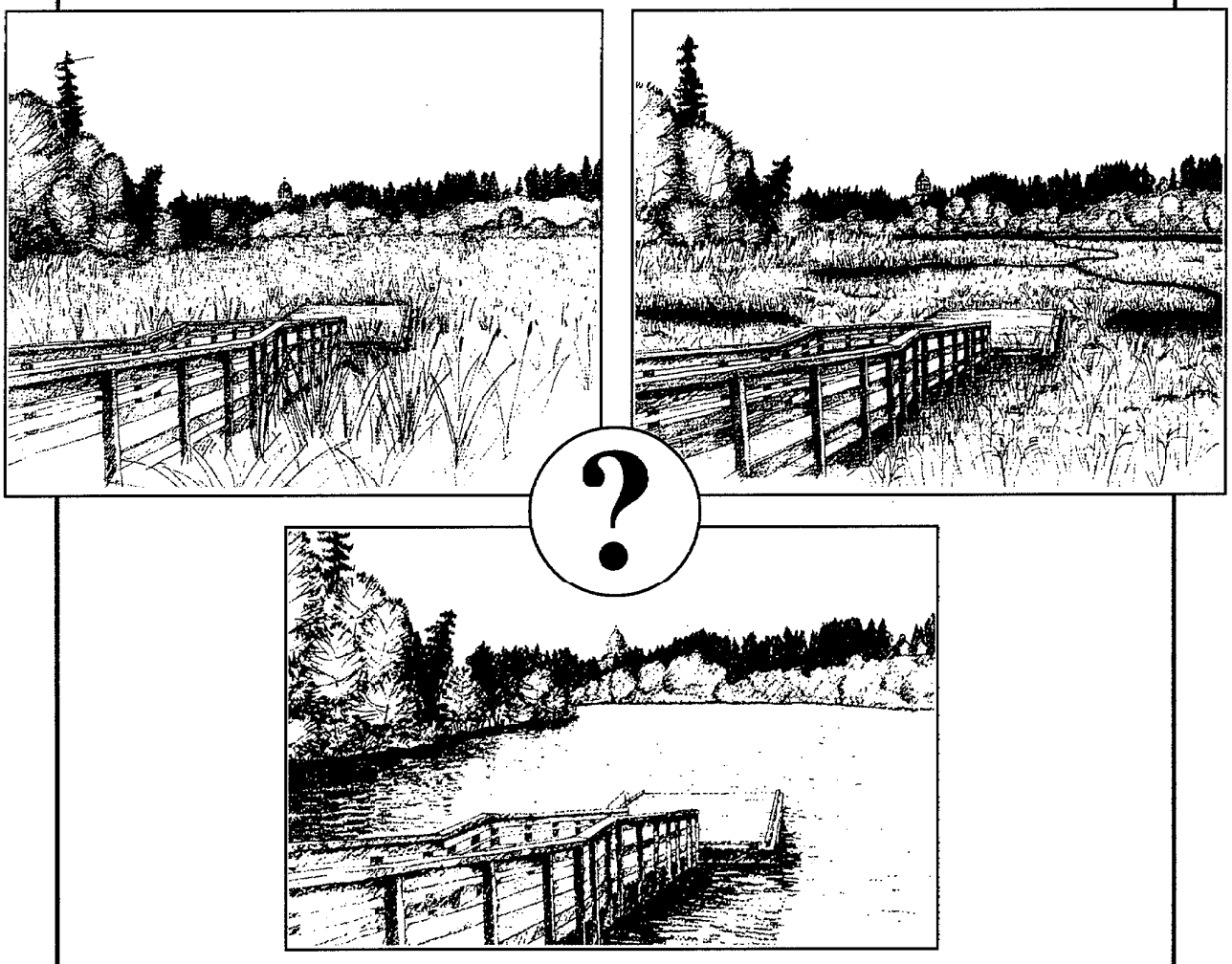
Capitol Lake
Adaptive Management Plan
Phase One
Task 11 - Sediment Management: Answers to Technical Questions



July 2000

Phase One
Task 11 - Sediment Management: Answers to Technical Questions

Capitol Lake Adaptive Management Plan
1999 to 2001

Olympia, Washington

Prepared For
Washington State Department of General Administration

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SUMMARY

This report answers questions related to maintenance dredging of Capitol Lake as part of the Capitol Lake Adaptive Management Plan (CLAMP). The primary management question to be answered is:

> *Based upon new data contained in the hydraulic scour, flood analyses, and the sediment sampling, do these findings suggest a long-term course of action for managing sediment within Capitol Lake?*

The long-term course of action relates specifically to answering:

- How to dredge and how much to dredge in the lake?
- When to dredge?
- How to handle dredged material in the immediate vicinity of the lake?
- Where to dispose the dredged material?

This report does not analyze the question of "What beneficial uses should the lake be managed for?" An answer to this question will guide decisions on whether or not the lake should be dredged and where it should be dredged. This is a future topic of the CLAMP decision process. For this report, the CLAMP Sediment Work Group agreed that the Middle Basin sediment trap was the most environmentally acceptable location for dredging in Capitol Lake (**figure 1**).

There has been considerable work related to dredging in Capitol Lake's history. The lake is actually a "run of the river" reservoir that was constructed in the former estuary of the Deschutes River in 1951. Natural and human-influenced processes of watershed and riverine erosion and sedimentation have resulted in approximately 35,000 cubic yards per year of sediment entering Capitol Lake. In 1995, a State Environmental Policy Act (SEPA) Supplemental Environmental Impact Statement (SEIS) was prepared to address dredging 60,000 to 70,000 cubic yards of material from an area about twice the size of the original sediment trap in the Middle Basin of Capitol Lake. The plan was to dredge every other year to provide long-term maintenance dredging. The lake had been dredged previously in 1979 and 1986 using hydraulic dredging techniques and upland disposal. The lake has not been dredged since 1986. In 1996, the dredging frequency was modified to once or twice every five years and the Draft SEIS (DSEIS) was revised to reflect this change.

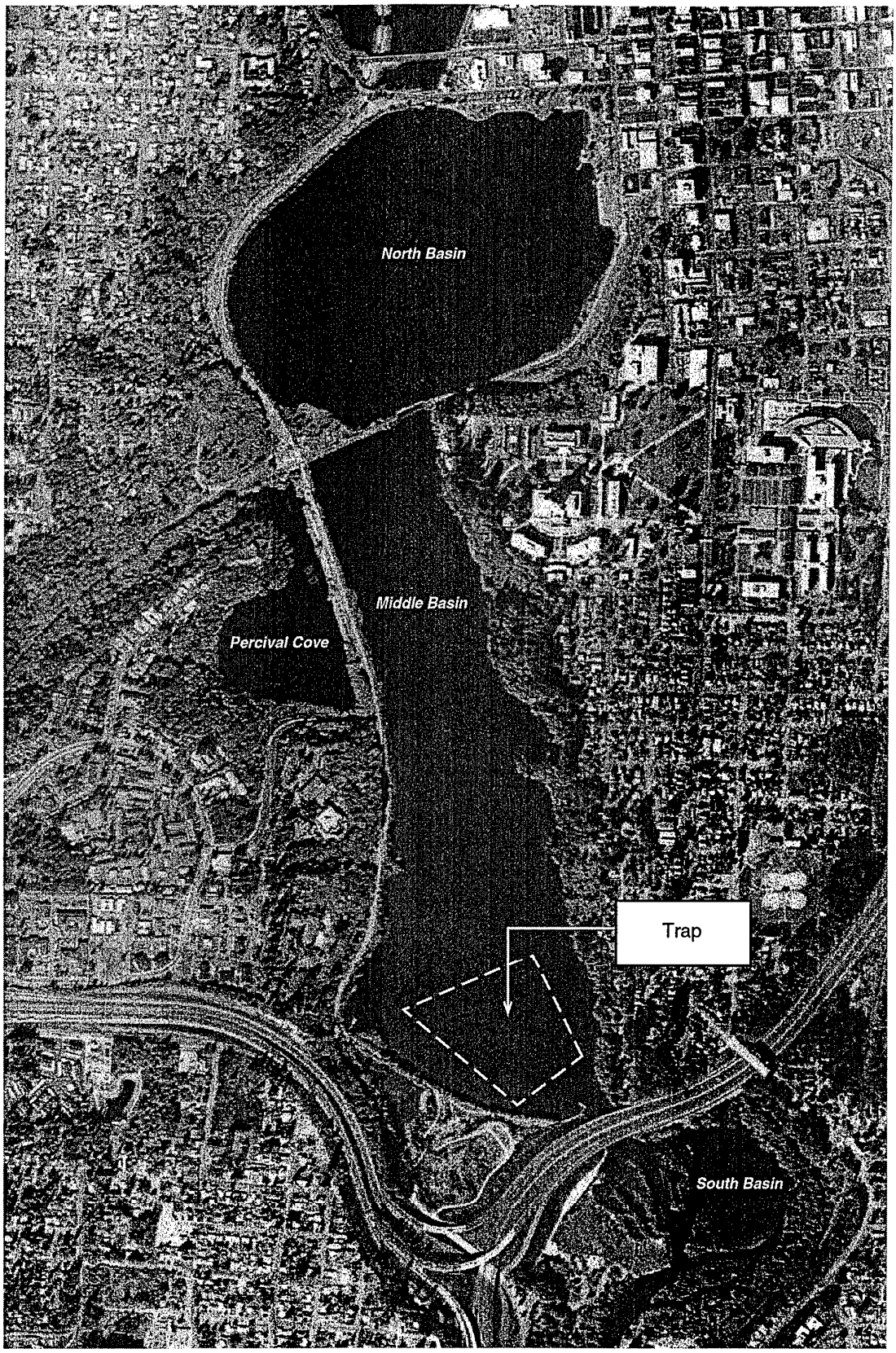

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Figure 1
Capitol Lake Middle Basin Sediment Trap

How to Dredge and How Much to Dredge in the Lake?

There have been significant changes in the immediate vicinity of Capitol Lake that affect potential dredging operations; most notably, the wetland mitigation area established for the Heritage Park project has replaced the former Middle Basin dredged material disposal area. This area was large enough to allow gravity dewatering, which is the conventional technology for handling hydraulically dredged material. The challenge was to find a location near the shore with enough space to handle gravity dewatering of hydraulically dredged material. Our team concluded that a site no longer exists. As a result, the study team focused on a clam-shell dredge operation (see **figure 2**). This type of operation produces dredged material with a much lower water content, resulting in an operation with lower space requirements.

Figure 2
Clam-shell Dredge

Information related to a clam-shell dredge operation for Capitol Lake is presented in this report. However, once the clam-shell dredging alternative was scoped, planning-level cost analysis revealed that this alternative was more expensive than hydraulic dredging due to the unique character of the Capitol Lake basin. Therefore the study team decided to also revisit a newer technology to dewater hydraulically dredged material using a "mechanical" dewatering approach. Entranco (**1995, 1996, 1998**) previously studied the concept of hydraulic dredging (see **figure 3**) and mechanical dewatering; a pilot program was conducted in 1995.

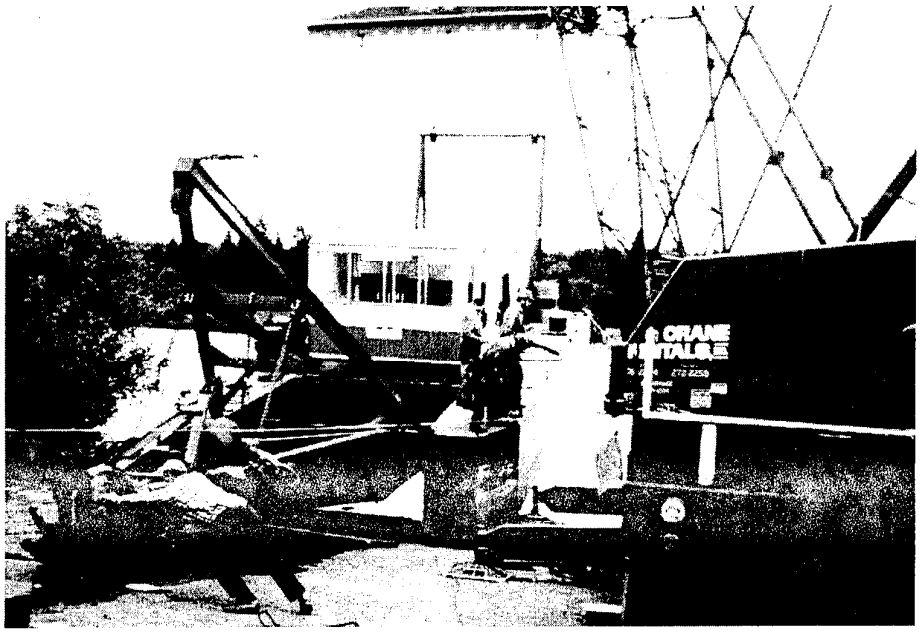


Figure 3
Hydraulic Dredge

Based on the analysis of both clam-shell and hydraulic dredging, both options are presented to allow further dialogue and selection of a preferred method by the Washington State Department of General Administration (DGA).

The amount of dredged material to be removed in a one-time pilot program is limited by available budget of about $800,000. If clam-shell dredging is selected by DGA, the volume of dredged material that could be removed with available funding is approximately 9,000 cubic yards. For hydraulic dredging, approximately 12,000 cubic yards could be removed for the available budget.

The amount of dredged material to be removed for a long-term program for the Middle Basin trap is approximately 60,000 cubic yards per dredge season, with a frequency of once every five years. A dredging frequency of once every five years will allow the trap to become filled, assuming an average sedimentation rate. However, an adaptive management monitoring approach is recommended to check depths annually because large flood flows could fill the trap sooner.

Since the Middle Basin captures only a portion of the annual sediment load, other areas of the lake will continue to experience sediment deposition. Dredging of the Middle Basin trap will delay, but not eliminate, the eventual filling in of Capitol Lake.

When to Dredge

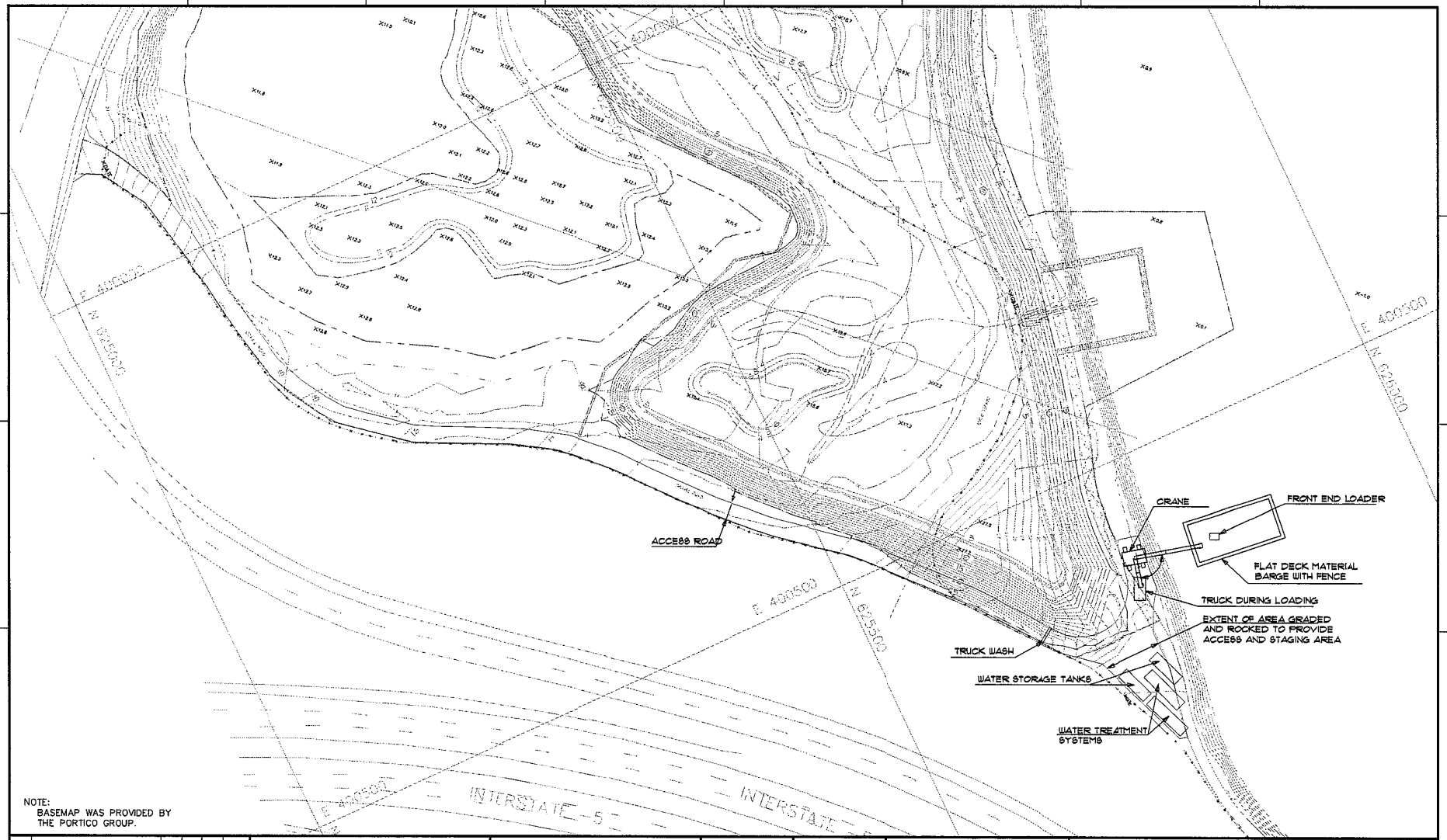
Permitting requirements have traditionally constrained the construction timing of "in water work" such as dredge operations via the State's Hydraulic Project Approval (HPA). However, because the Puget Sound chinook have been listed as a threatened species under the Endangered Species Act (ESA), the regulatory constraints are particularly focused on salmon and salmon habitat protection. The dredging construction window is estimated to be from December 1st to March 15th. It was assumed that the maximum dredging time for a particular season would be 900 work hours (15 weeks x 6 days per week x 10 hours per day).

How to Handle Dredged Material In Shoreline Areas?

Dredged material removed by a clam-shell operation would be dewatered on the barge overnight and then would be transferred directly to trucks for transport to the upland disposal site. Water drained from the sediments would be collected and provided water quality treatment. Several areas were considered for the off-loading operation including the existing boat launch at Tumwater Park and the old brewery site in the South Basin, and the power plant on the east shore and other sites on the west shore of the Middle Basin. It is recommended that the area between the north side of Interstate 5 (I-5) and the wetland mitigation site be used for the off-loading operation (**figure 4**). Dredged material would be barged to shore and off-loaded using a crane or a long-reach excavator. An access road and shore off-loading facilities would need to be constructed to transfer the material into the trucks (**figure 4**).

The only site found to be capable of handling the hydraulically dredged material, with a mechanical dewatering component, was an 11-acre site owned by DGA on the west shore of Capitol Lake (**Entranco 1996**). This site is shown in **figure 5**.

Dredged material removed by a hydraulic dredging operation would be pumped via pipeline to the 11-acre site, mechanically dewatered at that site, and then transferred to trucks (see **figures 6** through **8**). Mechanical dewatering is experimental and may not be as reliable as the clam-shell operation. Depending on final site design, it may be possible to store dewatered dredged material to allow a longer time for truck transfer to the upland disposal site. The volume of water from the dewatering operation would be much larger than for clam-shell dredging. This water would require treatment before discharging it back into Capitol Lake.



NOTE:
BASEMAP WAS PROVIDED BY THE PORTICO GROUP.

