Draft Supplemental
Environmental Impact Statement

Capitol Lake Restoration and Recreation Plan

Revised Maintenance Sediment Removal Plan

Prepared for
Washington State Department of
General Administration

February 1996

STATE OF WASHINGTON
DEPARTMENT OF GENERAL ADMINISTRATION
DIVISION OF CAPITOL FACILITIES
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February 7, 1996

TO: Interested Individuals and Regulatory Agency Staff

FROM: Marziah Kiehn-Sanford, AICP, Division of Engineering & Architectural Services MK-S
Nick Cockrell, Division of Capitol Facilities NC

SUBJECT: **DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT PUBLICATION AND PUBLIC HEARING ON MARCH 7, 1996**

The Department of General Administration has significantly modified the draft SEIS published in October, 1995 following the comments of individuals, regulatory agencies and preliminary test results of sediments in the middle basin of Capitol Lake.

The resulting changes in project scope affect both the project area (reducing the geographic area from ten sectors to two sectors which include the sediment trap) and the frequency of sediment removal (dredging during a three month period in 1996-1997 and once more in the following four years if conditions warrant). The modification in scope is, we feel, consistent with the 1977 EIS for maintenance dredging in the area of the middle basin trap.

This document also strengthens the environmental analysis on "in-situ" lake impacts during the dredging operation and on potential wetland impacts for upland disposal. It more completely addresses consistency with the Shoreline Master Program for the Thurston Region, and critical area/conservancy zone management strategies.

And finally, we have proposed a comprehensive long-range management plan be developed for Capitol Lake with the involvement of local government, regulatory agencies, tribal interests and the general public. We anticipate the planning would be initiated later this year, and would include recommendations related to water quality, pollution control as well as property development issues along the lower reaches of the Deschutes River and Capitol Lake. The plan would identify management practices to reduce watershed erosion, flood control and operation of the lake system.

A public hearing on the plan is scheduled for March 7, 1996, General Administration Building Auditorium (1st Floor, 210 W. 11th Street) at 6:30 p.m. to solicit oral comments from the general public. Written comments may also be prepared and submitted by March 20, 1996 to:

Marziah Kiehn-Sanford, AICP, Environmental Review Officer
Division of Engineering and Architectural Services
PO Box 41012
Olympia, WA 98504-1012

Technical questions about the project may be addressed by telephone to Nick Cockrell at 586-5256.

For Review Only

Draft Supplemental Environmental Impact Statement

CAPITOL LAKE RESTORATION AND RECREATION PLAN

Revised Maintenance Sediment Removal Plan

Prepared for

Washington State
Department of General Administration

Prepared for the review and comments of citizens, citizen groups, Indian tribes, and government agencies

Prepared in Compliance with State Environmental Policy Act of 1971 Chapter 43.21C, Revised Code of Washington, As Amended

and

SEPA Rules, Effective April 4, 1984 Chapter 197-11, Washington Administrative Code, As Amended

February 16, 1996

Title

Supplemental Environmental Impact Statement - Capitol Lake Restoration and Recreation Plan - Revised Maintenance Sediment Removal Plan

Description of Proposal

This environmental evaluation supplements and updates the 1977 Capitol Lake Restoration and Recreation Plan Final EIS.

The proposed action would involve maintenance sediment removal in two sectors of Capitol Lake's middle basin over a five-year period. The first sediment removal cycle would occur from December 1, 1996 to March 1, 1997 and would remove 60,000 to 70,000 cubic yards of sediment. A date for a second cycle would be determined in 1999–2001, if the middle basin sediment trap is found to be 75 percent full based on results of periodic monitoring.

No Action Alternative. Under the No Action Alternative there would be no sediment removal. The lake would continue to fill in with sediment completely filling the middle basin over a period of 30 to 85 years, and the north basin over a period up to 100 years.

Action Alternatives. The following action alternatives would excavate sediment from the lake by hydraulic dredging, but would have different means of dewatering and disposal as described below.

Gravity Dewatering Alternative. Under this alternative, sediments would be dewatered by gravity settling in the original facility constructed for this purpose. This facility is behind the dike, near the Capitol Lake Interpretive Center in the middle basin's southwest corner. Dewatered sediments would be transported by truck to one or two optional upland disposal sites: the Thurston County Landfill or the Chehalis Western Trailhead.

Mechanical Dewatering Alternative. Under this alternative, sediments would be dewatered mechanically, using a system of screens and centrifuges. Dewatered sediments would be

transported by truck to one or two optional upland disposal sites as described for the Gravity Dewatering Alternative.

Marine Disposal Alternative. Under this alternative, the sediment-water slurry from the dredge would be piped north across the surface of Capitol Lake, along the bottom of Budd Inlet, and then into a marine barge at the Port of Olympia. The sediment-water slurry would be discharged directly to barges and transported to an approved deep, open-water, marine disposal site located between Anderson and Ketron Islands in Pierce County.

Beneficial Use Sites. Although the main focus of this Supplemental Environmental Impact Statement is to evaluate the impacts of disposal on the two optional upland sites and the deep, open-water marine disposal site, Capitol Lake sediments may ultimately be taken to other sites for a beneficial use. Such uses may include (1) capping contaminated sediments, (2) reclaiming abandoned gravel pit sites, or (3) applying the sediment as topsoil to parklands or park trails. Such applications would be pursued, subject to completing separate environmental review, and acquiring the necessary regulatory permits and approvals.

