority that includes new construction (Section 101[a]) as well as operation and maintenance (O&M) of federally authorized navigation channels (Section 101[b]). Since several of the CSO sediment sites are located within federally authorized navigation channels (e.g., Duwamish/Diagonal CSO footprint), existing O&M authorities (Section 101[b]) can be readily applied within this area, subject to funding conditions. Typically, the Corps includes up to 2 feet of overdredging below the authorized channel. Under some project conditions, additional advance maintenance dredging of up to another 2 feet may also be included. This overdepth allowance would generally remove most of the contaminated materials present within the CSO footprints in the navigation channels.

The costs of dredging, disposal, and long-term operation and maintenance of a Section 101 general navigation project are shared between the Corps (federal sponsor) and a qualified non-federal sponsor (typically a state, county, port, or local entity) in accordance with current cost sharing provisions and formulas. Based on the range of authorized depths present in the SMP area, the current federal share of a general navigation project would be approximately 70 percent, while the non-federal share would be approximately 30 percent.

The basis for federal involvement in a waterway dredging project is the statutory authorization that is typically contained in an omnibus public works act. However, this authorization is not a mandate, it merely gives the Corps a basis for proceeding. The legislation authorizes the government to undertake and maintain the project but it is not legally required to do so unless:

- The local sponsor discharges its statutory obligations;
- There is a need for the maintenance activity; and
- The project remains economically justified.

Prior to the 1996 WRDA Amendments (e.g., see Sections 201 through 207 below), the least-cost disposal site was normally selected for all general navigation projects. Typically, the open-water, dispersive Puget Sound Dredge Disposal Analysis (PSDDA) site was commonly used for this purpose. The Corps would likely budget on the order of $4/CY for a project of this nature.

In order for the project to be authorized, the national economic development (NED) benefits resulting from the action must exceed the total cost of the project. In making this determination, the Corps estimates the present worth value of increased navigation and commerce over a 50-year project life. It is not yet clear whether NED benefits outside the East Waterway would justify the project costs under a Section 101(b) authority. The total cost of the project must also fall within the authorized Corps O&M budget. These determinations would need to be made by the Corps and Congress following a feasibility analysis. Section 101(b) appropriations in this case may also be added to the other authorities, as outlined below.

Section 201 – Cost Sharing For Dredged Material Disposal Areas

The 1996 WRDA Amendments modified the earlier cost sharing provisions to include a consistent role for federal participation in dredged material disposal facilities, including CAD and/or upland facilities. Specifically, the definition of projects eligible for federal authorization and cost sharing now includes the construction and operation/maintenance of those dredged material disposal facilities that are necessary for general maintenance dredging (i.e., Section 101[b] projects), given the following project conditions:

- Dredging and disposal of contaminated sediments which are in the navigation channel or which may affect maintenance of such channel;

- Mitigating the effects of operation and maintenance of navigation channels (such as the erosion of shoreline and beaches; potentially also including habitat impacts); and

- Operation and maintenance of dredged material disposal facilities.

These project conditions suggest that sediment disposal facility alternatives under consideration for the SMP area may be eligible for federal authorization and cost sharing. Under the 1996 WRDA Amendments, the costs of constructing, operating, and maintaining these disposal facilities, including diking and other improvements necessary for proper disposal, would be shared in accordance with the cost sharing established for general navigation features by Section 101 (see above). Based on the range of authorized depths present in the SMP area, the current federal share of a general navigation project would be approximately 70 percent, while the non-federal share would be approximately 30 percent. However, in order for the project to be authorized, the NED benefits resulting from the action (e.g., combining the present worth value of increased navigation and commerce and environmental restoration over a 50-year project life) must exceed the total cost of the project. The total cost of the project must also fall within the authorized Corps O&M budget. Although these determinations would be made by the Corps and Congress following a feasibility analysis, preliminary discussions with the Seattle District

suggest that the authorized O&M budget is relatively limited, and not sufficient to fund such actions. The Corps has issued Policy Guidance Letter No. 47 to further explain Corps policy regarding cost sharing for dredged material disposal facilities and partnerships.

Section 204 – Restoration of Environmental Quality

This section expands the authority provided in Section 1135 of WRDA (1986) to allow implementation of environmental quality restoration projects in those situations where the project constructed by the Corps has contributed to the degradation of the quality of the environment, and the measures do not conflict with authorized project purposes. This provision provides the authority for the Secretary to undertake restoration when the Secretary determines that operation of the project has contributed to the degradation of the quality of the environment. The share of the cost of such measures shall be 25%/75% non-Federal / Federal and no more than $5 million may be spent from Federal funds on any single restoration project. Congress has stated that a good example of a high priority area that may receive environmental restoration funding under this authority is the Duwamish River, which has been heavily altered as a result of a variety of Corps operations including dams, levees, and navigation channels.