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Figure 4

Conceptual Plan View of the Off-loading & Associated Equipment for the Clam-shell Dredging Alternative

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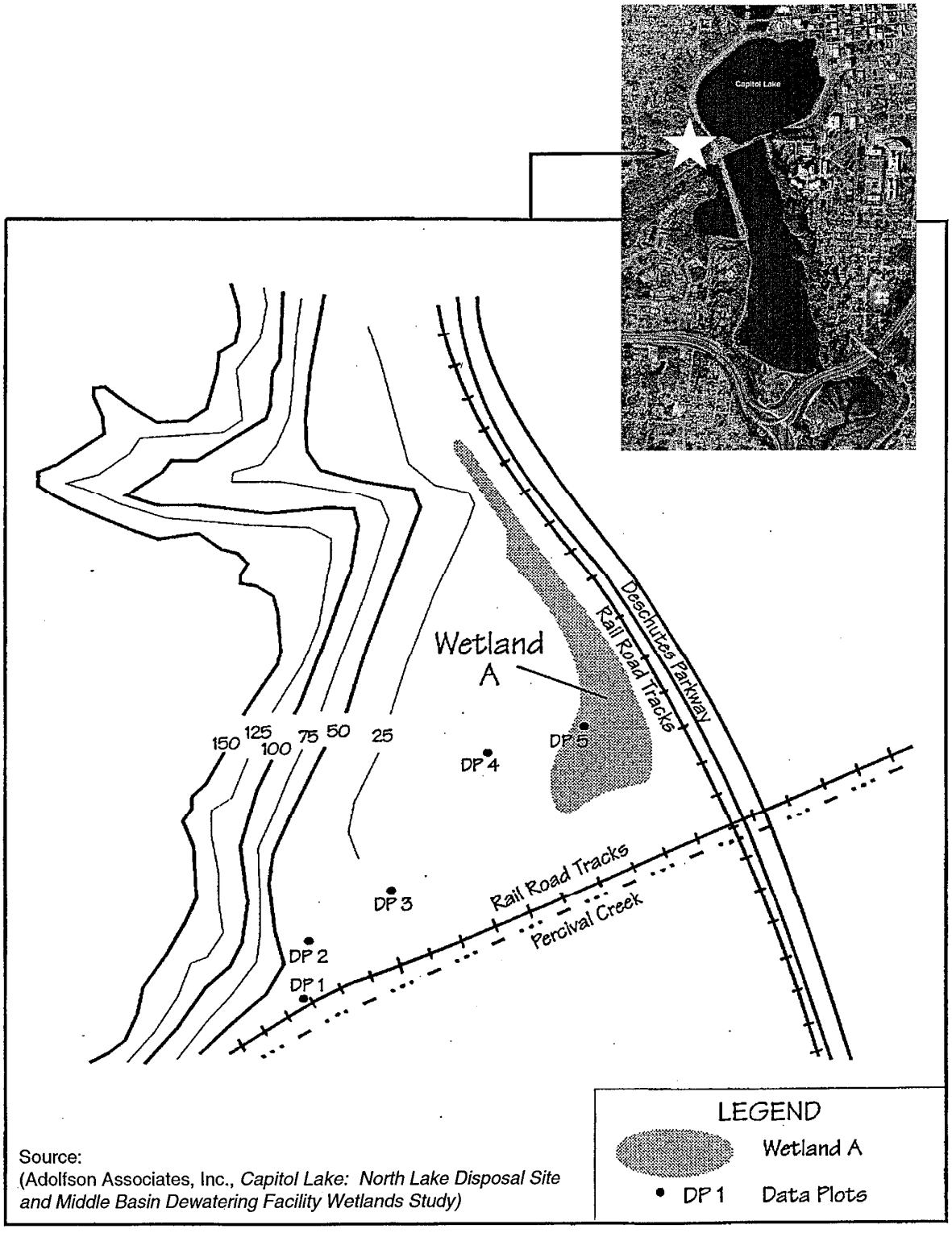

Source:
(Adolfson Associates, Inc., *Capitol Lake: North Lake Disposal Site and Middle Basin Dewatering Facility Wetlands Study)*

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Figure 5
Hydraulically Dredged Material Dewatering Site, Return Water Treatment, and Potential Dredged Material Storage Site

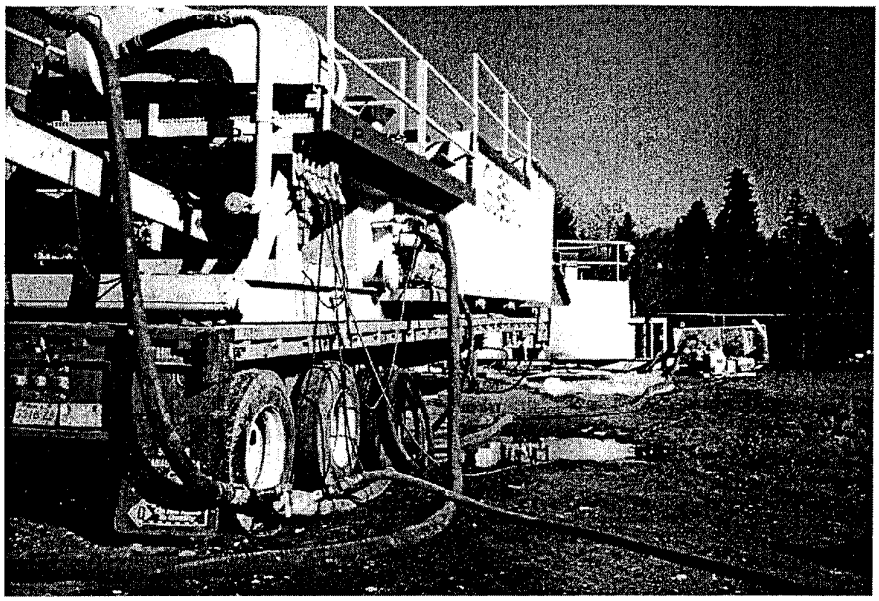

Figure 6
Mechanical Dewatering - Centrifuge and Associated Equipment
for Hydraulically Dredged Material

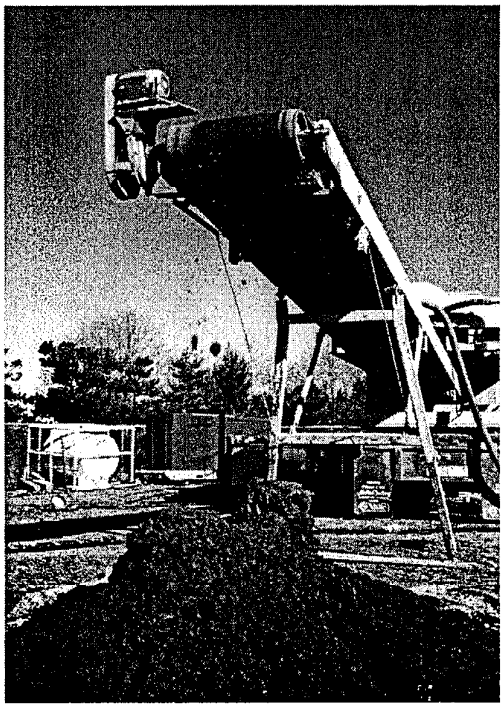

Figure 7
Conveyor and Sediment Storage

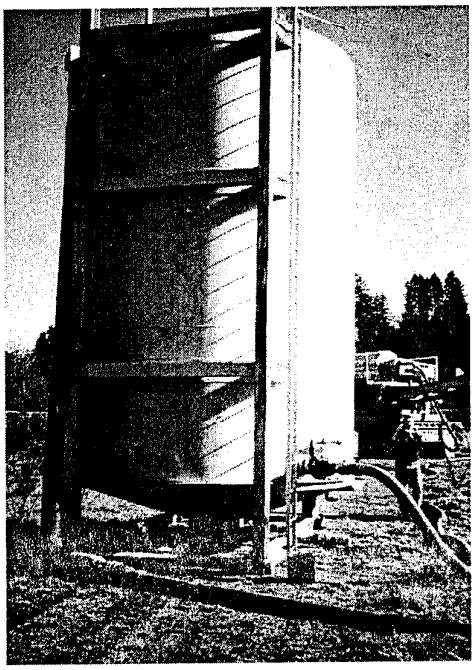

Figure 8
Return Water – Water Quality Treatment Tank

Where to Dispose Dredged Material?

The disposal analysis pertains to both clam-shell and hydraulic dredged material. Considerable effort has been expended to determine the suitability of Capitol Lake dredged material for disposal in marine and upland sites. Marine disposal was eliminated from consideration due to regulatory concerns over the spread of the noxious week purple loosestrife.

Sediment testing has shown the dredged material would likely be acceptable for upland disposal. Final confirmation of regulatory approval will be dependent on pilot program permitting. Several upland sites were evaluated for disposal and possible beneficial use. It is recommended that either the Thurston County Roads or Parks departments sites be used as the disposal location.

Planning-level Costs

Based on the two alternatives of clam-shell and hydraulic dredging, planning-level unit costs for long-term sediment maintenance have been estimated at $35 and $40 per cubic yard for hydraulic and clam-shell operations, respectively. Both of these alternatives assume the same upland disposal costs. These unit costs translate to a total cost every five years of $2.4 million and $2.1 million for

hydraulic and clam-shell operations, respectively. Both of these alternatives assume removal of 60,000 yards.

For the pilot dredging project with a budget of approximately $800,000, the estimated volume that could be removed is 9,000 (clam-shell dredging) and 12,000 cubic yards (hydraulic dredging). These small-scale operations have higher costs due to their higher fixed costs relative the amounts dredged.

Decision on a Preferred Dredging Alternative

The cost difference between the clam-shell and hydraulic dredging alternatives is not the only factor to consider in selecting a dredging strategy. Both clam-shell and hydraulic dredging are proven, commonly used techniques. However, the mechanical dewatering, associated with the hydraulic dredging, is an experimental technique. This approach has more uncertainty in both the dewatering technique and the water quality treatment of return water. A pilot mechanical dewatering study (**Entranco 1995**) used a small dredge (4-inch) and low dredging production rate. There is some uncertainty on how well this will perform under a full-scale operation. Operators noted that the sand content of Capitol Lake sediments should be separated prior to dewatering the fines. This would require additional equipment and would affect ultimate costs.

Relationship of the CLAMP Hydraulic and Flood Analyses Results to the Recommended Pilot Dredge Program

Hydraulic analyses for the CLAMP lake alternative showed that a minimal dredging program, focused on the Middle Basin sediment trap, would not have a significant impact on the potential for scour-related impacts during large river flooding events. Similarly, flood flow analyses showed that the Middle Basin trap dredging program would not significantly affect the predicted flood levels.

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TASK 11 - SEDIMENT MANAGEMENT

Introduction

This report answers questions related to maintenance dredging of Capitol Lake as part of the Capitol Lake Adaptive Management Plan (CLAMP). The primary management question to be answered is:

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There has been considerable work related to dredging in Capitol Lake's history. The lake is actually a "run of the river" reservoir that was constructed in the former estuary of the Deschutes River in 1951. Natural and human-influenced processes of watershed and riverine erosion and sedimentation have resulted in approximately 35,000 cubic yards per year of sediment entering Capitol Lake. In 1995, a State Environmental Policy Act (SEPA) Supplemental Environmental Impact Statement (SEIS) was prepared to address dredging 60,000 to 70,000 cubic yards of material from an area about twice the size of the original sediment trap in the Middle Basin of Capitol Lake. The plan was to dredge every other year to provide long-term maintenance dredging. The lake had been dredged previously in 1979 and 1986 using hydraulic dredging techniques and upland disposal. The lake has not been dredged since 1986. In 1996, the dredging frequency was modified to once or twice every five years and the Draft SEIS (DSEIS) was revised to reflect this change.

CLAMP Technical Committee Interaction

The CLAMP process has established a Sediment Work Group. The sediment work group has met several times to discuss sediment management for Capitol Lake. In an effort to achieve collaboration between the Entranco consultant team and the Work Group, a sediment management workshop was held on February 29, 2000. The participants discussed their views on sediment management for Capitol Lake. The specific meeting objective was to discuss the issues related to dredging Capitol Lake so the Entranco consultant team could better define key questions that needed answers. Meeting results were used to help the Entranco consultant team focus their work to produce the Task 11 – Sediment Management report.

The attendees included:

- Steven Morrison – Thurston Regional Planning Council
- Cliff Ikerd, Andy Stepelton, and Peter Waugh - Washington State Department of General Administration
- Dale Anderson, David Morency, and Ralph Nelson – Entranco
- Rob Zisette – Herrera Environmental Consultants (sub to Entranco)
- Jerry Ramsden – Ogden Beeman & Associates (sub to Entranco)
- LeGrand Velez – City of Olympia (for Emmett Dobey)
- Perry Lund – Washington State Department of Ecology
- Dan Barth – Washington State Department of Natural Resources
- Margaret McPhee – City of Olympia
- Jim Fraser – Washington State Department of Fish and Wildlife
- Jeff Dickison – Squaxin Island Tribe

At the beginning of the workshop, the overall objective of the sediment task within CLAMP was stated:

> *"Manage sediment within the basin in the most cost effective and environmentally appropriate way."*

Several topics were on the agenda including:

- Discuss the Sediment Work Group minutes of January 25, 1999

- Establish environmental criteria for comparison to clarify above objective
- Location of dredging (lake and/or estuary)
- Method of dredging
- Method and location of dewatering
- Method and location of disposal
- Frequency and duration of dredging
- Mitigation measures
- Overview of hydraulics/flood analyses

A summary of the workshop is provided in **Appendix A.**

Highlights of the workshop included:

- It was agreed that, for the purposes of this project, the "minimalist" approach for dredging in Capitol Lake was to remove only new sediment that is deposited in the Middle Basin trap.
- Presence of purple loosestrife in Capitol Lake sediments is a significant reason why marine disposal may not be a long-term solution. Permitting agencies are concerned about spreading this noxious weed to other shoreline areas of Puget Sound.
- Listing of the Puget Sound chinook under the Endangered Species Act poses a new regulatory constraint for any dredging project.
- New ideas for dredging included the use of geo tubes for marine disposal, use of a barge for dewatering clam-shell dredged material, and use of a "concrete pumper" for transporting clam-shell dredged material to the shore.

Sediment Strategy Components

This report section provides discussion on different components of a sediment management strategy. This information serves as the basis for the screening and selecting a recommended alternative. To avoid confusion between the terms "mechanical dredging" and "mechanical dewatering", this report uses "clam-shell dredging" in place of mechanical dredging.

Location of Dredging Operations

As mentioned previously, participants in the Sediment Group workshop decided that the dredging location should be Capitol Lake's Middle Basin sediment trap (**figure 1**). This is similar to the decision made during preparation of the 1996 SDEIS for sediment management; however, the area proposed for dredging was about twice as large. The Middle Basin trap is also significantly smaller than the original 10 Middle Basin sectors addressed in a draft SDEIS, prepared on October 25, 1995. This area is in the vicinity of the original dredging operations identified in the 1977 Final EIS (**CH2M Hill 1977**).

The long-term location of Capitol Lake dredging is dependent on future decisions by the CLAMP Steering Committee (SC). It is understood that the SC will be discussing the desired beneficial uses for Capitol Lake and its shoreline. This will ultimately lead to a decision on how the Capitol Lake basins will be managed, including decisions on whether or not a long-term dredging program will occur.

Frequency and Duration of Dredging

The proposed long-term dredging plan would remove an estimated 60,000 cubic yards of material from the Middle Basin trap with each dredging cycle. (This is distinguished from the pilot dredging program, which has a budget limit that determines the amount of sediment removed.) It is recommended that maintenance dredging be carried out every five years. This frequency for maintenance dredging can be verified through periodic soundings of the Middle Basin trap using recording fathometer technology. This may be appropriate given the fact that large quantities of sediment are likely to be deposited in the trap during years with large flood events. Whenever the trap is approximately 60 percent full of sediment, maintenance dredging should be repeated.

Based on previous estimates of annual sediment loading of 35,000 cubic yards per year to the lake, 175,000 cubic yards of sediment would be deposited over the five-year cycle. Therefore, a once-in-five-year maintenance operation to dredge 60,000 cubic yards would remove 34 percent of the total load and reduce the overall rate of shoaling in the lake accordingly. Since the Middle Basin captures only a portion of the annual sediment load, other areas of the lake will continue to experience sediment deposition. In the Sediment Management Workshop, it was stated that Capitol Lake fills about 1 inch per year, when the annual sediment load is averaged over the area of the three lake basins. Dredging the Middle Basin trap will delay, but not eliminate, the eventual filling in of Capitol Lake.

Method of Dredging

This section discusses the methods, advantages, and disadvantages of hydraulic dredging and clam-shell dredging as they may be applied in Capitol Lake.

Hydraulic Dredging

Hydraulic dredging systems use a barge-mounted centrifugal pump with either an electric- or diesel-powered drive (**figure 3**). The dredging area is reached by means of a "ladder" or mechanical frame suspended from the front of the barge, which extends the suction side of the pump. The barge is secured by means of spuds (metal pipes) mounted on the back of the barge or wire rope connected to anchors. The dredge moves ahead by alternatively raising and lowering the spuds allowing the dredge to "walk" along the proposed cut or by using the wire rope to adjust the dredge position relative to the anchors.

Hydraulic dredges may be equipped with a cutterhead mounted over the suction opening at the end of the ladder to facilitate loosening and digging sediments. Conventionally, material discharges through a pipeline running from the pressure side of the pump to an in-water or upland disposal area. Thus, a dredge of this type is often called a hydraulic cutterhead dredge or, simply, a pipeline dredge. Alternative designs are available including "horizontal auger dredges", which use a turning auger on the end of the ladder to loosen material and move it to the suction opening, or specialized systems where an open pump design serves to loosen material through hydraulic action.

Hydraulically dredged sediments are typically transported in a slurry with a solids concentration of approximately 10 percent to 20 percent by volume. This material is discharged by the hydraulic dredge to an upland site for dewatering.

For gravity dewatering, the area needs to be of sufficient size to allow ponding and settlement of solids prior to decanting the excess water to the waterway. Disposal pond capacity design must accommodate material placed in the site plus any material bulking and sufficient volume to accommodate the water. One limiting factor in design is a requirement that the site accommodate the required ponded water depth on the last day of dredging. In addition, the disposal area would likely have dikes and freeboard (i.e., unused distance between the top of the ponded water and the top of the dike as a safety precaution) increasing the land area required.

Mechanical dewatering was performed as a pilot project in 1995 at Capitol Lake (**Entranco 1996**). For either gravity or mechanical dewatering, the unique character of Capitol Lake would require more aggressive treatment of return water using coagulants to meet water quality criteria.

Often a shortened work day or work week is specified for hydraulic dredging projects to allow more time for solids settlement at the gravity disposal site to enhance effluent water quality. A 10-hour work day would be anticipated for the project.

Hydraulic Dredging Advantages

Hydraulic dredging systems have several advantages over competing systems:

- Cleanup. Because the loosened material is drawn into the suction side of the pump, the system has the capability to produce a good cleanup of the dredged area. This may require a plain suction to be used in lieu of a cutterhead, thus reducing the tendency to stir up and disperse bottom sediments. The equipment can be operated to minimize resuspension of material resulting in reduced turbidity impacts at the in-lake dredge site.

- Delivery of Material. In locations where disposal areas can be designated on land or in-water within pumping distance of the dredge, material can be delivered economically by the pipeline system. The pumping distances for conventional equipment that could be used at a site such as Capitol Lake (i.e., a hydraulic dredge with a 6-inch pipeline) would be less than one mile, although the distance may be extended by using booster pumps with associated increased cost.

- High Production Volumes. Depending on the size of dredge and imposed limitations, hydraulic dredges can achieve very high production volumes. Limitations on dredge size at Capitol Lake include the ability of mechanical dewatering to function at the same rate as the dredging operation, as well as likely need for aggressive treatment of return water.

- Availability of Dredging Equipment. Hydraulic dredge equipment and experienced contractors are widely available in the Puget Sound area.

Hydraulic Dredging Limitations

The hydraulic dredging systems have limitations. The most apparent limitations are listed below:

-- Upland Areas for Gravity Dewatering. Hydraulic dredging adds water to the *in-situ* materials. Upland disposal areas must be provided to receive this material and provide sufficient ponding time to allow settlement of solids prior to decanting the excess water back into the waterway. Final material disposal must be accommodated if the site is to be re-used. The previously used gravity dewatering site was converted to wetlands as part of the mitigation for Heritage Park. A suitable site for gravity dewatering no longer exists.

- Availability of Mechanical Dewatering Equipment. As operating constraints are imposed by permitting conditions or other external factors, special equipment may be required for water treatment systems. In the case of Capitol Lake, specialty mechanical dewatering equipment is needed. This specialized equipment and operating constraints can substantially limit the number of contractors available to conduct the work who are experienced with this specialized equipment.

- Excess Water. Hydraulically dredged material contains a high water content, which is removed by dewatering. This resulting return water must be treated prior to discharge back to the waterway. Treatment often consists of gravity settling in the disposal site pond and decanting the return water over a weir prior to discharge back to the waterway. Occasionally, as is the case with Capitol Lake sediments, the return water also needs to be more aggressively treated by adding coagulants and or using filtering systems. Mechanical dewatering can substantially reduce space needs but at a significant added cost that may reduce the cost benefits associated with hydraulic dredging.