Location of Sites

Capitol Lake - Sediment Removal site: Olympia and Tumwater, Washington
T18N, R2W, Sections 14, 15, 22, 23, 26 and 27.

Thurston County Landfill - Optional Upland Disposal site: Thurston County, Washington: T18N, R1W, Sections 11 and 12.

Chehalis Western Trailhead - Optional Upland Disposal site: Thurston County, Washington: T17N, R1W, Section 16.

Port of Olympia, Budd Inlet barge mooring site: Olympia, Washington: T18N, R2W, Sections 10, 11, 14 and 15.

	Anderson/Ketron Island - Optional Deep, Open-Water Marine Disposal site: Pierce County, Washington: T19N, R1E.
Proponent	Washington State Department of General Administration 206 General Administration Building P.O. Box 41012 Olympia, Washington 98504
Date of Implementation	Project work is planned for September 1996 through March 1997, subject to completion of the SEIS and acquisition of all permits and approvals.
Lead Agency	Same as Proponent
Responsible Official	Marziah Kiehn-Sanford, State Environmental Policy Act responsible official (360) 664-8875
Contact Person	Nick Cockrell, Senior Facilities Planner (360) 586-5256
Permits, Licenses, and Approvals Required	Joint Aquatic Resources Permit Application (JARPA), involving a single permit application, to be issued for those permits identified with an asterisk below. * Washington State Department of Fish and Wildlife - Hydraulic Project Approval * US Army Corps of Engineers - Section 10 and 404 Permits and Puget Sound Dredged Disposal Analysis (PSDDA) letter of authorization for marine disposal of sediments (PSDDA authorization includes concurrent review by U.S. Environmental Protection Agency, and Washington State departments of Ecology and Natural Resources.) * Cities of Olympia and Tumwater - Shoreline Substantial Development Permit * Washington State Department of Ecology - Coastal Zone Management (Shoreline Substantial Development Permit) review, Water Quality

Certification and Temporary Water Quality Modification Permits.

Washington State Department of Ecology - NPDES Permit for site clearing and grading of over five acres. May apply to site clearing and grading of Chehalis Western Trailhead site.

Washington State Department of Natural Resources - Aquatic lands use permit .

Environmentally Sensitive Areas Approvals and Excavation/Grading Permits from the Cities of Olympia and Tumwater and from Thurston County.

Washington State Department of Agriculture and Thurston County Weed Control Board - Permit for disposal and monitoring of sediments possibly contaminated with purple loosestrife.

Thurston County Board of Health - Approval for use of flocculents for water quality treatment.

Authors and Principal Contributors

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Sediment removal planning assistance

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Date of Issue of Draft SEIS	February 16, 1996
Date of Hearing on Draft SEIS	March 7, 1996
Date Comments are Due on Draft SEIS	March 18, 1996
Tentative Date of Issue of Final SEIS	April 12, 1996
Tentative Date of Official Action	April 19, 1996
Location of Background Information	Same as Proponent Peter Waugh, Senior Project Engineer (360) 902-7255 Entranco Ed Berschinski, Project Manager, or David Morency, Senior Environmental Scientist 1-800-454-5601
Cost to Public of a Copy of the Draft SEIS	$10.00

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1.0 INTRODUCTION - THE BASIS FOR ISSUING A NEW DRAFT SEIS

Several important changes have been made in the approach to the proposed project in response to public, tribal, and agency comments received on the October 1995 Draft Supplemental Environmental Impact Statement (DSEIS) for the Capitol Lake Restoration and Recreation Plan - Revised Long-Term Maintenance Sediment Removal Plan. The changes are aimed at limiting the scope and impact of the project, resulting in a project sufficiently different from the one described in the October 1995 DSEIS, that the Washington State Department of General Administration (DGA) decided to issue this new DSEIS. The following important changes have been made:

- The DGA has limited the scope of maintenance dredging work to sectors 1 and 2 of the middle basin. Sector 1 is the original middle basin sediment trap, and sector 2 is an adjacent sector. Both sectors are in the vicinity of the original dredging operations identified in the 1977 Final EIS (**CH2M Hill 1977**). This is a major reduction from the 10 sectors proposed in the October 25, 1995 DSEIS.

- The DGA has reduced the frequency and duration of maintenance dredging from once every two years over a ten-year period, to once or possibly twice over a five-year period. This is more consistent with past maintenance dredging efforts. This reduction in scope makes the proposed action more consistent with the intent of a "Supplemental" environmental document.

- The DGA has made a commitment to sponsor the development of an updated Capitol Lake Management Plan (CLMP) with participation by other agencies, tribal interests, and the public. The need for long-term maintenance dredging will be addressed in the context of this comprehensive planning process.

- The DGA has eliminated the Centralia Coal Mine site from further consideration as an optional upland disposal site.

- The DGA has expanded the discussion of environmental impacts and mitigation in a number of sections of the DSEIS to incorporate responses to comments received on the October 1995 DSEIS.