Section 205 – Environmental Dredging (Section 312 Of WRDA 90)

Section 312 of the 1990 WRDA established a 5-year program to allow the Corps of Engineers to perform dredging in and adjacent to navigation channels for environmental purposes if costs are appropriately shared by non-Federal interests (typically on a 50-50 basis), and if justified based on benefit-cost analyses. Section 205 of the 1996 WRDA amended WRDA 90 Section 312 by authorizing the Secretary to remove as well as remediate contaminated sediments. The annual funding level was also increased from $10 million to $30 million, and removed the sunset that existed in the 1990 act. Congress also included five areas as priorities for Section 205 appropriations, including the Ashtabula River in Ohio. The applicable authorities under this section include:

- Section 312(a) of the 1990 WRDA states that contaminated sediment outside the boundaries of and adjacent to the navigation channel may be removed as part of operation and maintenance of a navigation project. The justification for this is that the removal of contaminated sediment from areas immediately adjacent to the navigation channel may reduce the cost of future navigation dredging. The federal share for 312(a) dredging in this case is 100%, but no federal involvement is authorized for disposal or O&M of these materials. There would also be a requirement to demonstrate commensurate environmental/economic benefits, primarily by avoiding the future use of additional confined disposal facilities, and to ensure consistency with Policy Guidance Letter No. 49 (see below).

- Section 312(b) of the 1990 WRDA states that contaminated sediment may be removed from navigable waters of the United States for the purpose of environmental

enhancement and water quality improvement. The cost share for 312(b) is 50-50 for dredging, and no federal involvement is authorized for disposal or O&M of these materials. It is important to note that much of the prospective WRDA funding for the Ashtabula Partnership project is tied to Section 312(b) authorities, since the Partnership successfully demonstrated that dredging of these areas would result in relatively large environmental/economic benefits. However, a big difference between the Ashtabula and SMP areas is that there was no CERCLA or state cleanup authority that applied to most of the Ashtabula project area, whereas state SMS/MTCA and potentially also federal Superfund cleanup requirements do apply to the SMP area. This issue is discussed in more detail relative to the Corps' Policy Guidance Letter 49 (see below).

- Section 312(d) of the 1990 WRDA states that the cost of disposal of contaminated sediment removed under this section shall be a non-federal responsibility.

Policy Guidance Letter No. 49 (PGL 49)

On January 28, 1998 the U.S. Army Corps of Engineers issued Policy Guidance Letter No. 49. This policy stated that the authorities of Section 312 of WRDA 90 (Section 205 of WRDA 96) will not be used to remove or remediate contaminated sediment from a site designated by EPA or a state for a response action under CERCLA, or if they are part of a NPL site under CERCLA.

Shortly after the initial release of the Corps' PGL 49, on February 6, 1998 members of Congress sent a letter to General Ballard, Commanding General of the Corps of Engineers stating:

> *"Unfortunately, we believe PGL 49 as it is currently written is overly restrictive and negates the effectiveness of Section 312. The current language would prohibit the use of the authority if a CERCLA or state response action had been designated. Section 312 directs the Secretary of the Army to give priority to the Ashtabula and Lower Fox Rivers, where the U.S. EPA has developed the basis for a CERCLA or state administered response. Section 312 authority could be used to facilitate the complete and brisk removal of contaminated sediments on a voluntary basis while preserving the rights of the federal and state governments."*

The General responded in March 1998 and concluded that the original PGL 49 prohibiting the use of Section 312 authority for CERCLA designated sites was appropriate for the following reasons:

- Limited Corps budgets are not adequate to provide up-front funding of the high costs incurred in the cleanup of aquatic CERCLA designated sites;

- Advance removal of sediment from CERCLA sites weakens the "polluter pays" principle of CERCLA; and

- The Corps may be exposed to liability associated with the removal, transport and disposal of contaminated sediment.