- Thin Cuts. Use of conventional hydraulic dredges does not result in thin cuts. Auger type feed mechanisms can handle thinner cuts by using a screw auger to control the depth of cut and deliver a high solids mixture into a conventional dredge pump. Cutterheads tend to overexcavate and stir up materials below the final cut line. It should be anticipated that excess dredging would be required to achieve thin cuts and disposal area sizes and costs would be adjusted accordingly.

- Debris. Hydraulic dredge performance is affected when debris larger than the suction inlet or the impeller clearances within the pump are encountered. While pipeline dredges are equipped with pump cleanouts, the process is time consuming and may require back flushing the line. The process may need to be repeated many times per day in areas with significant amounts of debris. Capitol Lake receives wood and other debris from river floods, which could interfere with the operation.

Clam-shell Dredging

Clam-shell systems are identified by the use of a basic excavating unit, normally a crane. The crane may be wheel (truck) or crawler mounted or may be directly mounted on a barge for in-water work (**figure 2**).

There are several types of buckets used in sediment dredging. These include production or digging buckets (with teeth) and finish buckets that can take a smaller cut and leave a smoother surface. In recent years the "Cable-Arm" finish bucket (also known as the "environmental bucket") has been introduced. The concept is to positively close the bucket by means of a cable before lifting the

bucket. Cabling the bucket closed and adding seals to prevent leakage, reduces loss of material into the water column during the process of lifting the bucket, thus minimizing the further redistribution of sediment. Use of the "environmental bucket" is therefore appropriate for Capitol Lake.

As an alternative to a conventional crane, another clam-shell dredging technique is the backhoe. While crane-based systems depend on wires to deploy and retrieve the suspended bucket, a backhoe deploys and retrieves the bucket by a mechanically fixed arm. As a result, the backhoe is often used to excavate more difficult materials. The fixed arm, however, forces the digging stroke to be in a circular motion resulting in a reduced ability to take a thin cut, leaving a flat bottom.

There are several alternatives available for transport and disposal of material dredged with clam-shell systems. Normally, the dredged materials are placed on a barge that is moored alongside the dredging equipment (**figure 2**). Flat deck barges are often fitted with a fence several feet high around their perimeter to contain the dredged material and in some cases provide for control of runoff water and porewater generated by the consolidating sediment. Containment of water runoff from barge dewatering operations is appropriate for Capitol Lake.

The type of barge used to transport the dredged material would be dependent upon the proposed disposal method. For Capitol Lake, dredged material is to be transported to shore via a deck barge, as described above. Material would be transferred from the barge to shore via a crane or excavator and bucket, using the same methodology as was used to excavate the material from the bottom. A conveyor system or trucks may be used to transport the material from the water to a stockpile area for further dewatering.

Clam-shell Dredging Advantages

Clam-shell dredging systems have several advantages over competing systems:

- Availability. Since the method relies on the use of a conventional crane, there is usually a large array of equipment available to assure good competitive conditions.

- High Solids Content. clam-shell systems can lift logs and debris directly and dig sediments at near their *in-situ* density. Thus, there is generally little if any downtime associated with debris and a minimum amount of free water added during the excavation process. This eliminates transporting, treating, and disposing of unnecessary excess water.

- Control of Cut. The introduction of electronic systems for horizontal and vertical control of equipment, along with advancements in bucket technology, has enhanced the ability to control both the location and

depth of cut. For Cable-Arm buckets, with careful operation, a realistic goal is +/- 1.0 foot vertical and +/- 2.0 feet to 3.0 feet horizontal accuracy to achieve a designated cut in granular sediments without debris. This assumes precise bathymetry is available.

Clam-shell Dredging Limitations

The clam-shell systems described above have some limitations in the context of dredging very soft sediments and thin dredging cuts as may be required in portions of Capitol Lake beyond the sediment trap area.

- Thin Cuts. Clam-shell dredging systems are not designed for thin cuts less than approximately one foot in the vertical dimension. The size of the equipment, and the control mechanisms available, suggest minimum cut depths of at least one foot and accuracies in this same range. Debris deposits measured in inches are not practical for removal by clam-shell systems without entrainment of underlying sediments.

- Redistribution of Debris. The clam-shell systems have a tendency to redistribute debris during the removal process. The act of closing the bucket and lifting it through the water column inevitably redistributes material, although it may be a small percentage of total material handled.

- Costs. The planning-level costs for clam-shell dredging developed for Capitol Lake (as discussed later in this report) are relatively higher than hydraulic dredging.

Method and Location of Dewatering

The extent of dewatering required for Capitol Lake sediments prior to final disposal depends on the disposal site as well as the method to dredge and transport the material. If sediment is dredged using a hydraulic system, the sediment must be dewatered before transport to either an upland disposal site or to a PSDDA in-water site. If the material is clam-shell dredged, it may or may not need to be dewatered, depending on the disposal site and the method of transport.

Clam-shell Dredged Sediments

A primary benefit of clam-shell dredging is the ability to dredge the sediment at near its in-situ water content without adding extra water. Depending on the disposal site, dewatering requirements, and the physical characteristics of the dredged material itself, the material may not need any dewatering. For example, if the material could be disposed of in water at one of the PSDDA disposal sites the material would only need to be dewatered enough to transport the material

from Capitol Lake to a haul barge at the Port of Olympia (there is no navigation access between Puget Sound and Capitol Lake). No dewatering would be required if the material can be mechanically dredged and transported to a haul barge in Puget Sound using a high-density slurry pipeline. Another option that would not require dewatering, is to use clam-shell dredging and to deliver the material directly to an upland site in the vicinity of Capitol Lake using a high-density slurry pipeline.

If material is clam-shell dredged and transported to an upland site using either rail or truck, the material will, at a minimum, need to be dewatered to the point where it can be easily handled with excavators or front end loaders. If the disposal site is a Subtitle D landfill, the material will need to meet the paint filter test. If the material is to be used as cover material in a landfill, there may be more stringent dewatering requirements. Sediment that has been clam-shell dredged is commonly dewatered on the material barge at least overnight before off-loading it either to a temporary upland dewatering site or directly into trucks for transport elsewhere. If the material must be dewatered to meet the paint filter test, this is sometimes done over a period of several days on a barge (several barges may be used to store several days worth of dredged material). Another option is to off-load the material from the barge to a temporary upland dewatering site for several days. In many cases, the space available to store sediment is limited, and if some or all of the sediment does not dewater as needed within the required time frame (based on the dredging production rate and the available space), drying agents may be used to speed up the process.

Hydraulically Dredged Sediments

For the array of identified disposal options, sediment that is hydraulically dredged needs to be dewatered before transport to the final disposal site unless the material will be transported by pipeline to a permanent disposal facility. In the event that the material is delivered to the final disposal site by pipeline, the material cannot be dewatered at the site using gravity dewatering because no suitable site remains in the immediate vicinity of Capitol Lake. For in-water disposal to one of the PSDDA sites, the agencies have stated sediment from a hydraulic dredging operation that has not been dewatered is not acceptable.

Mechanical dewatering is a feasible alternative. Hydraulically dredged material will need to be dewatered using a mechanical dewatering facility (see **figures 3** through 8). The only site found to be capable of handling the hydraulically dredged material, with a mechanical dewatering component, was an 11-acre site owned by DGA on the west shore of Capitol Lake (**figure 5**).

Dredged material removed by a hydraulic dredging operation would be pumped via pipeline to the 11-acre site, mechanically dewatered at that site, and then transferred to trucks. Mechanical dewatering is experimental and may not be as reliable as the clam-shell operation. Depending on final site design, it may

be possible to store dewatered dredged material to allow a longer time for truck transfer to the upland disposal site. The volume of water from the dewatering operation would be much larger than for clam-shell dredging. This water would require treatment before discharging it back into Capitol Lake. Mechanical dewatering is considered experimental. This approach has more uncertainty in both the dewatering technique and the water quality treatment of return water. A pilot mechanical dewatering study (**Entranco 1995**) used a small dredge (4-inch) and a low dredging production rate. There is some uncertainty on how well this will perform under a full-scale operation. Operators noted that the sand content of Capitol Lake sediments should be separated prior to dewatering the fines. This would require additional equipment and would affect ultimate cost.

Method and Location of Disposal

Overview

There are four methods to transport material from Capitol Lake to any of the potential temporary and or permanent disposal sites. Potential transport methods include truck, rail, pipeline for either high-density or low-density slurry, or a barge. The transport method would be governed primarily by the selected disposal site and what level of dewatering must be accomplished prior to disposal.

The potential disposal site options are identified and screened in this report section. Since in-water disposal at one of the Puget Sound PSDDA sites has been eliminated due to agency concerns regarding potential propagation of purple loosestrife, barge transport is no longer a viable transport option (**Appendix B**).

The availability of rail is discussed below. Although rail access is available at Capitol Lake, the lack of any disposal sites directly serviced by rail with associated off-loading facilities would require the material be transferred to trucks enroute to the disposal site. This secondary transfer would eliminate any economic advantage that may have been realized by rail transport. Also, rail car loading is only available three days per week. This would require a sizable stockpile area near the rail line to store material over a full day before loading it onto the rail cars. Therefore, the rail transport option was eliminated from further consideration.

Truck transport is a viable option especially for the upland disposal sites and recycling options identified and evaluated. If sediment is dredged hydraulically, truck transport could be used after the material has been mechanically dewatered. For clam-shell dredged material that had been allowed to dewater for a limited period of time (on the order of a day or two), truck transport is still

viable provided the truck beds are sealed to prevent leakage and the disposal site would accept fairly wet sediment.

Pipeline transport of hydraulically dredged slurry could be a viable option provided an appropriate disposal site could be identified within a few mile radius of Capitol Lake. The disposal site would need to provide for return water treatment and discharge.

High-density slurries have been pumped over distances of several miles with the aid of booster pumps (**C. Sturdivant, personal communication**). Although clam-shell dredging and use of a high-density slurry pipeline system is another transport option for a local site, significant amounts of granular material (such as 50 percent sand by volume or more **[C. Sturdivant, personal communication]**) may clog the system. For some portions of Capitol Lake, in particular the sediment trap area with sand fractions ranging from approximately 50 percent to 95 percent, significant amounts of sand render the high-density slurry system infeasible.

This remainder of this section evaluates alternatives for open-water disposal, upland disposal, beneficial use, and transportation of dredged sediments. The discussion of each selected disposal alternative includes a review of sediment chemical testing results, potential disposal site locations, and purple loosestrife transport and monitoring requirements. The discussion of transportation options includes a review of rail and truck transportation methods. Planning-level costs are presented near the end of this report, along with a discussion of the preferred sediment disposal and transportation strategy. This evaluation is based on personal contacts with regulating agencies and experts in disposal and transport of sediments, and a review of similar disposal and transport projects in the Puget Sound area.

Open-Water Disposal

Under this alternative, dredged sediments from Capitol Lake would be disposed of at an approved PSDDA open-water disposal site. The following summarizes recent sediment test findings, identifies potential disposal locations, and discusses issues relating to purple loosestrife seeds in the dredged sediments.

PSDDA Open-Water Disposal Sediment Testing

In 1995, sediments from Capitol Lake's Middle Basin were determined not to be suitable for open-water disposal because concentrations of benzoic acid exceeded the PSDDA maximum level criterion (**Entranco 1996**). These results increased the PSDDA rank for Capitol Lake sediments from low-moderate to high. This new rank required a larger set of test requirements for a full PSDDA characterization. A partial PSSDA characterization was performed in April 2000 for sediments in the Middle Basin sediment trap to determine if contaminant concentrations were low enough to reduce the PSDDA rank from high to low-moderate (**Herrera 2000**). The partial characterization results were also used to assess the potential for open-water disposal of dredged sediments at an approved PSDDA site.

The PSDDA maximum level criteria were not exceeded in any of the four samples collected in April 2000 from the Middle Basin sediment trap. Therefore, PSDDA would likely reduce the rank for the Middle Basin sediment trap from high to low-moderate. Concentrations of PSDDA contaminants of concern were also below PSDDA screening-level criteria, with the exception of mercury at one of the four sampling stations. A full sediment characterization using a low-moderate rank would be required before open-water disposal could be approved by PSDDA. If the PSDDA screening-level criterion for mercury (or any contaminant) is exceeded in any sample, then additional sampling for biological testing would be needed to reach a decision on the suitability of the sediments for open-water disposal.

Open-Water Disposal Site Locations

Because purple loosestrife seeds are present in Capitol Lake sediments and there is concern that a significant number of seeds could be dispersed to the Nisqually River delta, PSDDA has mandated that open-water disposal cannot occur at the Anderson/Ketron Island site (**D. Kendall, personal communication**). However, PSDDA would allow the Commencement Bay PSDDA disposal site to be used for clam-shell dredged material on a one-time only basis if results of a full characterization were acceptable (**D. Kendall, personal communication**). The Commencement Bay site is located approximately 20 miles northeast of the Anderson/Ketron Island site (**figure 9**). Therefore, open-water disposal is not a viable long-term disposal option (see **Appendix B**).

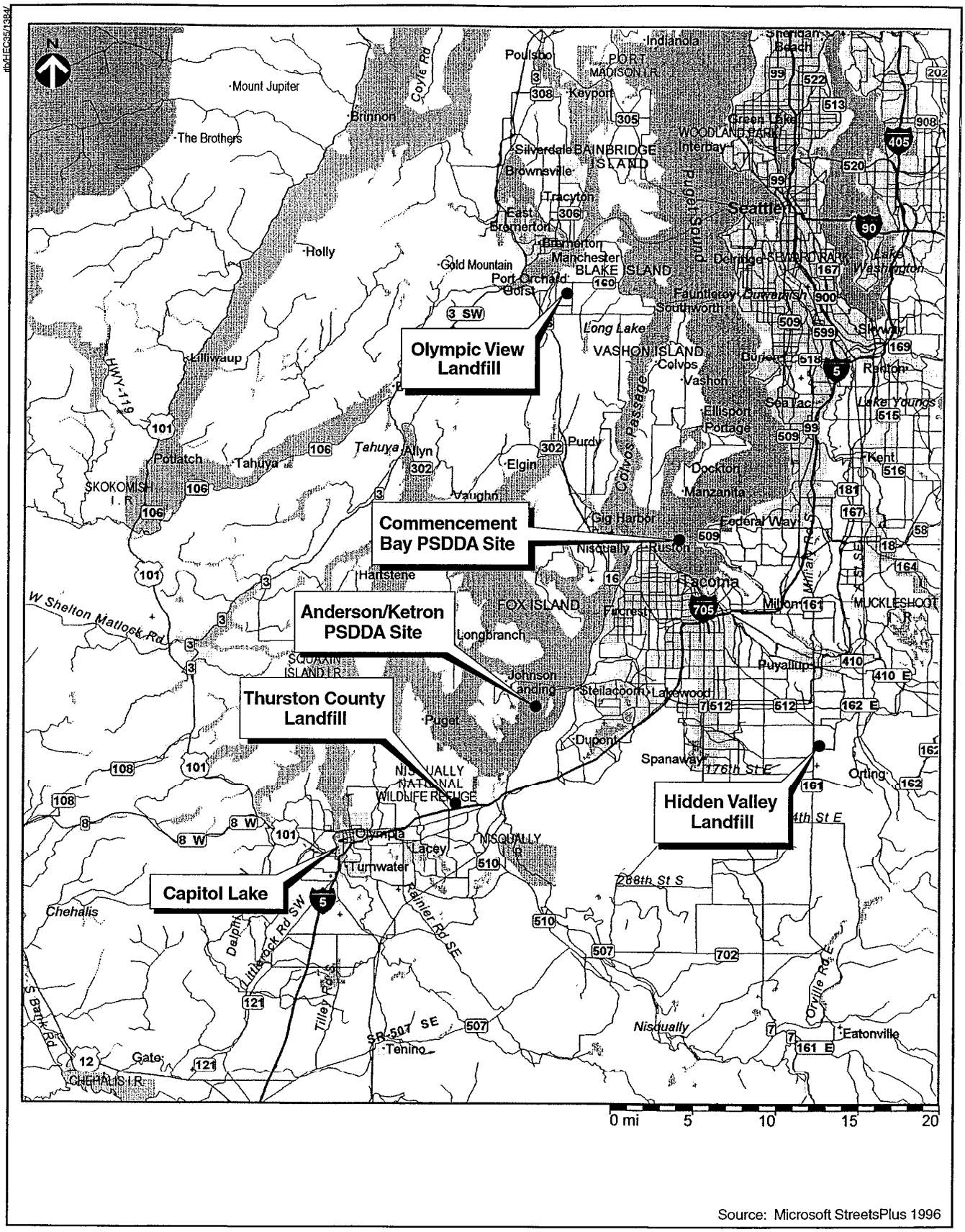


Figure 9
PSDDA Disposal Sites and Landfill Sites

Purple Loosestrife Transport and Monitoring Requirements

The Washington State Department of Agriculture (WSDA) issues permits for the transport of sediments containing purple loosestrife plants, plant parts, and seeds under the authority granted by the Washington Administration Code (WAC) 16-752-410 - *Rules Relating to Lythrum Quarantine*. These permits stipulate that no infestation is to be created by transportation activities conducted under the permit. In the past, WSDA has recommended (to PSDDA) against open-water disposal of any sediment containing purple loosestrife (**G. Haubrich, personal communication**). Thus, it is uncertain whether WSDA would issue a permit for open-water disposal because the agency prefers upland disposal of purple loosestrife. In addition, the WSDA is required to consult with local governments and the Washington State Weed Control Board (WWCB) before making any decision on issuing a transport permit for the disposal of sediments containing purple loosestrife seeds. Recent communication with WSDA indicates that it is likely the WWCB would recommend against allowing open-water disposal (**G. Haubrich, personal communication**).

If WSDA issues a purple loosestrife transport permit, conditions of the permit could include monitoring the Nisqually River delta area and other nearshore areas along the transport route for purple loosestrife infestation over a period of three years (**G. Haubrich, personal communication**). In addition, PSDDA has recommended that monitoring be conducted for seed dispersal during open-water disposal of Capitol Lake sediments (**D. Kendall, personal communication**).

Conclusion

Generally, open-water disposal of Capitol Lake sediments could be a cost-effective disposal alternative because of the close proximity of Capitol Lake to Puget Sound. However, because purple loosestrife seeds in these sediments, PSDDA would restrict disposal to a distant site (Commencement Bay) on a one-time basis only. Furthermore, uncertainty exists that WSDA would issue a permit for disposal at this or any other site in Puget Sound. Therefore, open-water disposal is not considered to be a feasible disposal option and was not explored further (see **Appendix B**).

Upland Disposal

Under this alternative, dredged sediments from Capitol Lake would be disposed of at an approved upland location in Thurston County. The following summarizes recent sediment test findings, identifies potential disposal locations, and discusses issues relating to purple loosestrife seeds in the dredged sediments.

Upland Disposal Sediment Testing

Sediments in the Middle Basin sediment trap were sampled in April 2000 to determine the acceptability of dredged sediments for upland disposal (**Herrera 2000**). Chemical concentrations of various sediment contaminants were compared to the Washington State Model Toxics Control Act (MTCA) cleanup regulation (WAC 173-340) to determine if the sediments are suitable for upland disposal. The toxicity characteristic leaching procedure (TCLP) was also conducted using these sediments to determine the maximum concentration of metals that could leach into groundwater if the sediments were disposed of at an upland location. The TCLP procedure complies with the Washington State dangerous waste regulations (WAC 173-303-100), and with Thurston County rules and regulations governing solid waste handling (**Thurston County 1996**).

Tests showed the MTCA Method A cleanup levels for contaminants were not exceeded in any of the samples. The TCLP test results showed that metal concentrations at all sampling stations were substantially less than dangerous waste criteria and Thurston County high risk waste threshold levels. Therefore, it is likely that sediments from the Middle Basin sediment trap would be classified as inert material and no additional testing would be required for disposal at an approved upland location in Thurston County. Review of the sediment characterization results and an assessment of the proposed disposal site by the Thurston County Health Department would be required for regulatory approval of the upland disposal location (**P. Beale, personal communication**).

Upland Disposal Site Locations

Upland locations investigated include landfills, Thurston County Roads Department gravel mines, and Thurston County Department of Parks and Recreation land. These potential sites are described below.