These changes are explained in greater detail below, and throughout the remainder of this DSEIS. The DGA acknowledges and thanks the following organizations/groups for their comments on the October 1995 DSEIS: the City of Olympia, the City of Tumwater, Washington Department of Ecology, the Squaxin Island Tribe, Mr. Steve Shanewise, and other companies and individuals. Comments from these organizations and individuals have made a significant difference in the scope of the proposed action, with reduced impact and mitigation needs.

1. New Proposed Action and New Capitol Lake Management Plan

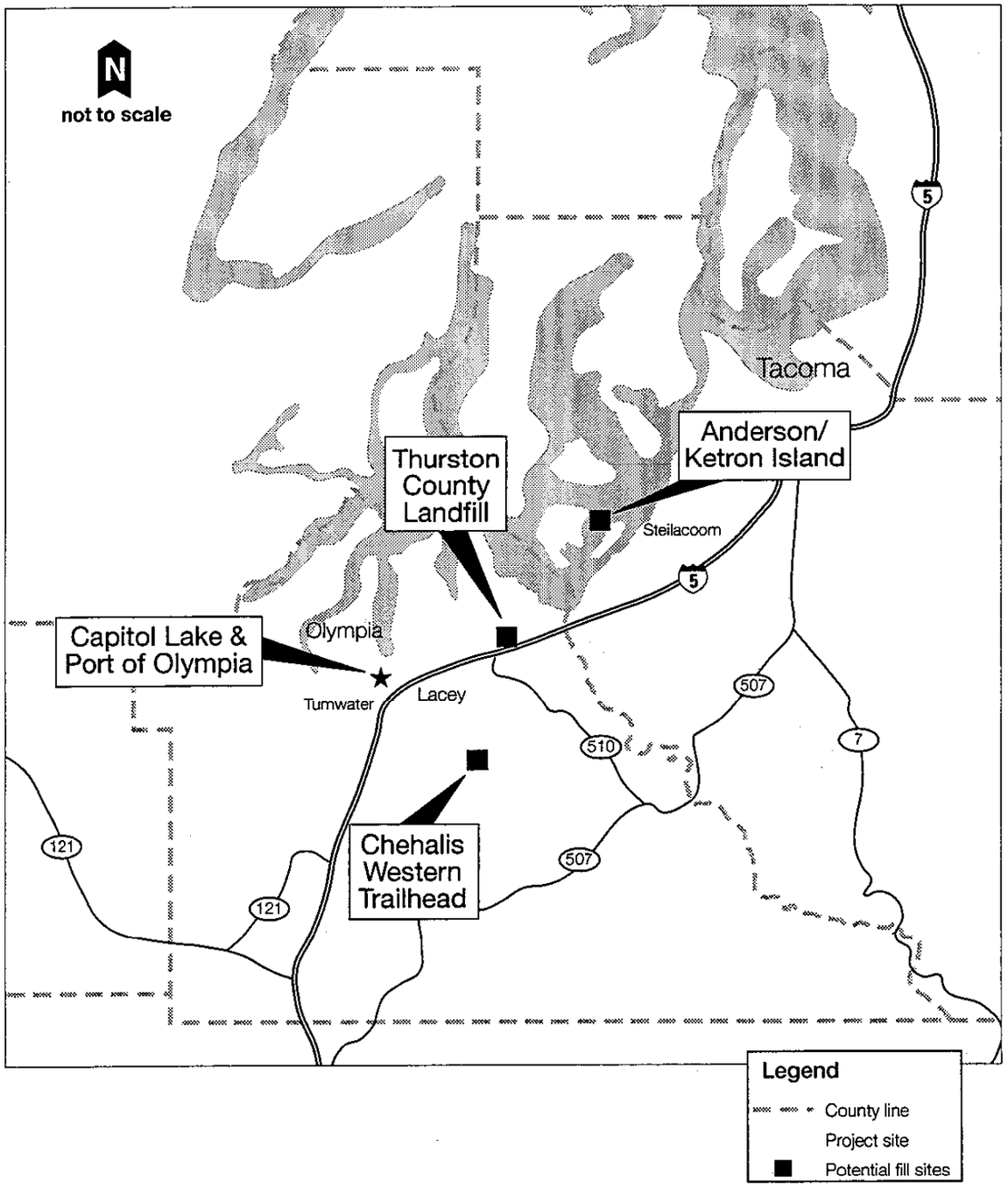
The area, volume, and time frame of maintenance dredging will be reduced under the new proposed action. The 10-year plan extending over the entire middle basin has been withdrawn pending preparation of a comprehensive CLMP. In the interim, maintenance dredging would only be performed within and near the middle basin sediment trap at dredging sectors 1 and 2 (**figures 1 and 2**). Interim dredging would involve removal of 60,000 to 70,000 cubic yards from this area in the 1996–1997 time frame, and would involve one additional round of sediment trap maintenance dredging within the five-year permit period, if warranted by field surveys (sediment trap found to be 75 percent full). These changes would make the proposed action more consistent with the original recommendations of the 1977 Final EIS (**CH2M Hill 1977**).

Trap capacity is estimated at approximately 55,000 cubic yards, and 75 percent of this volume would be 41,250 cubic yards. Field surveys would be conducted once or twice per year following the 1996–1997 dredging cycle. The 75 percent criteria was selected because: (1) trap efficiency is expected to decline once the trap reaches 75 percent of total capacity, and (2) some additional trap filling is likely to occur between the time the 75 percent volume is reached and the time the next cycle of actual in-lake dredging begins. This is because at least 12 months would be needed to obtain permits and award another dredging contract for the next dredging window between December 1 to March 1 of the ensuing year.