Because most of the SMP area has not been designated a CERCLA/NPL site, PGL 49 may not be directly applicable to the CSO sediment sites. However, substantive concerns raised by the General may still need to be addressed to secure Section 205 appropriation in this case. For example, the use of WRDA funds would likely need to preserve the "polluter pays" principle of MTCA (which is similar to CERCLA). This could potentially be accomplished by limiting the authority of Section 205 to only those actions that are above and beyond normal cleanup requirements. In addition, an appropriate hold harmless agreement may be required from Ecology to release the Corps from potential MTCA liability associated with the removal, transport and disposal of contaminated sediments related to application of the environmental dredging authority. Indemnification language currently being drafted by EPA and the Corps for possible application of WRDA environmental dredging authorities at the Commencement Bay Nearshore/Tideflats Superfund Site may aid in resolution of such a hold harmless agreement.

As discussed above, WRDA requires a suitable demonstration of commensurate environmental and economic benefits to justify environmental dredging costs. In the case of Section 312(a), these benefits include avoiding the future use of additional confined disposal facilities, at potentially great cost. Other economic benefits would also result from application of the environmental dredging authority in this case, including improved navigation and commerce within the deepened waterways, and facilitating substantial habitat restoration efforts associated with the CADs (see above). Thus, there may be ample economic justification for appropriation of environmental dredging funds to the SMP area.

Section 206 – Aquatic Ecosystem Restoration

This provision enables the Secretary to carry out ecosystem restoration and protection projects when the Secretary determines that such projects will improve the quality of the environment, are in the public interests, and are justified based on monetary and non-monetary benefits. Congress determined that there is a need for ecosystem restoration projects that involve manipulation of the hydrology but which are not linked to existing Corps civil works projects. The non-Federal share of costs is 50% for construction and 100% for operation and maintenance. No more than $5 million in Federal funds may be allotted to a project in any single locality. This section authorizes $25 million annually to carry out this section. Unlike some of the other WRDA environmental authorities (i.e., Section 201 through 205), Section 206 appropriations have been made for various habitat restoration projects within the Seattle District.

In 1995, a reconnaissance study was initiated by the Corps on ecosystem restoration in the Duwamish/Green River Basin. The reconnaissance study investigated 54 restoration sites throughout the basin. King County is the sponsor of the study and the study. Thus, there may be ample justification for appropriation of aquatic ecosystem restoration funds

to the SMP area, particularly when applied to a combined Slip 4 CAD and habitat restoration project.

Section 207 – Beneficial Uses of Dredged Material

This section increases the flexibility of the Secretary to select a disposal method for dredged material generated by a navigation project that may result in additional environmental benefits, despite the fact that such a method may not be the least-cost option. In cases where there are significant benefits to the environment, such as the creation of wetlands or the restoration of eroded shoreline, and where added costs are minimal, the Secretary may pursue other than least-cost options. Section 207 of WRDA 96 amended the earlier Section 206 of WRDA 92 so that the incremental costs of disposal to achieve environmental benefits, over and above the least-cost option, are shared between federal and non-federal sponsors as follows: construction – 75% federal; and O&M – 0% federal. Depending on the cleanup alternative, Section 207 may be potentially applicable to the SMP action(s), or it may be used as further justification to apply the other available authorities outlined above (i.e., Sections 101(b), 205, and 206).

Section 209 – Cost Recovery

This section requires that monies recovered under section 107 of CERCLA for response actions undertaken by the Secretary, as well as other cost recoveries for environmental response activities, be credited to the trust fund account that paid or will pay for the response action. There are instances where the Corps finds itself faced with cleaning up civil works properties that are contaminated with hazardous or toxic substances by other parties. In such instances, the Secretary can seek recovery from the responsible party under subsection 107 of CERCLA. This provision, which is similar to authority provided to the Secretary of Defense under the Defense Environmental Restoration Program, would enable a direct credit of the amount recovered to the trust fund account from the cost of the cleanup had been taken or will be used.

Section 210 – Cost Sharing of Environmental Projects

This section establishes a 50% non-Federal share for costs of environmental protection projects, applicable to projects authorized after the date of enactment. WRDA 1990 established environmental protection as one of the missions of the Corps of Engineers. Section 103 of WRDA 1986 set forth the cost sharing formulas for water resources development projects, but did not include a cost sharing formula for environmental protection and restoration projects. This new (WRDA 96) provision creates a consistent cost sharing formula of 50-50 Federal/non-Federal responsibility for the costs of projects for environmental protection and restoration that could be applied to the various authorities for the Corps to carry out such projects.

A likely scenario for federal participation in the SMP would be that the Corps would perform all dredging within the federal channel areas, and would transport these materials to CDF and/or CAD facilities constructed and maintained by the PLPs (e.g., Port and King County). Under WRDA, the Corps may also be responsible for the development and adaptive management of habitat restoration components of the overall action(s), such as the Slip 4 mudflat.

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