Landfills

The availability and preliminary costs for disposal of sediments from the Middle Basin sediment trap were investigated for solid waste landfills that are located in the vicinity of Capitol Lake (see **figure 9**). The Thurston County Landfill is located approximately 9 miles northeast of Capitol Lake. However, this landfill closed on May 1, 2000 and will no longer accept waste, grading, or capping material (**D. Merril, personal communication**). The Hidden Valley (Pierce County) Landfill is located in Puyallup, approximately 30 miles east of Capitol Lake. However, this landfill does not need any grading/capping material and would charge the full disposal fee of approximately $60/cubic yard (**H. Doman, personal communication**). The Olympic View (Kitsap County) Landfill is located in Port Orchard, approximately 50 miles north of Capitol Lake. This landfill is closing in the summer of 2002 and may accept approximately 100,000

to 200,000 cubic yards of sediment to be used as grading/capping material for a fee of approximately $1/cubic yard (**D. DeFrates, personal communication**).

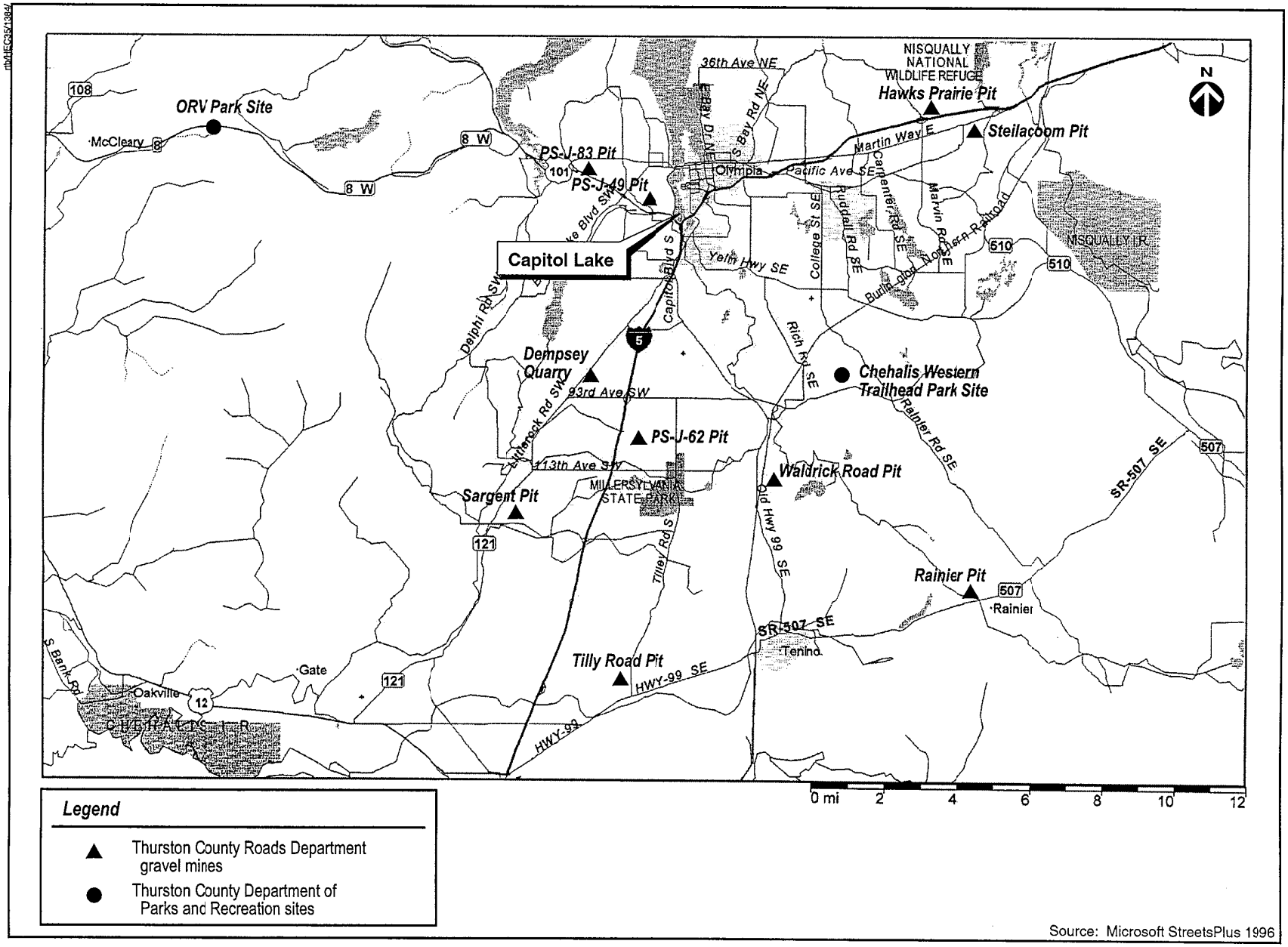
Because the Thurston County Landfill is closed and the Hidden Valley Landfill will charge a disposal fee of approximately $60/cubic yard, the only feasible landfill option is the Olympic View Landfill. The Olympic View Landfill requires that disposed sediments be analyzed for those contaminants listed under the Washington State dangerous waste regulations. The landfill typically requires analysis of 10 samples for the first 2,000 cubic yards of material and one sample per 500 cubic yards, subsequently. To meet this sampling requirement, 76 samples would need to be analyzed for 35,000 cubic yards of sediment. However, the landfill may accept a reduced number of tests for such a large volume of sediment (e.g., 20 samples for 35,000 cubic yards) (**K. Clayton, personal communication**).

Thurston County Roads Department Gravel Mines

The Thurston County Roads Department operates 10 gravel mines that are at least 5 acres in size and located within 15 miles of Capitol Lake. Each site may accept sediments for use as fill material during future site reclamation (**figure 10**). The location, size, and permit status of these gravel mines are presented in **table 1**. Only the Waldrick Road Pit is located on a main rail line; no other sites are located on either a main or spur rail line.

Table 1
Thurston County Roads Department Gravel Mines

Name	General Location (Township, Range, Section)	Approximate Distance From Capitol Lake (mi)	Size (acres)	Mining Permit Status
PS-J-49	TWN18 RNG02W SEC21S	1	12	Terminated
PS-J-83	TWN18 RNG02W SEC18S	3	9.7	Terminated
Dempsey Quarry	TWN17 RNG03W SEC22S	5	10	Terminated
PS-J-62 Pit	TWN17 RNG02W SEC28S	6	25	Terminated
Hawks Prairie Pit	TWN18 RNG01W SEC12S	7	20	Active
Steilacoom Pit	TWN18 RNG01E SEC18S	7.5	13	Active
Waldrick Road Pit	TWN17 RNG01W SEC31S	8	15	Active
Sargent Pit	TWN16 RNG03W SEC27S	10	15	Active
Tilly Road Pit	TWN16 RNG02W SEC29S	13	32	Active
Rainier Pit	TWN16 RNG01E SEC05S	15	29	Active



Source: Microsoft StreetsPlus 1996

Figure 10
Thurston County Roads Department Gravel Mine Sites and Thurston County Department of Parks

Presently, the Thurston County Roads Department has not decided whether to allow disposal of Capitol Lake sediments at a department mine site due to concerns about future liability. The Roads Department is uncertain about the timing of mine site closures and the stockpile capacity of each site. Therefore, use of these gravel mines would be contingent upon further discussion and approval by Thurston County Roads Department (**D. Weston, personal communication**). It is likely that the Roads Department would not charge a fee for disposal of sediments if the site were properly graded, capped, vegetated, and monitored by the proponent. If these disposal options are selected, further dialogue is needed to define "liability" concerns and potential solutions.

The Thurston County Health Department regulates permitting and analytical requirements for disposal of sediments at upland locations in the county (**J. Libby, personal communication**). Before allowing upland disposal of Capitol Lake sediments, the Thurston County Health Department would review the analytical results from the sediment samples collected in April 2000 to determine if additional samples need to be collected and analyzed. Because no contaminants of concern were present in April 2000, the Thurston County Health Department would not likely require any additional sediment testing for disposal at an upland site.

Thurston County Department of Parks and Recreation Land

The Thurston County Department of Parks and Recreation identified two parks that could be used to dispose of sediments from Capitol Lake (**figure 10**). These parks include the Chehalis Western Trailhead Park and the Off-Road Vehicle (ORV) Park described below.

The Thurston County Department of Parks and Recreation is willing to accept Capitol Lake sediments at either site as long as there is sufficient capacity and the site is graded, capped with at least 6 inches of soil, and revegetated. The Parks Department would not charge a fee for disposal at a county park and has not expressed concerns about future liability (**M. Welter, personal communication**).

As noted previously for the Thurston County Roads Department gravel mines, it is not likely that the Thurston County Health Department would require additional sediment testing for disposal in county parks.

Chehalis Western Trailhead Park. The Chehalis Western Trailhead Park is located approximately 8 miles southeast of Capitol Lake near the junction of 89th Avenue SE and Fir Tree Road (see **figure 10**). The park covers 20 acres and includes a 5-acre abandoned gravel mine located in the northeast corner of the park. This site is not located on a main or spur rail line.

Approximately 64,000 cubic yards of sediment from the Heritage Park wetlands mitigation site was recently disposed of at the abandoned gravel mine in the

park (**M. Welter, personal communication**). Previous estimates indicated that this site had sufficient capacity to stockpile up to 120,000 cubic yards of sediment (**Entranco 1996**). Therefore, this site could potentially accept up to 56,000 cubic yards of sediment. However, the Parks Department is uncertain about the remaining capacity and a detailed site evaluation is needed to accurately determine the actual capacity (**M. Welter, personal communication**).

Off-Road Vehicle Park. The ORV Park is located 16 miles west of Capitol Lake on State Highway 8 near the border of Thurston County and Grays Harbor County (**figure 10**). The ORV Park site is not located on a main or spur rail line.

There is a 2.5-acre abandoned gravel mine in the park that could be used as a disposal site for Capitol Lake sediments. In addition, there is a 5-acre site where the Parks Department wants to place up to 4 feet (32,000 cubic yards) of fill material to create playing fields (**M. Welter, personal communication**). The capacity of the 2.5-acre site and the suitability of dredged sediments for fill material in the 5-acre site are presently unknown. A detailed site evaluation is needed to accurately determine the actual capacity and suitability of these sites.

Purple Loosestrife Transport and Monitoring Requirements

The WSDA regulates the transport of purple loosestrife as described above for open-water disposal. Because of the potential to spread purple loosestrife, upland disposal of Capitol Lake sediments is WSDA's preferred disposal method. The WSDA would require that sediments be disposed of at a dry location, covered with at least 6 inches of soil within two weeks of disposal, and not be disturbed for a period of 8 years (**G. Haubrich, personal communication**). For upland disposal, the transport permit would likely specify conditions similar to those outlined in a previous WSDA permit issued to Simpson Timber on July 15, 1997:

- A dredged material dewatering plan and transportation route must be provided to WSDA.
- The proponent must inspect each stream crossing along the transportation route for the presence of purple loosestrife. The inspections extend for 50 feet along the banks of each stream crossed and along roadside ditches exhibiting wetland vegetation. An initial inspection at the time of transport and in the following spring are required, as well as annual inspections for a period of three years.
- Dredged material containing loosestrife must be covered by a minimum 6-inch layer of soil within two weeks of disposal.

The WSDA has stated that if the proponent covers the trucks during transportation, WSDA will consider eliminating the wetland monitoring

requirements noted above (**G. Haubrich, personal communication**). The Thurston County Weed Control Board (TCWCB) recommends using covered trucks because the board is responsible for monitoring public lands in Thurston County for purple loosestrife, and would assume responsibility for monitoring the wetlands and the disposal site at no cost to the proponent (**P. Beale, personal communication**).

Conclusion

Disposal of sediments at a landfill would not be cost effective because of high costs associated with testing, disposal, and transportation. Only the Thurston County gravel mine and park sites were evaluated for planning-level costs of upland disposal because these sites are not likely to require additional testing, have no disposal fee, and are located near Capitol Lake. In addition, the Thurston County Parks and Recreation Department has previously received dredged material from the Heritage Park wetlands mitigation site, and has expressed an interest in receiving additional dredged material at the ORV park site.

Beneficial Use

Under this alternative, dredged sediments would be disposed of at an approved composting facility or soil recycling facility. The potential options available are discussed below.

Composting

The TCWCB stated that disposal of Capitol Lake sediments at a compost facility would not be allowed because a commercial composting operation would not generate enough heat to kill the purple loosestrife seeds (**P. Beale, personal communication**). Therefore, this is not a feasible disposal alternative and was not investigated further.

Soil Recycling

Soil recycling is a method designed to remove organic contamination by heating sediments to temperatures of 450 to 800°F. Purple loosestrife seeds ignite at these temperatures, thereby allowing the sediments to be used for soil amendments or other beneficial uses. TPS Technologies has estimated that it would require 3 months to sterilize 20,000 cubic yards of sediment at their facility in Tacoma (**P. Hogan, personal communication**). TPS Technologies would transport sediments by truck from Capitol Lake to Tacoma for treatment, and then sell the treated material. Due to a limited capacity for storage at the

treatment facility, a sediment holding facility would be required at Capitol Lake if the dredging rate exceeds the treatment rate.

Conclusion

Composting will not generate enough heat to kill purple loosestrife seeds and is not a feasible disposal option. Although soil recycling is more expensive than upland disposal and may require a holding facility for sediments, it has been included in the planning-level cost analysis because this disposal option provides a beneficial use of the sediments.

Transportation Options

For each upland disposal alternative, dredged material could be transported either by truck or a combination of rail and truck. The feasibility of using rail and truck transport is discussed below. Transportation options were not investigated for the open-water disposal because it is not a feasible alternative. Soil recycling would include truck transport provided by the recycling company.

Rail Transport

A Burlington Northern and Santa Fe (BNSF) spur line crosses Capitol Lake between the middle and north basins. The BNSF could provide rail cars for sediment loading on Tuesday, Thursday, and Saturday, and could provide an engine to move the cars. However, rail cars would not be allowed to block the line on other days of the week because the spur line is used by the Port of Olympia and other agencies/companies (**L. Smith, personal communication**). Therefore, rail transport would be limited to three days per week and would likely require additional sediment storage capacity at Capitol Lake.

Off-loading of rail cars would only be allowed on a spur line because the main rail line must be kept open for passenger and freight traffic (**L. Smith, personal communication**). Although there are no known upland disposal sites located on a spur line, several Thurston County Roads Department gravel mine sites are located within a few miles of a spur line. However, disposal at these sites would require transfer of sediments from the rail car to a truck for final transport to the site. Therefore, rail/truck transport would likely cost more than transport by truck alone. Moreover, any cost benefit of using rail transport versus truck transport typically applies only to travel distances in excess of 15 miles (**L. Smith, personal communication**).

Truck Transport

Truck transport is commonly used on construction projects that need to haul excavated materials. Trucks would have the ability to haul dredged sediments to any of the upland disposal sites investigated. Trucks were used in September and October 1998 to haul sediments from the Heritage Park wetland mitigation site to the Chehalis Western Trailhead Park (**D. Meyer, personal communication**). To haul these sediments, trucks were provided with specific ingress and egress routes to the wetland mitigation site. Use of Deschutes River Parkway by trucks is limited, but this restriction was waived by DGA to truck the wetland sediments. Therefore, trucks are a feasible transportation option for dredged sediments.

Conclusion

Trucks represent a proven low-cost transportation method to haul sediments to any upland disposal site, and were evaluated for planning-level costs. Conversely, due to problems with off-loading rail cars on a main rail line, the lack of upland disposal sites located on a spur line, and the limited cost benefit of using the rail line to transport sediments over short distances, rail transport was not analyzed for planning-level costs.

Preliminary Screening of Dredging Operations

A preliminary screening matrix (**table 2**) was prepared by the Entranco consultant team to identify and screen out alternatives with "fatal flaws", and to provide a relative alternative ranking. Because the number of combinations of dredging, dewatering, and disposal techniques is large, this preliminary screening helped the team identify two alternatives for development of planning-level costs.

Table 2
Preliminary Screening Results

Capitol Lake Dredging - Alternative Screening	Environmental Impact/ Ease of Permitting (1,2,3)	Scale 1 = Less Impact Engineering Feasibility (1,2,3)	Relative Cost (1,2,3)	Total
Clam-shell to Barge Dewater to Upland Disposal via Truck	2	1	2	5
Clam-shell to Concrete Pumper to Upland Disposal via Sealed Truck	1	3	3	7
Clam-shell to Concrete Pumper to Shore Dewater to Upland Disposal via Truck	3	3	2	8
Hydraulic to Shore Gravity Dewater to Upland Disposal via Truck	3	3	2	8
Hydraulic to Shore Mechanical Dewater to Upland Disposal via Truck	2	2	2	6
Hydraulic to Upland Disposal via Booster Line Along WSDOT ROW to Remote Site	3	3	3	9
Clam-shell to Barge Dewater to Truck to Port to Marine Disposal via Barge	3	2	3	8
Hydraulic to Mechanical Dewater at Port via pipeline to Marine Disposal via Barge	3	2	2	7

= Fatal Flaws = Selected for Costing

Alternatives Screened Out

An important "fatal flaw" was the aforementioned permitting constraint of open-water marine disposal, which effectively removed two alternatives in the screening matrix.

Although hydraulic dredging is feasible, the availability of an adequate disposal site for gravity dewatering and temporary storage of the sediment is no longer available, therefore a fatal flaw was identified for alternatives with upland gravity dewatering.

The feasibility of using "concrete pumper" technology or a high-density slurry line appears to be fatally flawed due to the high sand content of Capitol Lake sediments that deposit in the Middle Basin trap. Although there are some local sites that could potentially provide the opportunity to deliver hydraulically

dredged material directly to the final disposal site, the availability of the sites themselves for this use are undetermined at this time. Therefore the alternative "Hydraulic to Upland Disposal via Booster Line along WSDOT ROW to Remote Site" was dropped.

Alternatives Retained for Costing

The following two alternatives were retained for costing:

- Clam-shell dredging with upland disposal sites as well as soil recycling.
- Hydraulic dredging with mechanical dewatering at the DGA 11-acre site at the southwest corner of the North Basin of Capitol Lake and upland disposal. The 11-acre site contains some wetlands that would partially limit the useable area for mechanical dewatering, return flow treatment and temporary storage (**figure 5**).

For either clam-shell or mechanically dewatered hydraulic dredged material, it is recommended that dredged sediments be transported in covered trucks to a suitable upland disposal site located on Thurston County Roads Department or Parks Department property. A detailed evaluation of feasible sites and final site selection should be conducted once decisions are made regarding the actual dredging volume and timing. Each site should be evaluated for trucking route restrictions, estimated travel time, site access limitations, stockpile capacity, graded fill capacity, and soils, drainage, and groundwater characteristics. General concerns or specific constraints by department personnel should be identified. The site evaluation should also consider the potential benefits to abandoned gravel mine sites that are in need of remediation.

Permitting Implications Summary

The permits anticipated for this project are described in **table 3. Table 3** lists each permit, the reason the permit may be required, and the agency with statutory authority for the permit. This table was provided by Marziah Kiehn, DGA, and was recently updated by Herrera.

Mitigation Measures

Mitigation measures related to the two remaining alternatives would be determined during the subsequent SEPA and permitting processes for either the pilot program or the long-term program. The dredging operation planning has identified some of the following mitigation needs, which can be incorporated into the operation's design:

- Limit dredging area to minimize aquatic habitat impacts. Selection of the Middle Basin trap as the dredging location would minimize impacts.
- Limit dredging operations to appropriate construction windows to protect fish and wildlife. In-water construction would occur only from December 1st to March 15th.
- Protect Capitol Lake water quality. Water quality best management practices for treatment of dredged material return water would be incorporated.
- Protect groundwater at ultimate disposal sites. Review of sediment testing would minimize impacts.
- Protect public safety during dredging operations. Preliminary selection of the site just north of I-5 and the 11-acre site minimizes potential conflicts with the public. However, a traffic construction plan would need to be prepared and implemented to minimize truck traffic impacts during the winter construction season.

Planning-level Costs for Dredging

The two alternatives recommended for DGA's further consideration are presented in this section. These two options include:

- Hydraulic dredging with mechanical dewatering and truck transport of the sediment to an upland disposal site.
- Clam-shell dredging to a barge where the sediment would dewater overnight and then would be loaded to trucks for transport to an upland disposal site.