Depth of dredging is estimated at 1–5 feet in Sector 1, and 1–3 feet in Sector 2 (**figure 3**). However, depth of sediment in Sectors 1 and 2 (**figure 3**) has been determined from a 1991 survey. Therefore, the depth of sediment may be considerably deeper by the time dredging begins in December 1996. Post-dredging water depths would be approximately 12 feet in Sector 1 and approximately 7 feet in Sector 2.

It is important to note that the area included in the new dredging proposal (**figure 2**) is free of sediment contamination based on Puget Sound Dredged Disposal Analysis (PSDDA) and other sediment characterization studies prepared for the project.

The cumulative percent of total lake area affected by proposed dredging has been reduced from approximately 50 percent down to about 10 percent. As a result, the project would have significantly reduced temporal and spatial impacts on most elements of the environment.



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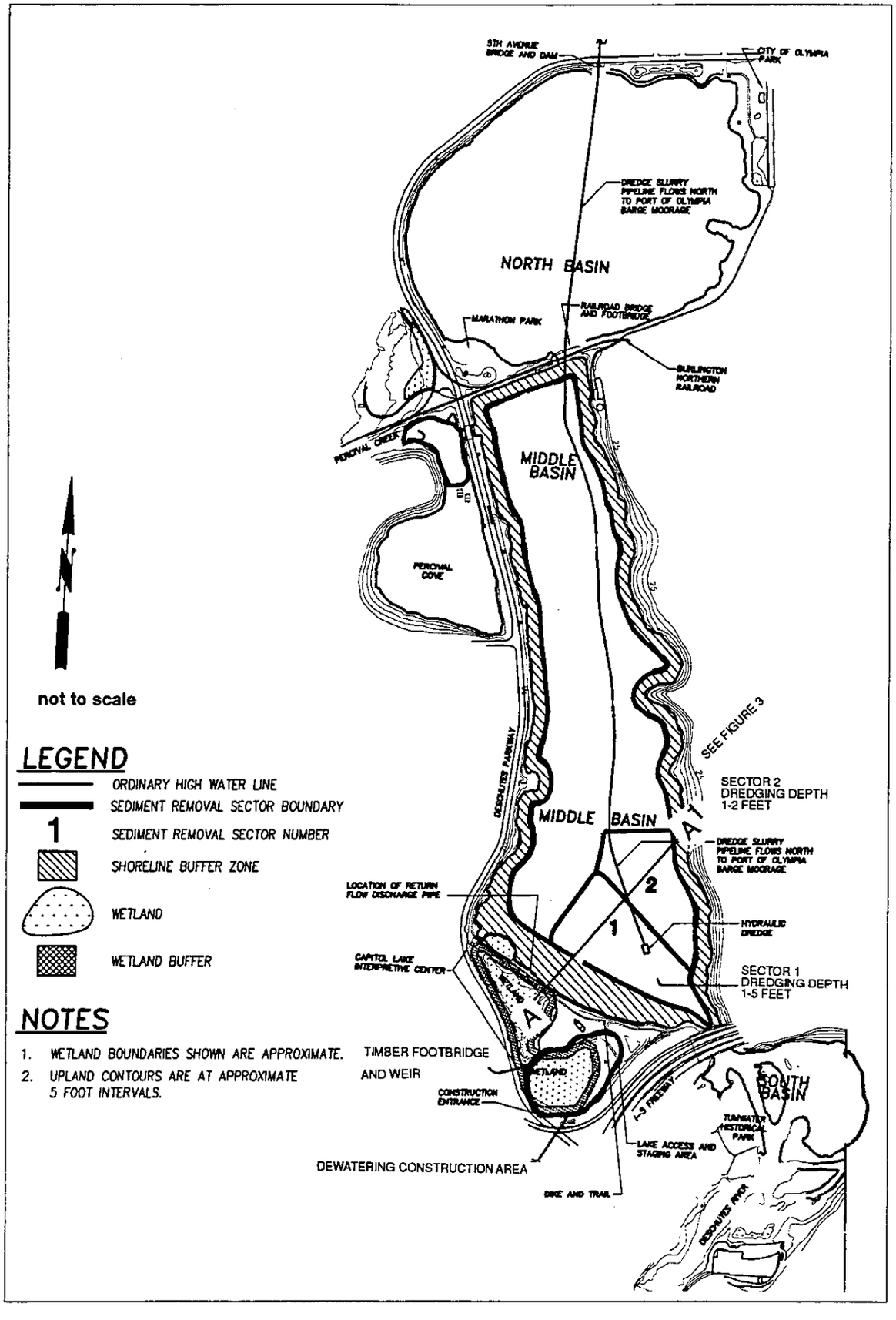
Capitol Lake SEIS