The hydraulic dredging alternative was developed previously and a cost estimate was presented (**Entranco 1996**). The hydraulic dredging alternative is discussed briefly below in *Hydraulic Dredging with Mechanical Dewatering and Upland Disposal.*

Table 3
Pilot Dredging Permit Information

Permit	Permit Triggered By	Contact and Statutory Authority
Section 106 Review	Triggered by the 404 Permit. Receiving federal funding, license or permit, or undertaking a federal project. Note that the National Historic Preservation Act of 1966 (NHPA) requires that all federal agencies take into account the affect of its actions on historic properties. This is a consultation.	The federal agency involved in the activity (permitting or funding agency)— Corps. Though the federal agency involved is responsible for initiating and completing Section 106 review, the project applicant may make direct contact with the Office of Archaeology and Historic Preservation.
Endangered Species Act **Section 7 - Biological Assessment (BA)** The BA evaluates the potential effects of the proposed action on listed and proposed wildlife, fish, and plant species and/or critical habitats that are likely to occur in the project area vicinity and to determine whether any such species or habitat are likely to be adversely affected by the action. • It is used to determine the need for consultation or conference. • It is required for informal and formal consultation. • It is used to achieve compliance with ESA and NEPA. • It is prepared by the project applicant, agent, or consultant. • It may include project recommendations and alternate actions (conservation measures) to reduce/avoid adverse effects. It is the technical basis for ESA coordination on a project.	Any project with a federal nexus (authorization, funding, land access, etc.) is subject to the provisions of the Endangered Species Act Section 7. This requires an evaluation for impacts (BA) to listed species (Chinook salmon and bull trout most recently listed). The U.S. Fish and Wildlife Service and/or National Marine Fisheries Service, depending on the species of fish or wildlife, conducts the evaluation of the BA. Basic responsibilities under ESA are an affirmative conservation mandate (Section 7(a)(1)), Prohibited Acts (Section 9(a)), and duty to avoid jeopardy (Section 7(a)(2)). Duty to avoid jeopardy means that it is the obligation of the federal agency to avoid jeopardizing endangered and threatened species. Project impacts are rated in degree of risk to species in increasing order: no effect, may affect but not likely to adversely affect, may adversely affect, take, and jeopardy. Section 7 is the Interagency Cooperation section requiring all federal agencies to use their authority to carry out programs for the conservation of listed species and prohibits an agency from any action that is likely to jeopardize the continued existence of any listed species. It further prohibits federal agencies or permit or license applicants from making any irreversible or irretrievable commitment of resources once Section 7 consultation has been initiated. A consultation is required anytime a project "may affect" a listed species. The effects can be either positive or negative. The federal action agency (Corps here) may initiate either informal or formal consultation. Informal consultation signifies that the impacts are insignificant or discountable and that the determination of effect is "may affect but not likely to adversely affect." Formal consultation means the determination of effect is "may affect and likely to adversely affect." Section 7 consultation processes involve six primary components that may overlap: (1) species lists, (2) conferences, (3) early consultations prior to the filing of an application for a federal permit or license (optional), (4) BAs, (5) informal consultations, and (6) formal consultations. The length of time for informal consultation is not statutorily defined. Rule of thumb, apart from the huge backlog of cases in the region, is 30 days. At the present time, few, if any, consultations are being heard within this timeframe. Initiation of informal consultation must be requested in writing by the federal agency. The request must include project information and analysis of the impacts as a result of the proposed project. If the federal agency determines (through the BA) that the action has "no effect" or "is not likely to adversely affect" (including a beneficial effect determination) AND the Service (USFWS/NMFS) concurs in writing, then the consultation is completed and no further action is required. Note: "No Effects" determinations do not usually receive a concurrence letter so make certain to request one. Formal consultation means that a federal agency determines that the proposed action "may affect, likely to adversely affect" a listed species or critical habitat. This consultation has a 135-day legal requirement with possible extensions. Through the formal consultation, an agency may recommend modifications to eliminate or reduce adverse effects. If effects can be reduced to insignificant or discountable level, then consultation can proceed informally. Formal consultation ends with the issuance of a Biological Opinion by the Service that identifies whether the action "is likely to jeopardize the continued existence of a listed species or adversely modify critical habitat." If the action is not likely to jeopardize, the project may proceed provided it follows the terms and conditions outlined in the Biological Opinion. If a "jeopardy" or "adverse modification" biological opinion is received, a project can proceed as long as any reasonable and prudent alternatives provided in the opinion are implemented. If no reasonable and prudent alternatives are contained in the opinion, the project must be abandoned, revised to avoid a jeopardy, or you can elect to pursue an exemption from the Endangered Species Act. ESA consultation can take from 4 months to 1 year.	U.S. Army Corps of Engineers (submitting agency) U.S. Fish and Wildlife Services (USFWS) for terrestrial and freshwater species, including bull trout. Contact for listing and info on listed species: • Gerry Jackson U.S. Fish and Wildlife Service 510 Desmond Dr. SE, Suite 102 Lacey, WA 98503-1273 753-9440 National Marine Fisheries Service (NMFS) for marine species, including salmon. Contact for listing and info on listed species: • Steve Landino National Marine Fisheries Services Habitat Program/Olympia Field Office 510 Desmond Drive SE, Suite 103 Lacey, WA 98503-12273 753-9440 16 U.S.C. Section 1531 Endangered Species Act of 1973 50 C.F.R. 402 Interagency Cooperation Regs

Table 3
Pilot Dredging Permit Information

Permit	Permit Triggered By	Contact and Statutory Authority
		and Tumwater if these activities occurred within both cities limits. *Permit fees required, payable to local government* Chapter 90.58 RCW Chapter 173-14 through 173-28 WAC Local Shoreline Plans and Ordinances Shoreline Management At of 1971 is administered at the local level
Corps 404 Permit **Corps Section 10 Permit**	Locating a structure, excavating, or discharging dredged or fill material in the waters of the United States, and transporting dredged material for ocean dumping. 404 Permit: Discharge of Dredge and Fill Material in waters of the United States. Corps Section 10 Permit: Work in Navigable Waters There are nationwide, regional, letter and individual permits. As part of its evaluation of individual permits (larger projects with greater potential impact), the Corps will look for efforts to avoid, minimize, and mitigate impacts (in that order). The Corps issues public notice on application, soliciting comments on the project. The public notice period is 30 days. Public comment will be factored into the evaluation of the application. As part of the evaluation, the Corps will analyze impacts on archaeological resources, historic properties, and endangered species. The Section 404 permit is only required if sediments will be transported and disposed of at a PSDDA disposal site in Puget Sound. The Section 10 permit is required for work in Capitol Lake and can take from 6 months to 1 year to be approved. This permit is the critical timeline permit for Capitol Lake dredging. All other required permits are reviewed during the same time period as the Section 10 permit. A Section 10 permit will only be approved for dredging projects that exhibit a clear beneficial use. The Corps could take longer to approve a Section 10 permit (up to several years or perhaps not at all) if they do not believe that the dredging is needed to maintain the beneficial use of the dredged area.	U.S. Army Corps of Engineers Regulatory Branch (Seattle) (206) 764-3495 33 CFR 320-330 (federal law requiring permits or licenses to comply with state water quality standards) 40 CFR 131 (federal water quality standards)
Section 9 Permit or Exemption	Not required for dredging Capitol Lake	U.S. Coast Guard
Aquatic Lands Use Permit	Not required for dredging Capitol Lake	Washington State Department of Natural Resources
NPDES Permit		Per Ecology, not needed
Water Quality Certification **401 Permit**	Triggered by an application for a federal license or permit to conduct any activity that might result in a discharge of dredge or fill material into water or wetlands, or excavation in water or wetlands. The federal agency is provided a certification from the state that the discharge complies with the discharge requirements of federal law and the state water quality standards. Usually, the federal agency requests this certification on behalf of the applicant. For Corps permit applications, timing of certification is tied to Corps permit applications. Public notice for a water quality certification may be piggybacked with the Corps public notice. The 401 Certification is required before you can obtain the Section 404 Permit (although you can apply for this along with other permits through JARPA). This permit is required to perform work in Capitol Lake and can take from 4 months to 1 year to be approved. The permit requires a BA and ESA consultation.	Ecology Headquarters Central Programs Environmental Review Section (360) 407-6300 Federal Clean Water Act, Section 401 Chapter 173-225 WAC

Table 3
Pilot Dredging Permit Information

Permit	Permit Triggered By	Contact and Statutory Authority
Ecology Section 173-304 Solid Waste Permit	An Ecology solid waste permit would be required for disposal at an upland site if sediment contaminant levels were greater than either the Model Toxics Control Act Soil Cleanup Regulations Method A criteria or the dangerous waste regulations. Upon review of existing waste characterization data, the Thurston County Health Department issues solid waste permits, and decides if the permit is required or more data are needed. In Thurston County, a solid waste permit is required if sediment contaminant levels exceed the Thurston County High Risk Waste criteria, which are one-tenth the level of the state dangerous waste criteria. The timeframe for obtaining this permit from Thurston County is unknown, but is not likely to be very long.	John Libby Thurston County Health Department (360) 786-5461 Chuck Mathews Department of Ecology (360) 407-5383
Department of Natural Resources Reclamation Plan	A DNR Reclamation Plan is required if sediments are disposed of at a gravel mine regulated by DNR, which includes all Thurston County Roads Department gravel mines. A reclamation plan requires information regarding the reclaimed lands slope stability, vegetative cover, and BMPs implemented to control off-site runoff of water and sediments. This plan can take from 2 months to 4 months to be approved, depending on site-specific conditions of the gravel mine.	Stephanie Zurenko Department of Natural Resources (360) 740-5805
Archaeological Excavation Permit (potential only if dredging brings up material of significance)	Excavation that alters or removes archaeological resources or native Indian grave sites. Note: Plans for protection or mitigation measures may be a condition of any permit issued. Be sure to cover in SEPA. The Department of Community Development, Office of Archaeology and Historic Preservation should be contacted before beginning the project to help determine any potential sites nearby that could be affected. A historic/archaeological excavation assessment may be required in some situations.	Community Development Office of Archaeology ad Historic Preservation (360) 753-5010 Chapters 27.44; 27.53 RCW Chapter 25-48 WAC
Temporary Modification of Water Quality Criteria (Water Quality Modification)	Conducting activities that might cause short-term water quality standard violations (construction, aquatic plant management, aquatic pesticide use, etc.), with particular emphasis on turbidity criterion on a short-term basis. Dewatering also triggers this. A Water Quality Modification may be required before Ecology can issue a Water Quality Certification 401 Permit. However, it is likely that Ecology would not allow temporary modification of water quality criteria for dredging Capitol Lake.	Ecology Regional Office Water Quality Program Chapter 90.48 RCW Chapters 173-20(A); 173-222 WAC
Coastal Zone Management Certification	Triggered by any projects authorized by the Corps and/or applying for certain federal permits or funding. This is a certification with Washington's Coastal Zone Management (CZM) Program. Unlike other certifications that are issued by the State, the project proponent prepares the Coastal Zone Certification, which includes a project description, a brief assessment of the impacts, and a statement that the project complies with the Coastal Zone Management Program. Ecology reviews the Certification and the proposed project for consistency with state environmental requirements, including shoreline permits. If the project is consistent, Ecology concurs with the certification in writing.	Contact: Ecology Headquarters Coastal Zone Management Program Statutory authority: Federal Law: US Coastal Zone Management Act (16 U.S.C. 1451 et seq.) and its regulations (15 CFR. Parts 923-930) Federal law requiring state management of coastal areas. Administered by the Department of Ecology.
Grading Permit	Unknown	Per Entranco: City of Tumwater Thurston County
Shoreline Permit **Shoreline Management Act** **Conditional Use Permit**	Developing or conducting an activity valued at $2,500 or more on the water or shoreline area, conducting a use or activity that materially interferes with the normal public use of the water or shorelines of the state regardless of cost, and uses constituting a conditional use or variance under the local master program. Note: floodplains and floodways incorporated into local shoreline master programs are also included. A public hearing is required. Local government requires affidavit of public notice (specific notice requirements for shorelines are different from most public hearings), a location map, a topographic map, and a site plan in addition to regular submittal requirements. If a shoreline variance or conditional use permit is required, Ecology must also approve or deny the permit or approve the permit with conditions.	Todd Stams City of Olympia (360) 753-8597 A shoreline permit would not be required by the City of Tumwater because dredging and off-loading are not proposed within the Tumwater city limits. A permit could be issued jointly by Olympia

Table 3
Pilot Dredging Permit Information

Permit	Permit Triggered By	Contact and Statutory Authority
Joint Aquatic Resource Permit Application (JARPA)	The Joint Aquatic Resource Permit Application (JARPA) applies only to aquatic resources and allows application for the following permits simultaneously: 401 Water Quality Certification Short-term Water Quality Modification Section 404 Permit Section 10 of Rivers and Harbors Act Permit Shoreline Substantial Development Conditional Use (shoreline) Variance or exemption (shoreline) Floodplain Management Hydraulic Project Approvals Endangered Species Act Consultations For dredging (either for open water or upland disposal), a JARPA must be submitted to the Corps. The JARPA must include the volume of sediment to be dredged, the area to be dredged, depth of dredging, dredging methods, dewatering methods, equipment used, proposed start date, estimated duration of activity, drawings of the proposed activity (vicinity, plan view, and cross-section view), the disposal site for excavated material, a Biological Assessment (BA), and a copy of the State Environmental Policy Act (SEPA) decision letter. The JARPA is submitted to the CCE and serves as a request for the permits listed above.	Jack Kenredy U.S. Army Corps of Engineers (Corps) Seattle (206) 764-3495 Cindy Barge U.S. Army Corps of Engineers Olympia (360) 764-5526
Hydraulic Project Approval (HPA)	Work that uses, diverts, obstructs, or changes the natural flow or bed of state waters. Applications for an HPA must include general plans for the overall project and complete plans and specifications of the proposed work within the high water mark of saltwater. The application must also include complete plans and specifications for the protection of fisheries and wildlife. The HPA will provide a restrictive window for in-water work in order to protect migrating salmon (or spawning shellfish). This permit takes approximately 2 months to be approved.	Washington State Fish and Wildlife Habitat Program (360) 902-2534 Chapter 75.20 RCW Chapter 220-110 WAC
Purple Loosestrife Transport Permit	The Washington State Department of Agriculture (WSDA) regulates the transport of purple loosestrife plants, plant parts, and seeds. The WSDA issues a permit for the transport of purple loosestrife under the authority granted by WSDA through WAC 16-752-410 - Rules Relating to Lythrum Quarantine. The permit stipulates that no infestation is to be created by transportation activities conducted under the permit. The permitee may have to meet conditions stipulated in the permit. The agency will discuss the conditions of the permit with the local noxious weed control agency.	R. Greg Haubrich Washington State Department of Agriculture Laboratory Services Division 21 N. 1st Ave., Suite 103 Yakima, WA 98902 (509) 225-2604 Perry Beale Thurston County Noxious Weed Control Agency (360)786-5576 Chapter 16-752-400 WAC
Thurston County Waste Disposal and Special Use Permit	A Thurston County Disposal and Special Use Permit is required if sediments are disposed of at a gravel mine that has an existing special use permit which limits on-site solid waste disposal. This permit can take from 2 to 4 months to be approved.	Gary Cooper Thurston County Development Services (360) 786-5475

The clam-shell dredging alternative had not been developed and presented prior to the current study. Therefore, since clam-shell dredging and off-loading to trucks for upland disposal is a feasible alternative, a conceptual plan was developed and is outlined below in *Clam-shell Dredging with Barge Dewatering and Upland Disposal*.

Table 4 provides a summary comparison of the costs developed and presented in **Appendix C**.

Table 4
Unit Costs Derived from Clam-shell and Hydraulic Pilot and Long-term Dredging Costs

Alternative	Total Costs	Cubic Yards Dredged	Unit Cost ($ per cubic yard)
Pilot Clamshell	$812,769	9,000	$90
Pilot Hydraulic	$801,759	12,000	$67
Long-term Clamshell	$2,385,558	60,000	$40
Long-term Hydraulic	$2,091,936	60,000	$35

Although clam-shell dredging with upland disposal is feasible, the estimated cost is higher than for the hydraulic dredging option. Most of this cost difference is due to higher mobilization and demobilization costs associated with the large equipment needed for clam-shell dredging.

The two alternatives identified for consideration by DGA are described below and cost estimates for both a pilot dredging project and a 60,000 cubic yards dredging operation are included in **Appendix C**.

Hydraulic Dredging with Mechanical Dewatering and Upland Disposal

The hydraulic dredge would pump the sediment slurry to the 11-acre site west of the southwest corner of the North Basin for mechanical dewatering and return water treatment. The dewatered dredged material will be hauled either to the Thurston County Chehalis Trailhead Park or to the ORV Park for final disposal and capped to prevent the germination and/or dispersal of purple loosestrife.

The methods and cost estimates for hydraulic dredging were presented previously by Entranco in the DSEIS (**1996**) and can be referred to for additional details. The costs for this alternative were estimated in 1996 based on a pilot study conducted at Capitol Lake. The updated cost estimates for this option are presented in **Appendix C**.

The 1996 cost estimate for this alternative was based on the assumption that the dewatering option would take place at the former gravity dewatering facility. Since the former gravity dewatering facility is now a wetland mitigation site, there will be some additional site preparation costs not accounted for in the 1996 cost estimate. Additional costs would be associated with preparing a portion of the 11-acre site for mechanical dewatering equipment and operations, a sediment stockpile area, and dredge pipeline crossings at Deschutes Parkway and the railroad. Site preparation work includes grading, access road improvement, drainage improvement, potential need for a biofiltration swale to detain stormwater runoff from the stockpile area, use of ecology blocks to create a sediment stockpile area, and installation of steel tubing under Deschutes Parkway and the railroad.

Clam-shell Dredging with Upland Disposal

A conceptual plan for the clam-shell dredging alternative with sediment dewatering on a barge and dredged material transport by truck to an upland disposal site was developed. This dredging plan, as discussed below, provided the basis for the planning-level cost estimate provided in **Appendix C**.

To dredge 60,000 cubic yards in a 105-calendar day in-water work period (900 work hours, assuming 15 weeks, 10-hour days, and working 6 days per week) with significant equipment will have to be mobilized to provide a daily production rate of 700 cubic yards.

Equipment and Cost Estimate

A concept that can provide a production rate of approximately 700 cubic yards/day for a maximum production of 63,000 cubic yards in a 3 ½ month in-water work period includes the use of the following equipment and methods.

A track mounted crane with a 2 cubic yards to 3 cubic yards clam-shell bucket is used to mechanically dredge the sediment and place it on a material barge. The crane is supported on a 30-foot x 80-foot barge composed of portable 10-foot x 40-foot barge sections (i.e., six sections are used to build the dredge barge). Three material storage barges, each assumed to be composed of eight portable barge sections (10-foot x 40-foot each), would provide a total surface area of 40 feet x 80 feet. A 4-foot-high fence would be constructed around the perimeter of the material barges to contain the sediment and runoff water. The cost estimate includes installation of one liquid storage tank on each barge so water from the dredge material can be collected and delivered to a water treatment system located onshore. Each barge's capacity is approximately 400 cubic yards of sediment. Once the barge is filled, the sediment would be allowed to dewater on the barge overnight before it is off-loaded to trucks using a crane and clam-shell bucket.

A truck access road would be prepared along with a staging area at the west side of the Middle Basin immediately north of the I-5 freeway (**figure 4**). The space available for this operation is extremely limited. Design would have to consider property lines. The conceptual off-load site plan (**figure 4**) was developed to minimize encroachment into the wetland mitigation site. Preparation of the off-load site includes grading, road preparation, and placement of rock on working surfaces. This preparation is required to provide adequate working surfaces during the rainy season when the work would be performed. A truck wash would be included to help mitigate environmental issues associated with control of purple loosestrife seed along transportation routes.

The material would be off-loaded directly from the barge to trucks using a crane with a clam-shell bucket. Due to the limited reach of the off-load equipment from shore, a small front-end loader would manage sediments on the material barge to make sure the crane can reach the material. Site constraints prevent construction of a complete truck turnaround that would require a circular road with an outside diameter of approximately 100 feet. Therefore, the site provides space for the trucks to drive in forward down the access road and then back into the location where they would be loaded. After the trucks are loaded, they can drive out of the site and pass through the truck wash without having to backup.

A water quality treatment system is provided to treat collected water from the material storage barge as well as water used in the truck wash. This treatment system includes two systems in parallel so that treatment can continue while the other is serviced. Each treatment system includes a 20,000-gallon storage tank and a filtering system contained on a 10-foot x 40-foot flatbed truck trailer. Common practice for clam-shell dredging of clean sediment in the Puget Sound area is to let the water from the consolidating sediment on the barge run back to the waterway; however, water quality protection in Capitol Lake is a major concern. Therefore, depending on the approach taken during permitting and agency feedback, the special water treatment system adds about $2.50/cubic yard to $3/cubic yard to the cost.

The conceptual plan (**figure 4**) includes the equipment within the off-load site as well as the material barge. Some dredging may be required to provide equipment access from the launch ramp on the south side of the I-5 freeway to the Middle Basin as well as a navigation channel between the dredging area and the off-load site. The cost estimate provided in **Appendix C** is based on the equipment and operations outlined above.

The planning-level cost estimate for the long-term maintenance dredging is $40/cubic yard based on 60,000 cubic yards of dredged material.

The pilot dredge program would use two less material storage barges and work less hours in the day, which would reduce the dredge production rate to about 400 cubic yards/day. For a pilot dredging project with a budget of $800,000,

approximately 9,000 cubic yards of sediment could be dredged at a cost of about $90/cubic yards. The reason for the high cost for relatively small dredge volumes is due to a relatively high mobilization and demobilization cost as well as costs to prepare the access road and off-load site. If clam-shell dredging were used more than one time, the costs of preparing the off-load site would be reduced significantly if the off-load site were left intact from the previous dredging operation.

Discussion of Costs

The costs for both dredging alternatives discussed above are high relative to more common dredging projects at other locations within Puget Sound. The primary reasons for these high costs include the uniqueness of the project site and the constraints.

For clam-shell dredging, the shallow draft of Capitol Lake limits the practical lifting capacity of the dredge. This reduced lifting capacity limits the size of the dredge bucket that can be used and adds to operation costs due to smaller production rates coupled with nearly fixed labor costs. Typically, clam-shell dredging operations in Puget Sound involving clean sediments placed on a barge allow the runoff water to decant back into the waterway as opposed to providing the aggressive water treatment included in this conceptual plan. Water treatment was included in the cost estimate due to the uncertainty as to whether water quality issues may result in permit conditions requiring treatment such as that included in the conceptual plan. In addition to the factors mentioned above, this is a planning-level study with resources to develop only a conceptual plan and a planning-level cost estimate for clam-shell dredging. Therefore, uncertainties that exist at the conceptual level, which could be answered with additional effort during the design phase, are compensated for by developing a more conservative cost estimate.

The costs associated with the mechanical dewatering operation for the hydraulic dredging alternative is not typical of conventional hydraulic dredging projects in the Puget Sound area. Conversion of the former gravity dewatering into a wetland mitigation site precludes the use of gravity dewatering, which is the low cost option for dewatering hydraulically dredged material prior to disposal at an upland site. For hydraulic dredging, additional costs are associated with locating the mechanical dewatering operation and sediment stockpile area at the 11-acre site in the southwest corner of the North Basin. These added costs include site preparation, drainage improvement, development of a stockpile site with ecology blocks, and installation of dredge pipeline crossings under Deschutes Parkway and the railroad line that were not included in the 1996 cost estimates (**Entranco 1996**) since the former gravity disposal site was to be used for mechanical dewatering.

For both clam-shell dredging and hydraulic dredging, the requirement to cap the material once it is placed in the disposal site is not typical for upland disposal of clean material. If the Thurston County Roads Department pit one mile away from the project site could be used for sediment disposal, the trucking costs would likely decrease by $5 to $6 per cubic yard (i.e., including contingency, taxes, etc.) relative to the cost estimates provided in **Appendix C**.

The costs above for both clam-shell and hydraulic dredging include the following planning-level costs for upland disposal. Planning-level costs were estimated for disposal of dredged sediments at the Thurston County gravel mines and parks, and at a soil recycling facility. Estimates considered prospective costs associated with transportation, disposal site work, and sediment treatment. These estimates are based on personal communications with trucking and construction companies, and a review of similar construction and mitigation projects within the Puget Sound region. The following items were included in the cost estimate:

- Trucking
- Traffic control
- Grading, capping, and revegetation
- Sediment treatment
- Contingency (assumed at 30 percent of the cost subtotal)

Preliminary cost estimates for the disposal are itemized and presented in **Appendix C**. Unit costs for upland disposal at the gravel mine and park sites range from $10.85 to $14.75 per cubic yard, and are substantially less than the estimated cost of $33.80 per cubic yard for soil recycling. Total costs vary among the upland disposal sites due to differences in assumed trucking costs.

Trucking costs are based on a unit cost of $6 per cubic yard that was previously estimated for dredging of Capitol Lake (**Entranco 1999**). A trucking company recently confirmed this unit cost, assuming a 1-hour loading and travel time (**D. Onslee, personal communication**). It was also assumed that the trucks would be covered to reduce the potential spread of purple loosestrife, which would increase transportation costs by up to $1 per cubic yard (**D. Onslee, personal communication**).

Based on a range of travel distances, a range of costs are presented for trucking to the Thurston County Roads Department gravel mines. The low estimate assumes a travel distance of less than 5 miles, while the high estimate assumes a travel distance of 10 to 15 miles. Costs for transportation to the gravel mine sites assume a rate of $5 per cubic yard for the low estimate and a rate of $8 per cubic yard for the high estimate. During disposal site negotiations, further discussion

for gravel mine site PS-J-49 is within one mile of Capitol Lake. If this were approved, a significant cost savings could be achieved.

Costs for transportation by covered trucks to the Chehalis Western Trailhead Park assume a rate of $7 per cubic yard for the 8-mile distance. Costs for trucking 16 miles to the ORV Park also assumes a rate of $7 per cubic yard because this site is located on a freeway and would require a similar travel time.

Traffic control costs assume a total of 600 hours and a rate of $50 per hour for each upland disposal site. The traffic control time is based on one 15-cubic-yard truck leaving the dredge site every 15 minutes. The traffic control rate is based on two persons to flag both directions of travel on Deschutes River Parkway.

Costs for grading at the disposal sites are based on $2 per cubic yard of dredged sediments (**D. Onslee, personal communication**). Capping costs assume that cover material would be excavated from the disposal site and would not be imported. Capping costs are based on $3 per cubic yard of cover material (**D. Onslee, personal communication**), and assume that 5 acres of land would be covered with 6 inches of material. Revegetation costs are based on $1,000 per acre (**D. Onslee, personal communication**), and assume that a revegetation seed mixture would be applied to 5 acres of land.

Costs are not included to monitor purple loosestrife at either the disposal site or wetlands located on the trucking route because the TCWCB would assume those responsibilities at no cost to the proponent (**P. Beale, personal communication**).

Implications of Hydraulic Scour and Flood Analyses Results on Sediment Management

Hydraulic analyses for the CLAMP lake alternative (**Entranco 2000a**) showed that a minimal dredging program, focused on the Middle Basin sediment trap, would not have a significant impact on the potential for scour-related impacts. Similarly, flood flow analyses (**Entranco 2000b**)showed that the minimal dredging program would not significantly affect the predicted flood levels.

Pilot Dredging Program

This draft report considers several alternative dredging programs. These alternatives were also considered as a pilot dredging program. These programs were screened down to two alternatives:

- clam-shell dredging with barge dewatering and trucking to upland disposal at the Thurston County Roads Department or Parks Department properties.

- Hydraulic dredging with mechanical dewatering at the DGA 11-acre site at the southwest corner of the North Basin of Capitol Lake and upland disposal at the Thurston County Roads Department or Parks Department properties.

For the pilot dredging project with a budget of approximately $800,000 the estimated volume that could be removed is 9,000 cubic yards (clam-shell dredging) and 12,000 cubic yards (hydraulic dredging). These small-scale operations have higher costs due to their higher fixed costs relative to the amounts dredged.

The cost difference between the clam-shell and hydraulic dredging alternatives is not the only factor to consider in selecting a dredging strategy. Both clam-shell and hydraulic dredging are proven, commonly used techniques. However, the mechanical dewatering, associated with the hydraulic dredging, is an experimental technique. This approach has more uncertainty in both the dewatering technique and the water quality treatment of return water. A pilot mechanical dewatering study (**Entranco 1995**) used a small dredge (4-inch) and low dredging production rate. There is some uncertainty on how well this will perform under a full-scale operation. Operators noted that the sand content of Capitol Lake sediments should be separated prior to dewatering the fines. This would require additional equipment and would affect ultimate costs.

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APPENDIX A

Capitol Lake Adaptive Management Plan Sediment Work Group Meeting

Capitol Lake Adaptive Management Plan
February 09, 2000 - Sediment Work Group Meeting

Summary and Preliminary Answers to Questions

Objective to be achieved:

"Manage sediment within the basin in the most cost effective and environmentally appropriate way." One specific dredging option will be analyzed—a "minimalist" approach to remove only new sediment that is deposited in the Middle Basin trap.

Agenda Included:

- Discuss the Sediment Work Group minutes of January 25, 1999
- Establish environmental criteria for comparison to clarify above objective
- Location of dredging (lake and/or estuary)
- Method of dredging
- Method and location of dewatering
- Method and location of disposal
- Frequency and duration of dredging
- Mitigation measures
- Overview of hydraulics/flood analyses

Attendees included:

Steven Morrison – TRPC

Cliff Ikerd – GA/DCF

Andy Stepelton – GA/DCF

Peter Waugh – GA/E&AS

Dale Anderson – Entranco

LeGrand Velez – Olympia (for Emmett Dobey)

David Morency – Entranco

Rob Zisette – Herrera (sub to Entranco)

Jerry Ramsden – Ogden Beeman (sub to Entranco)

Perry Lund – Ecology/SWRO

Dan Barth – DNR

Margaret McPhee – City of Olympia

Jim Fraser – WDFW

Ralph Nelson – Entranco

Jeff Dickison – Squaxin Island Tribe

Summary

The following summary was prepared from the recorded meeting notes.

During introductions, the difference between this meeting and the project scoping meeting held last October was clarified. The scoping meeting was to confirm that Entranco's scope was on target. The focus of this meeting was sediment management.

The meeting objective was to discuss the issues related to dredging Capitol Lake so the Entranco team can better define key questions to answer. Meeting results will help focus their work product in "Task 11 – Sediment Management – Answers to Technical Questions".

Meeting ground rules were established – For this meeting, we agreed not to debate whether or not dredging should be allowed in Capitol Lake. We also agreed that the purpose of this meeting was not to choose a CLAMP alternative—this is the responsibility of the CLAMP Steering Committee

Discussed the Sediment Work Group minutes of January 25, 1999 and January 12, 2000.

The following Questions *(Q)* were raised and some answers **(A)** were provided:

1. *Q: Disposal Standard Concentration – Is there a standard for purple loosestrife seed concentration that serves as a regulatory threshold for allowing/ disallowing Puget Sound disposal of dredged material?*

   A: No one knew of a disposal standard concentration. We need to clarify with the PSDDA agencies – a letter has been sent.

   PSDDA does not have a regulatory standard for purple loosestrife seed concentration to determine the suitability for disposal of dredged material (David Kendall, personal communication 2000). PSDDA held a meeting in

February 2000 to discuss a variety of disposal issues, including how to regulate purple loosestrife contaminated sediments (Ted Benson, personal communication 2000). As of March 28, 2000, a formal PSDDA decision on purple loosestrife seeds in sediments had not been made. Herrera has remained in contact with David Kendall (Corps) and Ted Benson (DNR), and will notify the project team if PSDDA makes any regulatory decision on this issue.

2. *Q: What is the regulatory dredging window for Capitol Lake?*

   A: Jim Fraser said - For Capitol Lake, late fall, November 1 to mid March.

3. *Q: What is the regulatory dredged material disposal window for Puget Sound?*

   A: Need to check for marine disposal.

4. *Q: Will ESA affect the dredging permit process with NMFS?*

   A: Yes, hatchery Chinook will receive NMFS attention for ESA. David Morency referenced federal register announcement, which may have bearing on this.

5. *Q: Who regulates the purple loosestrife quarantine for Capitol Lake?*

   A: Washington State Department of Agriculture (WSDA) is the lead; more research on process for regulatory approval is needed (Steven Morrison recently talked to them).

   The WSDA regulates transport of purple loosestrife plants, plant parts, and seeds (Perry Beale, personal communication 2000; Greg Haubrich, personal communication 2000). The agency issues a permit for the transport of purple loosestrife under the authority granted by the Department of Agriculture through WAC 16-752-410 - Rules Relating to Lythrum Quarantine. The permit stipulates that no infestation is to be created by transportation activities conducted under the permit (Greg Haubrich, personal communication 2000).

   The permit may specify conditions to be met. For example, the following conditions were included in a July 15, 1997 WSDA permit issued to Simpson Timber:

   - A dredged material dewatering plan and transportation route must be provided to WSDA.
   - The proponent must inspect each stream crossing along the transportation route for the presence of purple loosestrife. The

inspections must extend for 50 feet along the banks of each stream crossed and along roadside ditches exhibiting wetland vegetation. An initial inspection at the time of transport and the following spring are required, as well as annual inspections for a period of 3 years.

- Dredged material containing loosestrife placed in a landfill must be covered by a minimum six-inch layer of soil within two weeks of disposal.

6. *Q: How do we get a threshold decision by PSSDA Agencies and, if required, the State by Department of Agriculture, for disposal to Puget Sound? In other words, if Agencies won't allow disposal for dredged material that contains purple loosestrife seeds, it has a significant effect on how we proceed with sediment management (e.g. sediment disposal approach).*

A: We need to clarify with the Agencies – a letter has been sent. We need to do follow-up on the role of State by Department of Agriculture.

PSDDA has not finalized a regulatory policy on disposal of sediments containing purple loosestrife seeds (David Kendall, personal communication 2000; Ted Benson, personal communication 2000). However, PSDDA stated that they are concerned about the possible spread of purple loosestrife through disposal in Puget Sound (Ted Benson, personal communication 2000). The Corps has indicated that loosestrife policy issues are being made by DNR (David Kendall, personal communications, 2000). Although in the past, DNR has stated that they might consider open-water disposal at the Anderson/ Ketron site if the sediments were placed in geo-tubes, they recently stated that this disposal option is not likely due to the concern of spreading loosestrife to the Nisqually River delta area (Ted Benson, personal communication 2000). DNR recommended that another disposal option be investigated for Capitol Lake sediments (Ted Benson, personal communication 2000). In lieu of this recommendation, the Corps requested that DNR investigate the possibility of disposing of the sediments at the Commencement Bay PSDDA open-water disposal site (David Kendall, personal communication 2000). As of April 5, 2000 DNR had not contacted the Corps regarding the possibility of using the Commencement Bay site.

The WSDA regulates the transport of sediments containing purple loosestrife plants, plant parts, and seeds. Several years ago, WSDA recommended (to PSDDA) against open-water disposal of any sediment containing purple loosestrife (Greg Haubrich, personal communication 2000). Before open-water disposal is possible, the WSDA must issue a transportation and disposal permit. As of March 30, 2000, it is uncertain whether or not the WSDA would issue such a permit because the agency

prefers upland disposal of purple loosestrife. If the permit were issued, conditions of the permit could include investigating the Nisqually River Delta area for the presence of purple loosestrife infestation for a period of 3 years (Greg Haubrich, personal communication 2000).

7. *Q: Is there a link between benzoic acid and purple loosestrife?*

   A: No

8. *Q: What is problem with benzoic acid?*

   A: The 1995 Capitol Lake sampling found unacceptable concentrations in some sectors, which could preclude disposal in Puget Sound. Note: There was some discussion on potential upland sources of benzoic acid.

9. *Q: How do the 1995 sediment sampling results pose a sampling challenge now?*

   A: To follow PSDDA sediment testing protocol, the past results trigger more sampling than was budgeted (assuming we test the sediment for the entire Middle Basin and Percival Cove). One option is to follow the "minimalist" approach of just dredging the Middle Basin sediment trap; this would require less PSDDA sediment sampling.

10. *Q: How do we proceed with PSDDA sediment sampling of Capitol Lake?*

    A: We need to get the PSDDA agencies response to our letter.

    A draft sampling plan was submitted to the Corps, DNR, Ecology, and EPA. This sampling plan outlined the partial characterization of dredging 70,000 cubic yards from the Middle Basin sediment trap. A review of the plan is typically made within 3 weeks of receipt of the document (David Kendall, personal communication 1999). To meet the project schedule, sampling will be conducted in accordance with the draft plan, but attempts will be made to incorporate PSDDA comments into the sampling/ analysis methods if time permits.

    Sidepoint: Jim Fraser noted that a WDFW meeting was scheduled to discuss moving the Percival Cove rearing operation to an upland site; this could eliminate the need to dredge the cove.

The meeting moved on to discuss specific dredging issues – The agenda listed several dredging topics. A "Straw Poll" was informally taken on which topic was most important to discuss with the remaining meeting time. The vote was:

- 0 votes - Establish Environmental Criteria to define cost-effectiveness/ environmentally appropriate/minimalist approach

- 0 votes - Location of Dredging
- 2 votes - Method of Dredging
- 6 votes - Method and Location of Disposal
- 2 votes - Frequency and Duration of Dredging
- 1 vote - Mitigation Measures

The following information was discussed as a result of the voting:

Method of Dredging – Jerry Ramsden provided an overview of a hybrid Clam-shell/Hydraulic dredging approach. It uses a "Concrete" pumper to move sediment to:

- barge container
- rail container
- truck container
- geo-tubes ("socks" to contain material)

This approach to dredging appeared to have promise for the following reasons:

- It avoided disposal of a high water-content slurry of dredged material – the PSSDA agencies apparently will not permit the barge slurry concept developed for the earlier dredge plan (need to check this).
- It could be pumped to the above locations in a more manageable state

Dredged Material Handling by Clam-shell vs. a Concrete Pumping System

Given no restrictions on water content for either truck or rail car transport of dredged material to an upland disposal site (other than the adjacent 11-acre parcel), will a clam-shell to barge with subsequent clam-shell to truck (or rail) operation be more economical than using clam-shell to a concrete pumping system to truck (or rail car)? The answer to this type of question is dependent on many factors including dredge material gradation (i.e., do we have gravel exceeding a particular size, which will produce problems for a concrete pumping system), fines content of the sediment, how rapidly the sediment will dewater if left one or more days on a barge, the haul distance to the disposal site, and whether there is a tipping fee based on tonnage (all of which would increase costs associated with excess water in the sediment).

A concrete pumping system is capable of delivering a slurry with a higher percentage of solids than what is typical of a hydraulic dredging operation.

However, approximately one to two parts water per one part sediment, on a volume basis, is needed to provide adequate slurry flow properties in the concrete pumping system. Due to the difficulty of delivering material to Budd Inlet, a hydraulic system (i.e., either a concrete pumping system or a hydraulic dredging system) is likely the most economical approach for delivery of dredged material to a haul barge. However, if a viable off-site upland disposal location is identified, the material could be dredged using a clam-shell bucket, placed on a barge, and allowed to dewater for an evening or a few days. After some period of dewatering, the material could be loaded into trucks or onto rail cars using a crane operated clam-shell bucket. This may substantially reduce the water content of the material relative to what would be loaded on a truck or into rail cars directly from a concrete pumping system. If there is a substantial haul distance and/or tipping fees, the barge dewatering alternative needs to be compared against the costs associated with a the use of a concrete pumping system and disposal of dredged material with a higher water content.

One disadvantage of the concrete pumping system for transport of dredged material is the potential for a clogged pipe system and the need to provide sufficient water with the sediment prior to pumping. In contrast, the use of a clam-shell bucket to off-load the dredged material from a barge to a rail car or a truck will not be subject to potential problems associated with hydraulic transport of material including clogged pipes, clogged pumps, and debris. Some of the potential problems due to debris and over sized gravel or rock can be reduced through the use of a screen over the hopper feeding the concrete pumping system. Another possible disadvantage of the concrete pumping system occurs in the event that dredged material must be dewatered to meet the paint filter test before transporting the material to the designated disposal site. In such a case, the material will need to be dewatered after discharge from the concrete pumping system thereby eliminating the possibility of directly pumping the dredged material into trucks or rail cars.

Dredged Material Transport by Rail vs. Truck

Based on existing available information material can be transported by rail. However, is rail transport economical? Every time the dredged material is re-handled costs associated with the project increase. There is no way to tell if rail transport is economical until we have detailed information on all viable disposal sites and whether any of them have features or equipment that would allow cost effective placement of the material in the site after it arrives by rail. Alternatively, dredged material transported by truck can likely be delivered to the required location in the disposal site without a separate rehandling operation.