Figure 1
Vicinity Map



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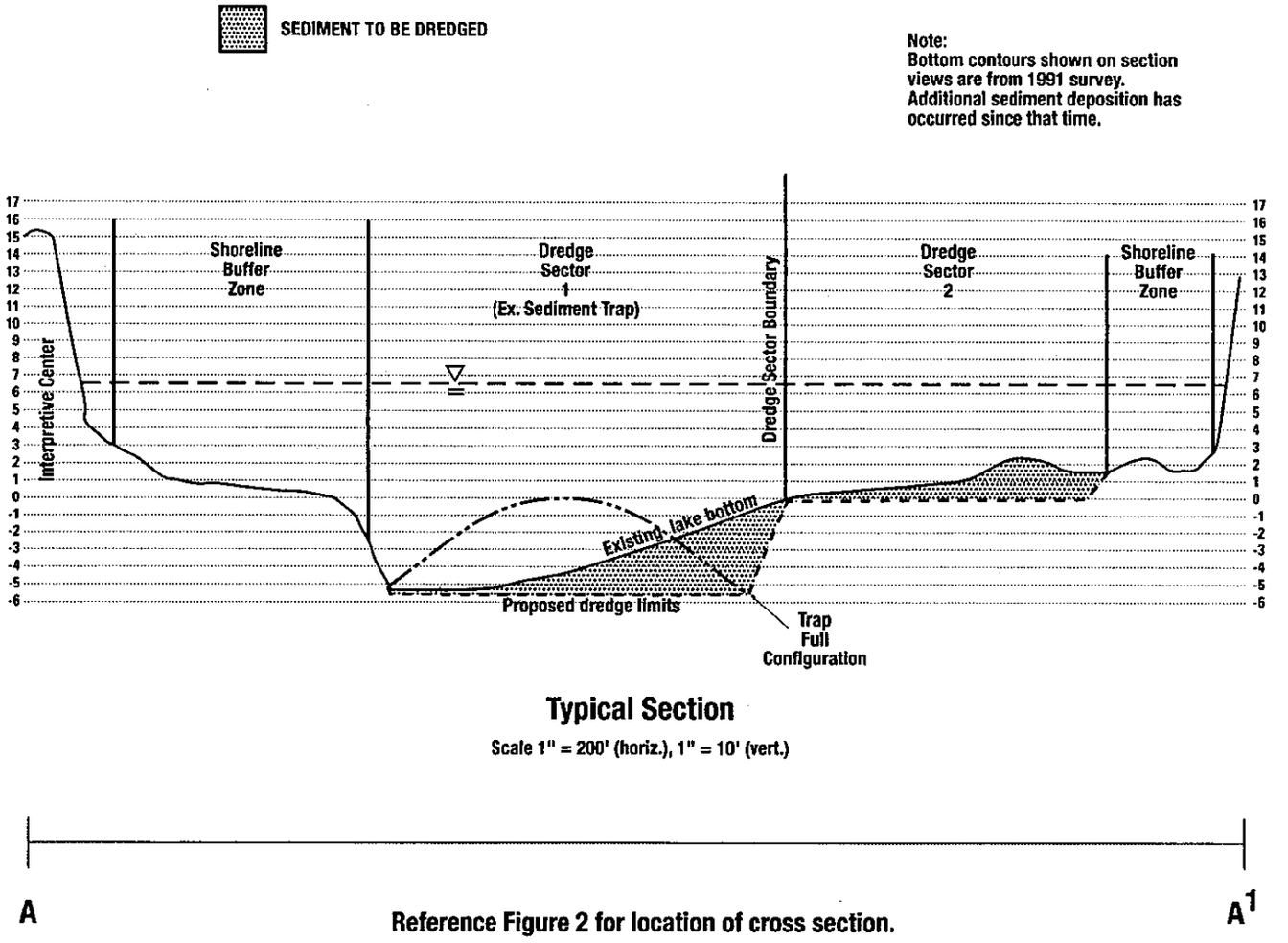
Capitol Lake SEIS

Figure 2
Proposed New Five-Year Sediment Removal Plan



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Capitol Lake SEIS

Figure 3
Typical Section of the Existing Bottom of Capitol Lake

2. Capitol Lake Management Plan

The proposed CLMP will be prepared in cooperation with the following organizations and the public:

City of Olympia	City of Tumwater	Thurston County
Port of Olympia	Squaxin Island Tribe	U.S. Army Corps of Engineers

Washington State Departments of: General Administration, Ecology, Fish and Wildlife, and Natural Resources

The purpose of the CLMP, to be completed in 1996 and 1997, is to review and reconsider—in the public forum—policies, goals, and specific operation management and maintenance measures for Capitol Lake for a 10- to 20-year planning period. It is anticipated that the planning will include:

a. A review of other action recommendations contained in the "Capitol Lake Action Plan" (**Capitol Lake Restoration Committee 1989**).

b. A review of possible benefits and adverse impacts to Capitol Lake and associated resources that could be expected to occur with and without continued long-term dredging.

c. A review of the advantages and disadvantages of saltwater flushing (see Section 5.3 for a brief description).

d. A review of lake management considerations relevant to fisheries management in the lake/river system, including benefits and adverse impacts.

e. A review of water quality and nonpoint pollution causes and potential solutions.

f. A review of existing and proposed recreational facilities and their relationship to lake management issues, including a review of benefits and adverse impacts.

g. A review of flood control benefits and how they relate to sediment removal and lake level management.

h. A review of shoreline erosion control needs and proposed actions.

i. An evaluation of the consistency of proposed management measures with shoreline and environmentally sensitive area designations.

One of the primary goals of the CLMP will be to reach consensus on recommendations for intergovernmental actions. It also is anticipated that new technical information may have to be collected and evaluated before some policy issues can be decided. A CLMP Technical Advisory Committee will be established

to make decisions about what additional technical information should be gathered and how to fund such work.

3. **Limitation of Action Alternatives Evaluated**

   Because alternative long-term sediment removal operations will be addressed in the forthcoming CLMP, they are not addressed in this SEIS. This approach is consistent with the intent of DGA to supplement the original EIS, which includes several alternative dredging schemes and methods, and also satisfies State Environmental Policy Act (SEPA) requirements for evaluating alternatives. This approach is also consistent with the latest public policy document for the lake—the "Capitol Lake Action Plan" (**Capitol Lake Restoration Committee 1989**)—which recommends "maintenance dredging on a planned and regular schedule" as an activity necessary to preserve Capitol Lake.

4. **Elimination of the Centralia Coal Mine Site as an Optional Upland Disposal Site**

   The Centralia Mining Company sent a letter to DGA requesting that it be eliminated as a possible upland disposal site. Therefore, this revised DSEIS does not include any discussion of the Centralia Coal Mine.

1.1 NEW SCOPING PROCESS

A new agency scoping meeting was held on December 19, 1995 to discuss these proposed revisions to the scope of the SEIS and to obtain feedback from interested agencies. Representatives from the Washington State Department of Ecology (Ecology), the Washington State Department of Fish and Wildlife (WDFW), City of Olympia, and City of Tumwater attended. Separate discussions took place between DGA and the Squaxin Island Tribe the week prior to this meeting. Keys issues consisted of the following:

1. The City of Olympia requested an opportunity to submit written comments by December 29, 1996. The DGA granted this request.

2. There was discussion about adding representatives from the U.S. Army Corps of Engineers (Corps) and Port of Olympia to the group that would be involved in preparing the proposed CLMP. The DGA agreed that it would be helpful to have input from these two organizations.

3. There was also additional discussion between Ecology, DGA, and the City of Tumwater about the need to expand the discussion of wetland impacts to include the effects of water level fluctuation, and sedimentation, minimization of impacts by use of additional berm construction, and a need to provide additional details about the conceptual mitigation plan. It was also agreed that there was a need for more discussion about the City of Tumwater Wetland Ordinance and how the project would comply with its requirements. This new DSEIS addresses these issues.

4. The idea of designating riparian restoration of the lower Deschutes River as a regional wetland mitigation bank was also discussed. The DGA favors this idea, and would be willing to participate in meetings organized by the City of Tumwater and Ecology.

5. The WDFW raised questions about the in-lake effects of dredging on aquatic plants and bottom-dwelling organisms. The DGA agreed to provide additional discussion of these concerns in this DSEIS.

6. The DGA asked the City of Tumwater whether or not a proposed revision to the noise ordinance should be used as the basis of limiting operation hours for construction equipment. The City indicated that the existing noise ordinance should be used at this time, but that a new ordinance may be approved prior to construction. If a new ordinance is approved, any limits on construction would comply with the new ordinance.

7. Ecology requested that the Cascade McFarland Pole site at the Port of Olympia be identified as a possible site for disposal of Capitol Lake sediments. The DGA agreed.

1.2 KEY ISSUES RAISED IN COMMENT LETTERS TO THE OCTOBER 1995 DSEIS

Comments to the October 1995 DSEIS are paraphrased in **Appendix H**, along with DGA's responses. The DGA has given careful and reasonable consideration to all comments received. For purposes of preparing this DSEIS, responses to comments were distinguished as (1) those that would be addressed by providing additional information or clarification in this new DSEIS, or (2) those that would be addressed in the context of the proposed CLMP and not in this DSEIS. The comments considered most important by DGA are summarized below. See **Appendix H** for more discussion of all comments.

A concern raised by the Squaxin Island Tribe was that the proposed sequential dredging of the entire middle basin was a substantial change from the original Draft EIS dredging plan (**CH2M Hill 1976**) that would not be analyzed in a supplemental EIS. The DGA has now limited the scope of maintenance dredging to sectors 1 and 2 only because this area was identified as a part of the limited middle basin dredging addressed in the 1977 Final EIS (**CH2M Hill 1977**).

A related concern expressed by the City of Olympia was that there was insufficient information to support the need for long-term maintenance dredging. This was based on the premise that flood control impacts, view impacts, property value impacts, and fish habitat impacts may not be as great as stated in the October 1995 DSEIS. The proposed revision in the scope of maintenance dredging—to allow only two cycles of dredging in the next five years—is supported by the policy direction given in the original Capitol Lake Restoration and Recreation Plan Draft EIS (**CH2M Hill 1976**) and the subsequent Capitol Lake Action Plan (**Capitol Lake Restoration Committee 1989**) to maintain options for all beneficial uses. It

allows DGA to implement existing public policy regarding the preservation of Capitol Lake and its beneficial uses, until such time that the purpose, need, and impact of long-term dredging or absence of dredging can be more thoroughly addressed in the CLMP.