We do not have the information at this time needed to estimate costs for deep-water disposal in geo-tubes or in a tremie tube. Development of cost estimates to serve as a comparison with other disposal options will require additional

information. As a basis for such an analysis, all other viable disposal sites need to be identified and summarized with respect to distance from Capitol Lake, dredged material dewatering requirements, capacity relative to the sediment volume, tipping fees, and costs of material handling within the disposal site if applicable.

Use of Clam-Shell vs. Hydraulic Dredging

Both are practical alternatives depending on the available disposal site. One major benefit of mechanical dredging is the minimization of excess water introduced into the dredged material. The use of hydraulic dredging adds significant amounts of water that must subsequently be removed from the dredged material. The benefit of hydraulic dredging is that in many cases it is less expensive provided a nearby disposal site can be used. If the material will need to be rehandled to another disposal site after being dewatered, the potential economic benefit of hydraulic dredging may be substantially reduced or eliminated relative to direct placement of dredged materials into trucks or rail cars for transport to an off-site disposal location.

Use of Rail Lines for Transport of Dredged Materials

See discussion provided above in the Summary Comment.

The Potential for Using a Barge or an Upland Site for a Dewatering Facility

Barges could be used to serve as a dewatering facility provided the material meets the water content requirements for the disposal site within a day or two. If more time is required for the material to meet the disposal site dewatering requirements, a larger upland dewatering facility may be needed. If material is not able to meet the dewatering requirements within a given timeframe by gravity dewatering, then desiccants (drying agents) can be added to the dredged material to eliminate the excess free water. The disadvantage of this approach is the extra cost and volume (tonnage) associated with adding the desiccant.

The option for hydraulic dredging and dewatering at the local 11-acre site adjacent to Deschutes Parkway may be worth pursuing especially if the City or County can use the dewatered material for construction or landscape projects in the local area. Use of the material locally would eliminate difficulties associated with transporting the dredged material outside of the quarantine area. Disposal costs may be lower if the material can be used beneficially.

Method and Location of Disposal

As mentioned in the Summary Comment the answer to this question is paramount. Viable disposal sites must be identified that can serve as a basis from

which to develop a set of dredge plans (including dredging methods, dredged material handling and dewatering methods, dredged material transportation options, disposal locations, and cost estimates) for evaluation.

The following discussion represents further questions on the highest ranked item of method and location of disposal:

Related to Feasibility of Dredging Operation

11. *Q: How much sediment are we going to move?*

    A: This question directly relates to the "where to dredge?" issue. This triggered a discussion of the long-term effectiveness of a "trap-only" dredging program. A point was made that other areas of the lake would experience sedimentation if only the trap were dredged. David Morency noted that past estimates of sedimentation are on the order of 1 inch per year as a lake average.

    Until the CLAMP makes a decision on the preferred alternative, we decided to define our "minimalist" approach as dredging only the Middle Basin trap. This will allow us to develop a dredging plan that can define how much sediment we are going to move.

    The PSDDA sampling plan assumed 70,000 cubic yards would be removed from the Middle Basin sediment trap. This sediment volume was calculated by using an average dredging depth of 3 to 4 feet over a 12-acre area. It is recognized that less sediment may be dredged for the pilot study based on the available budget. The amount and area of dredging will be determined upon further analysis of costs as they relate to disposal options and sediment characterization results.

12. *Q: What will be the size requirements for a dredging barge; what depth of water will it be able to operate in?*

    A: This needs further study.

    For a mechanical dredging operation, the working barge sections will likely be composed of 10-foot-wide by 40-foot-long barges that can be brought to the site, launched, and combined on the water to create the required surface area. For either a small clam-shell bucket operated by a crane or a backhoe, the barge supporting such equipment is likely to be in the size range of 30 feet to 40 feet wide, 80 feet long, and have a draft somewhere in the range of 2 feet to 4 feet. If the dredged material were to be temporarily stored on barges prior to off-loading, using equipment such as a clam-shell bucket, the 10-foot by 40-foot barge sections would be combined to a convenient size for use in temporary dredged material storage. When loaded with approximately 2 feet of dredged material, the barge would likely draft

somewhere in the range of 3 feet to 4.5 feet depending on the water content of the dredged material and the specific gravity of the solids. Therefore, a draft of approximately 6 feet should be sufficient for both the equipment barges and the fully loaded dredged material storage barges. A draft of 6 feet will also be sufficient to operate a small hydraulic dredge.

13. *Q: What will be the timing of dredging operations? How long will it take to remove the planned amount? How will this compare to the "fish window" for permitting?*

    A: Assume 200 cy to 400 cy of material can be dredged per day based on a single shift (8 hours) and a double shift (16 hours) for mechanical dredging, respectively. The number of working days required to dredge 20,000 cy would be 100 days for a single shift operation or 50 days based on a double shift. Therefore, work over a double shift may be required to remove 20,000 cy between Dec. 1 and March 1. However, depending on the contractor, equipment used, length of a single shift (8 hours or 10 hours), length of workweek, etc. the actual daily production rate and duration could vary from the estimate provided above. A material handling process consisting of either the concrete pumping system or clam-shell dredging to a barge with subsequent clam-shell off-loading from the barge to a truck or rail cars should be able to keep up with the 200 cy to 400 cy per day production rate assumed above.

    If hydraulic dredging with dewatering and temporary storage at the 11-acre site adjacent to Deschutes Parkway is assumed, the portable hydraulic dredge size can be selected to provide production rates sufficient to complete the project within the three-month work window.

Related to Method and Location of Disposal

14. *Q: Can we dispose of dredged material in Puget Sound?*

    A: See above discussion

15. *Q: Can we dispose of dredged material at upland sites?*

    A: This needs further study.

    The WSDA has stated that upland disposal of sediments containing purple loosestrife plants, plant parts, and seeds is the preferred disposal option (Greg Haubrich, personal communication 2000). Conditions for the transport permit required by WSDA for upland disposal were previously discussed under Question 5.

    For upland disposal, WSDA has stipulated that sediments containing purple loosestrife plants, plant parts, and seeds must be disposed of at a dry

location, covered with at least six inches of soil within two weeks of disposal, and must remain undisturbed for a period of at least 8 years (Greg Haubrich, personal communication 2000). The 8-year time period is an estimate, and the exact time frame for the sediments to remain dry and covered could change.

Upland sites being investigated as possible disposal options include landfills, gravel mines, and park lands in Thurston, Kitsap, and Pierce counties, as well as soil recycling facilities. Information pertaining to site location, capacity, availability, permits required, analysis required, and preliminary cost estimates are discussed below under Questions 17 and 18.

Related to How to "Treat" Purple Loosestrife

16. *Q: Can we use composting operation?*

    Heat kills loosestrife seeds

    Use – Convert to "resource"

    Growing – let it sprout at compost site

    Sediment remediation for chemical contamination

    Farm It – Grow the purple loosestrife then plow it under; suggestion to use City of Centralia – WSU site

    "Fire it" – To create ash

    A: This needs further study.

17. *Q: How do we transport dredged material to disposal site considering?*

    Leakage of containers

    City/ County laws for transport of seeds

    Use of geo-tubes is expensive

    Idea offered to install a permanent line for dredged material transport from Middle Basin Trap area to disposal or transfer site

    Idea to use the rail system to transport to disposal site

    A: This needs further study.

    - ***Leakage of containers.*** **Specify the use of sealed containers.**

- *City/ County laws for transport of seeds.* This question is deferred to the regulatory authorities responsible for providing guidance on such issues. One likely requirement is that transport occurs in a sealed container or a dump truck with a cover to prevent material loss during transport.

- *Use of geo-tubes is expensive.* Not only are geo-tubes expensive but the labor it takes to fill them and handle them is also expensive. For this project it is likely that the only potential economic use of geo-tubes would be for disposal of dredged material at an open water PSDDA site. In such a case, the low cost transport and disposal cost would at least somewhat offset the cost of the geo-tubes and the labor required to fill them.

- *Idea offered to install a permanent line for dredged material transport from Middle Basin trap area to disposal or transfer site.* For either a hydraulic dredging operation or a concrete pumping system, we do not suggest the installation of a buried pipeline. There is a potential for pipe failures and or clogs that would be more costly to remedy in the event of a buried pipeline. However, there may be locations where permanent installation of a submerged pipeline crossing may be warranted such as under Deschutes Parkway or under the railroad tracks.

The Thurston County Weed Board stated that disposal of sediments at a compost facility would not be allowed because a composting operation would not generate enough heat to kill the loosestrife seeds (Perry Beale, personal communication 2000). However, soil recycling facilities that are designed to remove organic contamination by heating sediments to temperatures of 450 to 800 degrees would kill the loosestrife seeds. At temperatures of 450 to 800 degrees, the loosestrife seeds will ignite, thereby allowing the sediments to be used for composting or other beneficial uses.

TPS Technologies Inc. (1-800-375-3755), a soil recycling company, was contacted. TPS could sterilize 20,000 cubic yards of sediment, but they do not have a large enough holding facility to store all the sediment on-site and would require a holding facility for sediments at Capitol Lake. The estimated length of time to sterilize 20,000 cubic yards was 3 months (Peter Hogan, personal communication 2000).

A cost estimate was generated using a dewatered sediment moisture content of 25% and a grain size distribution of 60% silt, 27% sand, and 13% clay (Entranco 1996). In addition, a ratio of 1.7 tons per cubic yard of sediment was used for all cost estimates. The initial cost estimate using the above parameters was $38/ ton to heat the sediment and $7/ ton to haul the sediment from Capitol Lake to the recycling facility (Peter Hogan, personal

communication 2000). It was recommended that a test burn be conducted on the sediments prior to the full scale operation to determine the temperature and heating time needed to sterilize the soil.

18. *Q: Where do we send the dredged material?*

    A: Some suggested sites included:

    - 11-acre site next to Marathon Park – possible upland staging site for loading sediment on rail cars to transport out of basin
    - Landfill for capping
    - Gravel pit sites
    - Use at Heritage Park

    This needs further study.

    Upland locations investigated include landfills, gravel mines, and parks department lands. Preliminary information on site availability, capacity, permits, analysis, and costs are provided below:

Landfills

- Thurston County Landfill: The Thurston County Landfill is located approximately 9 miles northeast of Capitol Lake. The landfill is closing May 1, 2000 and could accept approximately 35,000 cubic yards of sediment from Capitol Lake to be used as grading/ capping material, if the sediments are sufficiently dewatered (25% moisture) and delivered by August 1, 2000. The landfill needs a commitment by April 30, 2000 as to whether or not Capitol Lake sediments will be delivered by the August 1, 2000 deadline. The landfill would not charge a disposal fee, but the sediment must be delivered and dumped at the landfill (Dave Merril, personal communication 2000).

  Thurston County Health Department regulates permitting and analytical requirements for disposal of sediments at the landfill (John Libby, personal communication 2000). The Health Department would review the analytical results from the 4 sediment cores collected for the preliminary PSDDA sampling plan. If the data indicate that no contaminants of concern are present, the Thurston County Health Department would not require any additional sampling for disposal at an upland site. However, if contaminants are present at concentrations above the Thurston County Dangerous Waste Regulations, then the Health Department would require additional sampling at a frequency to be decided upon when the actual data are available (John Libby, personal communication 2000).

Thurston County requires that sediments be analyzed for contaminants listed under the Thurston County High Risk Waste contaminant list. This list is similar to the Ecology Dangerous Waste Regulation contaminant list. However, the Thurston County criteria levels are one-tenth the DOE criteria levels. Sediments would have to pass the more stringent Thurston County guidelines for disposal at the Thurston County landfill.

- Olympic View Landfill: The Olympic View Landfill is located in Port Orchard, Kitsap County approximately 50 miles north of Capitol Lake. The landfill is closing in the summer of 2002 and could accept approximately 100,000 to 200,000 cubic yards of sediment from Capitol Lake to be used as grading/ capping material. The landfill has an inert fill area where the sediments could be disposed of for use during closure operations. To be used for closure, the dredged material must be dewatered and bulkable. The landfill would require the sediments to pass a more stringent test than the paint filter test (i.e., the sediments need to be stackable). The landfill suggested using flyash, cement, or sawdust as filler material to bulk up the sediments so they could be used for closure. The landfill would charge a nominal disposal fee of approximately $15 per truck load of sediment (approximately $1/ cubic yard or $0.60/ ton) (Damon DeFrates, personal communication 2000).

  The Bremerton-Kitsap County Health Department has given the authority to regulate permitting and analytical requirements for disposal of sediments at the Olympic View Landfill to Waste Management Inc. (Kristin Clayton, personal communication 2000; Mike Mears, personal communication 2000). The Olympic View Landfill would require 10 samples for the first 2,000 cubic yards of sediment, and then 1 sample per 500 cubic yards. For 17,000 cubic yards of sediment, this sampling scheme works out to 40 samples. Because of the large volume of sediment, the landfill may accept a reduced number of samples depending on the results of the preliminary PSDDA sampling. If the 4 cores collected for the PSDDA sampling have low concentrations of all contaminants of concern, then the landfill would accept a reduced sampling effort (possibly 20 samples) (Kristen Clayton, personal communication 2000).

  The Olympic View Landfill requires sediments be analyzed for contaminants listed under the Ecology Dangerous Waste Regulation contaminant list. The Ecology contaminant criteria are used by the Olympic View Landfill.

- Pierce County Landfill: Hidden Valley Landfill (Pierce County) is located in Puyallup, Washington approximately 30 miles east of Capitol Lake. The landfill is new and has sufficient room to dispose of 70,000 cubic yards of sediment. However, the landfill does not need any grading/ capping material and would charge the full tipping fee (approximately $93/ ton) for sediment disposal (Harvey Doman, personal communication 2000).

The Tacoma-Pierce County Health Department regulates permitting and analytical requirements for disposal of sediments at the landfill (David Bosch, personal communication 2000). The sampling requirements are similar to the requirements for Thurston County described above, and the required analyses and criteria are similar to those described above for Kitsap County (David Bosch, personal communication 2000).

Gravel Mines

- Thurston County Private Gravel Mines: The Land Use Company owns a DNR licensed gravel mine located in Thurston County on the Old Yelm Highway approximately 9 miles east of Capitol Lake. This mine can accept up to 70,000 cubic yards of sediment by August 2000. Estimated disposal costs are $125 per truck dump (approximately $8 per ton), trucking costs are estimated to be $7 per ton (Edwin W. West, personal communication 2000).

  Sampling and analytical requirements are similar to those described above for Thurston County landfill disposal.

- Thurston County Roads Department Gravel Mines: Thurston County Roads Department owns several gravel mines that could accept Capitol Lake sediments to be used to fill in the gravel mine and reclaim the site. There would be no disposal cost; however, there would likely be a site reclamation cost. Trucking costs are estimated to be $7 per ton. At this time, Thurston County Roads Department is uncertain about when the mines would be reclaimed or how much sediment they may be interested in receiving. Therefore, use of the sites would be contingent upon further discussion and approval by the Thurston County Roads Department (Dick Weston, personal communication 2000).

  Sampling and analytical requirements are similar to those described above for Thurston County landfill disposal.

Thurston County Department of Parks and Recreation Land

- Chehalis Western Trailhead: The Chehalis Western Trailhead is located approximately 8 miles southeast of Capitol Lake. Approximately 64,000 cubic yards of sediment from Heritage Park was disposed of at this site in a 5-acre abandoned gravel mine located in the northeast corner of the park. Entranco (1996) estimated this mine had sufficient capacity to stockpile up to 120,000 cubic yards of sediment. Therefore, it is possible that this site could accept additional material from Capitol Lake. There would be no disposal cost; however, there would likely be a site reclamation cost. Trucking costs are estimated to be $7 per ton. At this time, the Thurston County Department of Parks and Recreation is uncertain about the possibility of receiving additional sediment at this site. Therefore, site use would be

contingent upon further discussion and approval by the Thurston County Department of Parks and Recreation (Michael Walter, personal communication 2000).

Sampling and analytical requirements are similar to those described above for Thurston County landfill disposal.

- Thurston County ORV Park: The Thurston County ORV Park is located 16 miles west of Capitol Lake on State Highway 8. This park has an abandoned gravel mine on the park land that might be able to be used as a receiving site for Capitol Lake sediment. There would be no disposal cost; however, there would likely be a site reclamation cost. Trucking costs are estimated to be $7 per ton. Information pertaining to abandoned mine size and capacity is unknown. At this time, the Thurston County Department of Parks and Recreation is uncertain about the possibility of receiving sediment at this site. Therefore, site use would be contingent upon further discussion and approval by the Thurston County Department of Parks and Recreation (Michael Walter, personal communication 2000).

  Sampling and analytical requirements are similar to those described above for Thurston County landfill disposal.

Permits Required for Upland Disposal

Gravel Mine Permits

- DNR Reclamation Plan: A DNR Reclamation Plan is required if sediments are disposed of at a gravel mine regulated by DNR. A reclamation plan requires information regarding the reclaimed lands slope stability, vegetative cover, and BMP's implemented to control off-site runoff of water and sediments. This plan can take from 2 months to 4 months to be approved, depending on site specific conditions of the gravel mine (Stephanie Zurenko, personal communication 2000)

- Ecology Section 173-304 Solid Waste Permit: A Ecology solid waste permit would be required for disposal at a gravel mine if sediment contaminant levels were greater than either the Ecology Model Toxics Control Act Soil Cleanup Regulations Method A criteria or the Ecology dangerous waste regulations (John Libby, personal communication 2000; David Bosch, personal communication 2000; Mike Mears, personal communication 2000). The local health department issues Ecology solid waste permits and decides if the permit is required. In Thurston County, a solid waste permit is required if sediment contaminant levels exceed the Thurston County High Risk Waste criteria, which are one-tenth the level of the state dangerous waste criteria (John Libby, personal communication 2000). The timeframe for obtaining this permit from Thurston County are unknown at this time.

- Thurston County Disposal Permit and Special Use Permit: A Thurston County Disposal Permit and Special Use Permit may be required if sediments are disposed of at a gravel mine that has an existing special use permit that limits on-site solid waste disposal (Gary Cooper, personal communication 2000). This permit can take from 2 to 4 months to be approved. The County disposal and special use permits are not required if the sediments are disposed of at an abandoned gravel mine on county property.

Landfill Permits

- Landfill Waste Disposal Application: Disposal of sediment at a landfill would require a landfill waste disposal application. Included with this application must be: The sediment analytical results, the QA/ QC report, and the chain-of-custody (Kristin Clayton, personal communication 2000; John Libby, personal communication 2000). This permit is obtained from the landfill.

Transportation Permit

- Transporting Capitol Lake sediments to an upland disposal site would require a WSDA purple loosestrife transport permit. Conditions of this permit were previously described under Questions 5 and 6.

17. *Q: How does the State Department of Agriculture determine the acceptable risk for transport of dredged material with purple loosestrife seeds?*

    A: Look at the Thurston Co. Parks – Chehalis Western Trailhead has received Heritage Park fill – check out this site to see if purple loosestrife is showing up. This needs further study.

    The WSDA allows transport of dredged material containing loosestrife seeds under the conditions previously described in Questions 5 and 6.

    Purple loosestrife has not been observed growing at the Chehalis Western Trailhead site that received Heritage Park fill (Michael Walter, personal communication 2000). There may be space to place 17,000 cubic yards of sediment on top of the Heritage Park fill. However, Thurston County Parks is uncertain about the placement of additional fill at this site and how much sediment could be accepted (Michael Walter, personal communication 2000). Use of the Chehalis Western Trailhead site would be contingent on further discussion and approval by the Thurston County Department of Parks and Recreation.

20. *Q: Would a permit meeting with the State Department of Agriculture and Noxious Weed Board help resolve some of the transport/ disposal issues?*

    A: Yes

Transport of purple loosestrife is regulated by WSDA. Any transportation and disposal of sediments containing purple loosestrife seeds is permitted by WSDA. Upland disposal is WSDA's preferred disposal method. The WSDA requires the sediments be disposed of at a dry location, to be undisturbed for 8 years, and to be covered with at least 6 inches of soil within two weeks of disposal (Greg Haubrich, personal communication 2000). Transportation and permitting guidelines required by WSDA were previously described in Questions 5 and 6.

21. *Q: Would an inquiry to Thurston County Health be helpful? (About a variance to allow transport of dredged material with purple loosestrife)*

A: Yes

The Thurston County Health Department does not regulate the transport of purple loosestrife, but provides input to WSDA on the loosestrife permit conditions. The health department will allow transport of dredged material with purple loosestrife as long as a permit has been issued by WSDA (John Libby, personal communication 2000).