Another key concern was expressed by the City of Tumwater and Ecology regarding the frequency of proposed maintenance dredging. The City and Ecology thought that the traffic, noise, and visual disruption of a two-year dredging cycle over a five-year period might be more significant than what should be allowed under the conservancy designation of the Thurston Regional Shoreline Master Program (**Thurston Regional Planning Council 1990**), or the Greenbelt Area zoning for the Capitol Lake Interpretive Center. Since the revised project scope would involve a maximum of two dredging cycles over a five-year period, DGA believes that the impacts would not be inconsistent with existing shoreline and land use designations. The frequency of long-term maintenance dredging (beyond five years) and consistency with existing zoning and shoreline designations will be addressed in the CLMP.

One person expressed concern that the impact of saltwater flushing in the lake might be greater than the impact of dredging. This issue is not directly relevant to the proposed dredging work, and is not addressed in detail in this DSEIS. However, this issue will be addressed in the CLMP and through future HPA permits issued by WDFW for lake drawdown activities.

Another person requested the authors of the DSEIS to avoid confusion about the No Action Alternative (allowing the entire lake to fill in over time including the south, middle, and north basins) and other wetland development concepts that would involve only partial filling. The DGA has attempted to make the distinction clear throughout the document.

There were also several businesses and organizations who indicated their support for the project, and their concerns about the adverse impacts that could occur in the absence of maintenance dredging.

These were the key issues raised in comments submitted for the October 1995 DSEIS. As indicated above, a paraphrase of comments received and DGA's responses are presented in **Appendix H**.

1.3 PURPOSE OF THIS SEIS

The purpose of this SEIS is to identify significant environmental impacts associated with alternative courses of action related to maintenance dredging activities at Capitol Lake, including no action. The DGA wants your comments in order to be certain that all significant impacts and a range of reasonable alternatives have been considered, and to be certain that there are no factual errors in the SEIS. Your comments will be most effective if they address these areas of concern. Please be as specific as possible with your comments, stating the exact location of the information in the SEIS related to your concern and as many specific details and suggestions as possible to help us understand the issue and make appropriate corrections.

After all the comments have been received and reviewed, the DGA will begin the process of selecting a preferred alternative. The DGA may select more than one alternative as the preferred action which would allow them to maintain flexibility in responding to this project's future needs. Selection of a preferred alternative or alternatives, will be based on public comments, evaluation of environmental impacts and their mitigation, and cost. Selecting more than one preferred alternative is consistent with the State Environmental Policy Act as long as the environmental impacts can be reasonably mitigated.

1.4 PROPOSED ACTION

The proposed action involves selective sediment removal within the southern end of Capitol Lake's middle basin (**figures 1 and 2**). An estimated 60,000 to 70,000 cubic yards of sediment would be removed between December 1, 1996 and March 1, 1997. An additional 60,000 to 70,000 cubic yards would be removed during the subsequent five-year permit period if field measurements indicate that 75 percent of the sediment trap volume has been filled with new sediment. Sediment removal would be done with a hydraulic dredge in accordance with the recommendations of the final EIS (**CH2M Hill 1977**) unless other removal techniques prove to be more effective and to have less impact.

The dredge would remove lake bottom sediment and water together creating a slurry which would be pumped to a predetermined location. After dredging, sediments would be transported either to a deep, open-water marine disposal site in Puget Sound or to one or more upland disposal sites. With marine disposal the sediment-water slurry would be pumped directly to a barge in Budd Inlet, as it would not require dewatering, and then would be transported to a designated deep, open-water marine disposal site located between Anderson and Ketron Islands. Upland disposal would require dewatering either by (1) gravity settling using two sedimentation ponds; or (2) mechanical screens and centrifuges. Optional upland disposal sites discussed in detail in this SEIS include the Thurston County Landfill and Chehalis Western Trailhead sites. Other possible sites for sediment disposal would include the Cascade McFarland Pole site at the Port of Olympia, the County Outdoor Recreational Vehicle Park, and gravel pits in north Thurston County. These latter sites would require a separate environmental and permit approval process.

1.5 PURPOSE AND NEED FOR THE PROJECT

Capitol Lake was created as a reflecting pool for the Capitol Buildings based on the original Capitol Campus plan of architects White and Wilder in 1911. Funding for construction of the dam and tide gate was authorized by the state legislature in 1947 and construction was completed in 1951, converting a large expanse of tidal mud flats into what is now a 270-acre lake. Today, the lake is a highly prized, multipurpose, freshwater reservoir. It provides fishery, recreation, aesthetic, socio-economic benefits, and limited flood control to the citizens of Olympia, Tumwater, Thurston County, and Washington State.

Since the dam was constructed and the lake was formed in 1951, an estimated 1.5 million cubic yards of sediment have been carried down the Deschutes River to the lake (30,000 to 35,000 cubic yards per year). As a result, the lake has become increasingly shallow and sediment removal is necessary to maintain the lake's beneficial uses.

In 1976, a draft environmental impact statement was prepared for the Capitol Lake Restoration and Recreation Plan (**CH2M Hill 1976**). The FEIS was published in 1977. This plan involved sediment removal in the south and middle lake basins with disposal inside the lake basin (**figure 4**). These plans were implemented in 1979. Recreational improvements also were to be provided in the southwest corner of the middle basin at the Capitol Lake Interpretive Center. At that time, long-range plans for disposal of subsequent maintenance dredging involved consideration of four optional upland disposal sites (**figure 5**). In 1986, another sediment removal operation occurred which removed approximately 57,000 cubic yards of sediment.