Near Term Action Items to Advance the Dredging Study

PSDDA sampling plan is on hold until:

- We obtain answers from PSDDA and State Department of Agriculture as to whether Puget Sound Disposal with purple loosestrife is acceptable.

  Information regarding the regulatory policies of PSDDA and WSDA on disposal of sediments containing purple loosestrife seeds were previously discussed in Questions 1 and 6.

- Confirm that discharge of dredge slurry to Puget Sound is not acceptable.

  PSDDA has confirmed that they will not accept non-dewatered hydraulically dredged sediment at a non-dispersive site such as Anderson/ Ketron Island (Ted Benson, personal communication 2000)

Depending on answers:

- Revise sediment sampling plan - Done
- Implement sediment sampling plan – PSDDA is reviewing the plan.
- Potentially trigger Department of Agriculture and Thurston Health Department sediment sampling for suitability of upland disposal - Done.
- Pursue Pilot Project with "minimalist" approach for the Middle Basin trap.

APPENDIX B

Agency Correspondence

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

June 14, 2000

Mr. Gary Larson
Washington State Department of General Administration
P.O. Box 41019, Mail Stop 1019
Olympia, Washington 98504-1019

Dear Mr. Larson:

This letter provides Dredged Material Management Program (DMMP) responses to the questions raised in your April 14, 2000 letter in attachment 1. This letter also provides the DMMP review of the March 2000 sampling and analysis plan (SAP) prepared for the proposed dredging as part of the Capital Lake 2000 Adaptive Management Plan. The SAP is approved subject to making the specific changes in the SAP detailed below.

1. To date, the Capitol Lake project is the first project faced with the problem of having to address the presence of purple loosestrife seed mixed in with the sediments to be dredged. Furthermore, as noted in the SAP, the seeds have been found to retain viability when immersed in salt water (up to 3 weeks) and can germinate in waters with salinities as high as 25 ppt. Thus one of the immediate concerns associated with the use of the Ketron Island disposal site is the potential effect of dispersing significant numbers of viable seed to the Nisqually River delta. The concern becomes even greater when the proposed method of dredging is by pipeline, as was proposed for the last dredging event at Capitol Lake. To make matters worse, the project also proposed to fill the bottom-dump barges so that no overflow would occur in Budd Inlet. Thus, the bottom-dump barge would be filled with an unconsolidated slurry of approximately 70-80 percent water and 20-30 percent sediment. It is reasonable to assume that pipeline dredging would cause seeds to become disassociated from the sediment and that the seed would remain in that state until disposed of. In the judgement of the DMMO, this dredging/disposal option presents too great a risk of significantly spreading purple loosestrife, regardless of which PSDDA disposal site is considered. Thus the use of PSDDA open-water disposal sites is not authorized for hydraulically dredged material from Capitol Lake.

2. The potential spread of purple loosestrife seed by a standard clamshell dredging/PSDDA disposal operation is more open to speculation. We do not know, for example, how much seed might become disassociated from the dredging action itself - a clamshell bucket typically takes a consolidated bite of material with very little entrainment of water. Nor do we know how much seed could become disassociated during the disposal event as the consolidated mass drops through the water column. We would assume that most seed carried to the bottom of the deep disposal sites is removed from the system.

a. For this project, the DMMO will allow the use of the Commencement Bay PSDDA disposal site for clamshell dredged material on a one-time only basis. Because of concerns about the potential spread of purple loosestrife to the Nisqually delta, use of the Ketron Island disposal site is not authorized. Furthermore, we recommend monitoring for seed dispersal at the Commencement Bay disposal site during disposal of Capital Lake dredged material. Of course the use of the Commencement Bay disposal site is predicated on the outcome of pending DMMP suitability testing.

b. The WA Department of General Administration may also wish to consider a sampling and analysis strategy in consultation with the Department of Ecology (Rick Vining), which specifically addresses upland testing requirements required by local Health Departments for upland landfills as an alternative to open-water disposal for any unsuitable material.

3. Page 13-17. A proposal to conduct a partial characterization (PC) sampling exercise for the purpose of DMMP consideration for potential downranking from a "high" concern to a "low-moderate" concern for conducting a future full characterization exercise should follow the requirements specified in the PSDDA Users Manual (see pages 23-24). As stated on page 23 of the "Users Manual", "a PC is not a substitute for an FC, but is only a means for establishing a "reason to believe" that a lower ranking is appropriate." The implications of the narrative between pages 13 and 17 of the SAP is that the data if shown to support a downranking decision from "high" to "low-moderate", would be used to support the full characterization (FC) requirements in lieu of conducting a separate FC sampling/analysis exercise. Data from a PC can be used as a "reason to believe" test to screen out certain chemicals of concern for a FC. On a limited basis the PC data may be used as a partial fulfillment of FC data submittal requirements.

4. The DMMP agencies would have to agree on how and to what extent the PC data would or could be used as part of the FC characterization requirements. That determination would only be made after the PC data had been submitted and reviewed by the DMMP agencies. However, the PC data would not preclude conducting a separate FC. The PC guidance was generally intended for use for much larger projects then the 70,000 cy Capitol Lake Project. For example, a two-step PC and followup FC for this project to consider downranking from high to low-moderate means collecting 4 samples and conducting 4 analyses. If the PC justifies the down-ranking to low-moderate, the subsequent FC would require 9 surface samples which would be composited into 2 analyses (4 samples composited in 1 dredged material management unit (DMMU), and 5 samples composited for the second DMMU). The PC and subsequent FC would result in a total of 13 surface samples and 6 analyses. Conducting the FC without a PC and reranking assessment would require 18 samples and 18 uncomposited analyses. So there would seem to be a potential cost savings related to analyses but that may be offset somewhat by having to mobilize for two sampling events.

5. Page 17, second paragraph, first sentence and page 24, Section 5.2. Bioassay testing is not a required part of a PC, and would only be conducted during the follow on FC, if chemical screening level exceedances were noted during FC sediment testing. Bioassays may be run at the discretion of the applicant during a PC; however, any decisions by the DMMO pertaining to a PC are based solely upon the results of chemical testing.

Please call me (206/764-3768) if you have any questions about the DMMP review of the SAP or have any questions about the collective DMMP response to the questions raised in your letter.

Sincerely,

David R. Kendall, Ph.D.
Chief, Dredged Material Management Office

Copies Furnished:

Corps Project Manager, Regulatory Branch
Erika Hoffman, EPA
Ted Benson, DNR
Rick Vining, Ecology
DMMO file

Attachment 1.

The DMMP responses to the questions raised by the Washington Department of General Administration April 14, 2000 letter to the DMMP agencies are provided below:

1) **Question.** "Assuming Capital Lake sediments meet PSDDA criteria, will the PSDDA agencies allow open-water disposal of unconfined Capital Lake dredged sediments in Puget Sound? Please provide the reasons for your response."

   Response. DNR has concluded that only clamshell dredged material will be allowed for open-water disposal of Capitol Lake dredged sediments by bottom-dumped barge at the Commencement Bay disposal site on a one-time basis only. Use of the Ketron Island disposal site is prohibited due to its proximity to the Nisqually river delta and wildlife refuge. DNR is concerned that viable purple loosestrife seeds present in unconsolidated hydraulically dredged material (also to a lesser extent clamshell dredged material) will be dispersed to the river delta and wildlife refuge and subsequently disrupt the marsh ecosystem by propogating the distribution of purple loosestrife. The outstanding issues relative to seed viability and dispersal in the environment will still have to be resolved before any additional disposal of Capitol Lake dredged sediments would be allowed at any of the DMMP open-water disposal sites beyond this one-time only use of the Commencement Bay site. The DMMP agencies generally require a consensus on disposal policy issues and therefore concur with DNR's position relative to the open-water disposal of Capitol Lake dredged material at the Commencement Bay disposal site on a one-time basis only, until all DNR issues and concerns relative to purple loosestrife viability and potential dispersal are resolved. To resolve these concerns, the DMMP agencies would need to see results of seed viability studies specifically addressing Capitol Lake sediments. The details of this study would need to be worked out in consultation with the DMMP agencies. Future disposal of Capitol Lake dredged sediments at DMMP disposal sites beyond the one-time only event discussed above would be predicated on the results of this study.

2) **Question.** "What is the position of PSDDA agencies concerning disposal of Capitol Lake dredged sediments in Puget Sound as it relates to the presence of purple loosestrife seeds in the sediments?

   Response. DNR's position is that the presence of purple loosestrife seeds in dredged material is a serious concern, and the presence of any viable seeds would effectively preclude the open-water disposal of dredged material at any DMMP open-water site. The DMMP agencies have special concerns at the Ketron Island disposal site for material dredged by hydraulic dredging/disposal due to the sites proximity to the Nisqually River delta and wildlife refuge. The DMMP agencies are inclined to allow clamshell dredged sediment to be disposed of at the Commencment Bay site on a one-time only basis, but will prohibit use of the Ketron Island site.

3) **Question.** "Is there a threshold "concentration" of seeds (e.g. number of seeds per unit volume of dredged sediment) that would trigger approval or disapproval of open-water disposal?

Response. DNR's position as one of the DMMP agencies is that there is no minimum threshold concentration of viable purple loosestrife seeds that would be considered suitable for open-water disposal of dredged material at the Ketron Island site. Moreover, the presence of any viable seeds in the proposed dredged material is enough of a concern to preclude open-water disposal at the Ketron Island disposal site. As noted in 1) above, the DMMP agencies will allow a one-time only disposal of clamshell dredged Capitol Lake dredged sediments (pending a suitability determination) at the Commencement Bay disposal site.

4) **Question.** Would an approach that deposits material directly on the bottom of Puget Sound be a viable option? Would all sediment require de-watering and disposal in geo-tubes?

Response. DNR is concerned about the open-water disposal of unconsolidated material containing purple loosestrife seeds at the Ketron Island disposal site if hydraulically dredged, even if placed directly on the bottom in geotubes. DNR considered allowing the use of geotubes, but decided that there was too much risk that the structural integrity of the geotube bag might be compromised during disposal at a 442 feet deep site, such as Ketron Island. Furthermore, DNR is concerned about the risk of spreading viable seeds to the Nisqually River delta and wildlife refuge and potentially disrupting that ecosystem with an evasive non-native species. Therefore, de-watering of dredged material and placement in geotubes for open-water disposal is not considered a demonstrated risk free alternative at this time.

5) **Question.** "If we were to manage Capitol Lake as an estuary, would PSDDA agencies have objection to increased dispersal of purple loosestrife seeds from Capitol Lake due to tidal flushing?"

Response. The DMMP agencies are opposed to any action that would promote or increase the potential dispersal of purple loosestrife seeds into habitats where it does not currently exist.

6) **Question.** "Are there any other PSDDA regulatory constraints that would prohibit disposal in Puget Sound? The Steering Committee needs to be clear on regulatory policy to best decide how to proceed with lake management decisions."

Response. There are no additional DMMP regulatory constraints on the disposal of this material, assuming that when the potential dredged material is tested it passes the nondispersive disposal testing guidelines.

APPENDIX C

Planning-level Cost Estimates

APPENDIX C
PLANNING-LEVEL COST ESTIMATES

The conceptual plans discussed in the sediment management report section, *Planning-level Costs for Dredging,* provide the primary equipment and operations that were used in estimating the dredging and off-loading costs presented in the tables in this appendix. Detailed discussion of the equipment associated with the hydraulic dredging and mechanical dewatering alternative were discussed in the Draft Supplemental Environmental Impact Statement (**Entranco 1996**). The cost for surveying were obtained from the previous cost estimates prepared by Entranco (**1996**) and were adjusted for inflation of approximately 9% between 1996 and 2000.

Table

PILOT PROGRAM - 12,000 YARDS - ONE TIME

COST ESTIMATE FOR HYDRAULIC DREDGING/MECHANICAL DEWATERING/UPLAND DISPOSAL

Mechanical Dewatering / Landfill — **Design Report Cost Estimate**

Item	Unit	Unit Price	Quantity	Cost
Dredging and dewatering				
Mobilization / Demobilization	L.S.	$120,000.00	1	$120,000
Dredge and Mechanical Dewatering	L.S.	$125,400.00	1	$125,400
Flocculents	C.Y.	$1.45	12,000	$17,400
Silt Fence	L.F.	$7.00	400	$2,800
Hydroseed	L.S.	$1,100.00	1	$1,100
Survey	L.S.	$10,000.00	1	$10,000
Subtotal				$276,700
Contingency @ 10 %				$27,670
Transportation to Chehalis Trailhead				
Trucking	C.Y.	$7.00	12,000	$84,000
Traffic control	HR.	$50.00	1,000	$50,000
Subtotal				$134,000
Contingency@10%				$13,400
Remote Site Work				
Grading	C.Y.	$2.00	12,000	$24,000
Capping	C.Y.	$3.00	1,400	$4,200
Re-Vegetation	Acre	$1,000.00	2	$2,000
Subtotal				$30,200
Contingency @ 10 %				$3,020
Construction Subtotal				$484,990
Sales Tax (8.2%)				$39,769
Subtotal				$524,759
Design and Construction - Basic Services				$100,000
Extra Services - Environmental and Permitting				$177,000
Construction Total				$801,759
TOTAL				$801,759

Notes: L.S. = Lump Sum; L.F. = Linear Foot; C.Y. = Cubic Yard; H.R. = Rate per Hour.

Table

LONG TERM PROGRAM - 60,000 YARDS EVERY FIVE YEARS

COST ESTIMATE FOR HYDRAULIC DREDGING/MECHANICAL DEWATERING/UPLAND DISPOSAL

Mechanical Dewatering / Landfill — **Design Report Cost Estimate**

Item	Unit	Unit Price	Quantity	Cost
Dredging and dewatering				
Mobilization / Demobilization	L.S.	$165,000.00	1	$165,000
Dredge and Mechanical Dewatering	L.S.	$627,000.00	1	$627,000
Flocculents	C.Y.	$1.45	60,000	$87,000
Silt Fence	L.F.	$7.00	400	$2,800
Hydroseed	L.S.	$1,100.00	1	$1,100
Survey	L.S.	$22,000.00	1	$22,000
Subtotal				$904,900
Contingency @ 10 %				$90,490
Transportation to Chehalis Trailhead				
Trucking	C.Y.	$7.00	60,000	$420,000
Traffic control	HR.	$50.00	1,000	$50,000
Subtotal				$470,000
Contingency@10%				$47,000
Remote Site Work				
Grading	C.Y.	$2.00	60,000	$120,000
Capping	C.Y.	$3.00	7,000	$21,000
Re-Vegetation	Acre	$1,000.00	9	$9,000
Subtotal				$150,000
Contingency @ 10 %				$15,000

Construction Subtotal	$1,677,390
Sales Tax (8.2%)	$137,546
Subtotal	$1,814,936
Design and Construction - Basic Services	$100,000
Extra Services - Environmental and Permitting	$177,000
Construction Total	$2,091,936
TOTAL	$2,091,936

Notes: L.S. = Lump Sum; L.F. = Linear Foot; C.Y. = Cubic Yard; H.R. = Rate per Hour.

Table

PILOT PROGRAM - 9,000 YARDS - ONE TIME

COST ESTIMATE FOR CLAMSHELL DREDGING/BARGE DEWATERING/UPLAND DISPOSAL

Mechanical Dredging / Upland Disposal — **Design Report Cost Estimate**

Item	Unit	Unit Price	Quantity	Cost
Dredging, dewatering, and offloading				
Mobilization / Demobilization	L.S.	$191,600.00	1	$191,600
Dredge, Dewater & Offload	L.S.	$149,400.00	1	$149,400
Survey	L.S.	$10,000.00	1	$10,000
Subtotal				$351,000
Contingency @ 10 %				$35,100
Transportation to Chehalis Trailhead				
Trucking	C.Y.	$7.00	9,000	$63,000
Traffic control	HR.	$50.00	260	$13,000
Subtotal				$76,000
Contingency @ 10 %				$7,600
Remote Site Work				
Grading	C.Y.	$2.00	9,000	$18,000
Capping	C.Y.	$3.00	1,050	$3,150
Re-Vegetation	Acre	$1,000.00	2	$2,000
Subtotal				$23,150
Contingency @ 10 %				$2,315

Construction Subtotal	$495,165
Sales Tax (8.2%)	$40,604
Subtotal	$535,769
Design and Construction - Basic Services	$100,000
Extra Services - Environmental and Permitting	$177,000
Construction Total	$812,769
TOTAL	$812,769

Notes: L.S. = Lump Sum; L.F. = Linear Foot; C.Y. = Cubic Yard; H.R. = Rate per Hour.

Table

LONG TERM PROGRAM - 60,000 YARDS EVERY FIVE YEARS

COST ESTIMATE FOR CLAM-SHELL DREDGING/BARGE DEWATERING/UPLAND DISPOSAL

Mechanical Dredging / Upland Disposal — **Design Report Cost Estimate**

Item	Unit	Unit Price	Quantity	Cost
Dredging, dewatering, and offloading				
Mobilization / Demobilization	L.S.	$301,600.00	1	$301,600
Dredge, Dewater & Off-load	L.S.	$828,000.00	1	$828,000
Survey	L.S.	$22,000.00	1	$22,000
Subtotal				$1,151,600
Contingency @ 10 %				$115,160
Transportation to Chehalis Trailhead				
Trucking	C.Y.	$7.00	60,000	$420,000
Traffic control	HR.	$50.00	1,000	$50,000
Subtotal				$470,000
Contingency @ 10 %				$47,000
Remote Site Work				
Grading	C.Y.	$2.00	60,000	$120,000
Capping	C.Y.	$3.00	7,000	$21,000
Revegetation	Acre	$1,000.00	9	$9,000
Subtotal				$150,000
Contingency @ 10 %				$15,000
Construction Subtotal				$1,948,760
Sales Tax (8.2%)				$159,798
Subtotal				$2,108,558
Design and Construction - Basic Services				$100,000
Extra Services - Environmental and Permitting				$177,000
Construction Total				$2,385,558
TOTAL				$2,385,558
Notes: L.S. = Lump Sum; L.F. = Linear Foot; C.Y. = Cubic Yard; H.R. = Rate per Hour.				

Cost Estimates for Upland Disposal of Capitol Lake Sediments

Item	Unit	Thurston County Roads Dept. Gravel Mines (<5 miles)			Thurston County Roads Dept. Gravel Mines (10-15 miles)			Thurston County Chehalis Trailhead Park (8 miles)		
		Unit Cost	Quantity	Cost	Unit Cost	Quantity	Cost	Unit Cost	Quantity	Cost
Trucking	Cubic Yard	$5	35,000	$175,000	$8	35,000	$280,000	$7	35,000	$245,000
Traffic control	Hour	$50	600	$30,000	$50	600	$30,000	$50	600	$30,000
Grading	Cubic Yard	$2	35,000	$70,000	$2	35,000	$70,000	$2	35,000	$70,000
Capping	Cubic Yard	$3	4,000	$12,000	$3	4,000	$12,000	$3	4,000	$12,000
Re-vegetation	Acre	$1,000	5	$5,000	$1,000	5	$5,000	$1,000	5	$5,000
Sediment treatment	Cubic Yard	$0	0	$0	$0	0	$0	$0	0	$0
Subtotal				$292,000			$397,000			$362,000
Contingency (30%)				$87,600			$119,100			$108,600
Total				**$379,600**			**$516,100**			**$470,600**

Item	Unit	Thurston County ORV Park (16 miles)			Soil Recycling (TPS Technologies, Tacoma)		
		Unit Cost	Quantity	Cost	Unit Cost	Quantity	Cost
Trucking	Cubic Yard	$7	35,000	$245,000	$0	0	$0
Traffic control	Hour	$50	600	$30,000	$0	0	$0
Grading	Cubic Yard	$2	35,000	$70,000	$0	0	$0
Capping	Cubic Yard	$3	4,000	$12,000	$0	0	$0
Re-vegetating	Acre	$1,000	5	$5,000	$0	0	$0
Sediment treatment	Cubic Yard	$0	0	$0	$26	35,000	$910,000
Subtotal				$362,000			$910,000
Contingency (30%)				$108,600			$273,000
Total				**$470,600**			**$1,183,000**

Note: See text for assumptions. Initial quantities were based on dredge amount of 35,000 cubic yards. For Final Alternative estimates, these costs were sacaled up or down for pilot and long-term dredging programs as appropriate.