The 1991 Legislature appropriated funds to update the 1977 sediment removal plan and to dredge selected areas of the lake. This SEIS has been prepared to:

- describe proposed revisions to the maintenance sediment removal plan
- evaluate the potential environmental impacts of alternative methods of dewatering and disposal
- present proposed mitigation measures for the updated plan

1.6 PROJECT GOALS

The goals of the sediment removal project are to:

1. Prepare an updated sediment removal plan to remove up to 140,000 cubic yards of sediment over a five-year period. This action would be an incremental investment aimed at preserving Capitol Lake as an open-water resource and its beneficial uses.

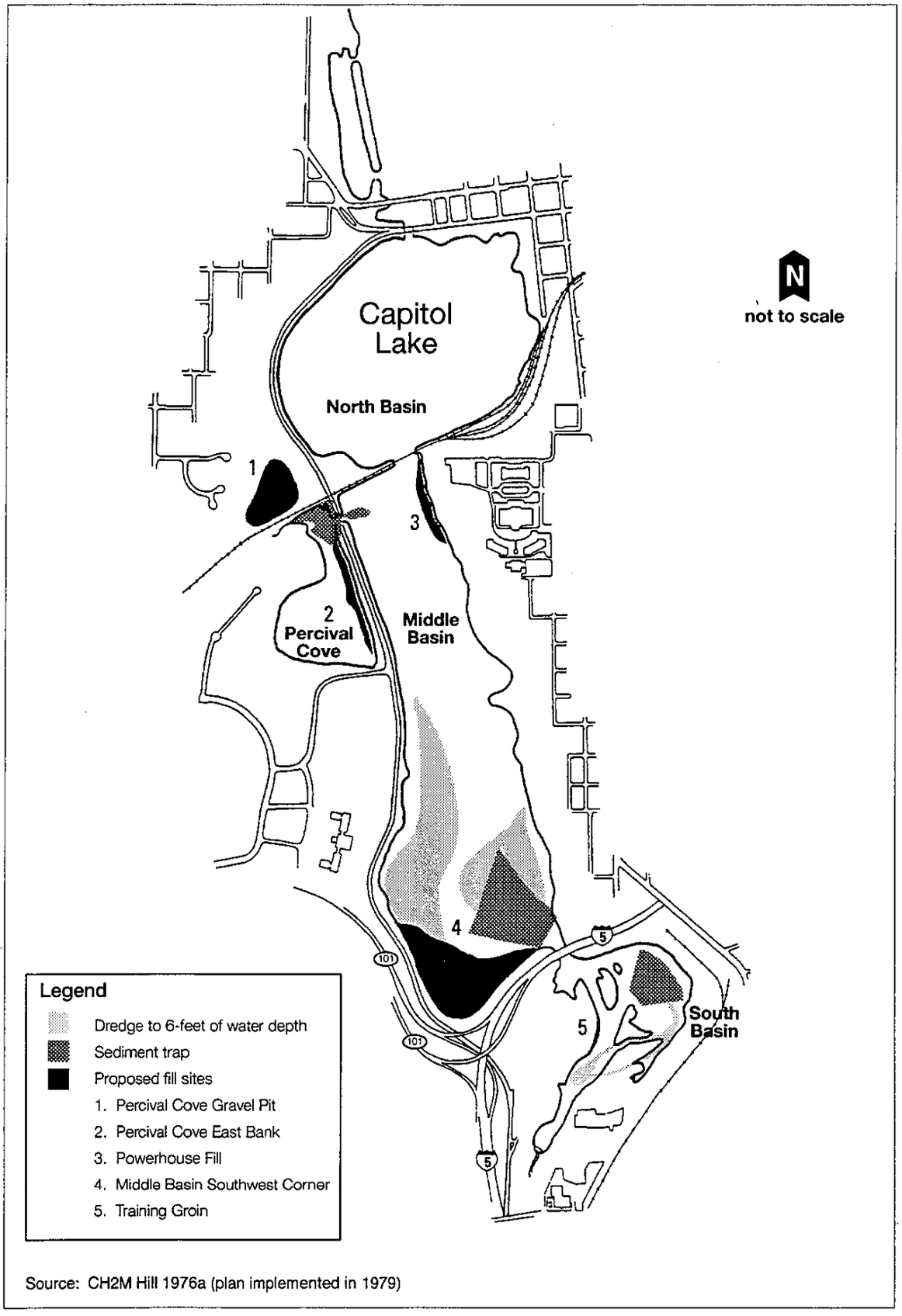
2. Avoid, minimize, and/or mitigate environmental impacts.

3. Involve federal, state, and local agencies; the Squaxin Island Tribe; and the public in the environmental review process.

4. Maintain flexibility with respect to the long-range sediment removal plan to preserve future options for beneficial uses and/or disposal of Capitol Lake sediments.

5. Recognize the possible beneficial uses of the sediments, such as: reclamation of gravel pits; topsoil for parks and trails; landfill liner material; clean capping material of contaminated sites; and others that may be identified later.

6. Select management options that make the best use of sediments as a resource, and at the same time provide sediment removal, recycling, and/or disposal in the most cost-effective manner.



Source: CH2M Hill 1976a (plan implemented in 1979)

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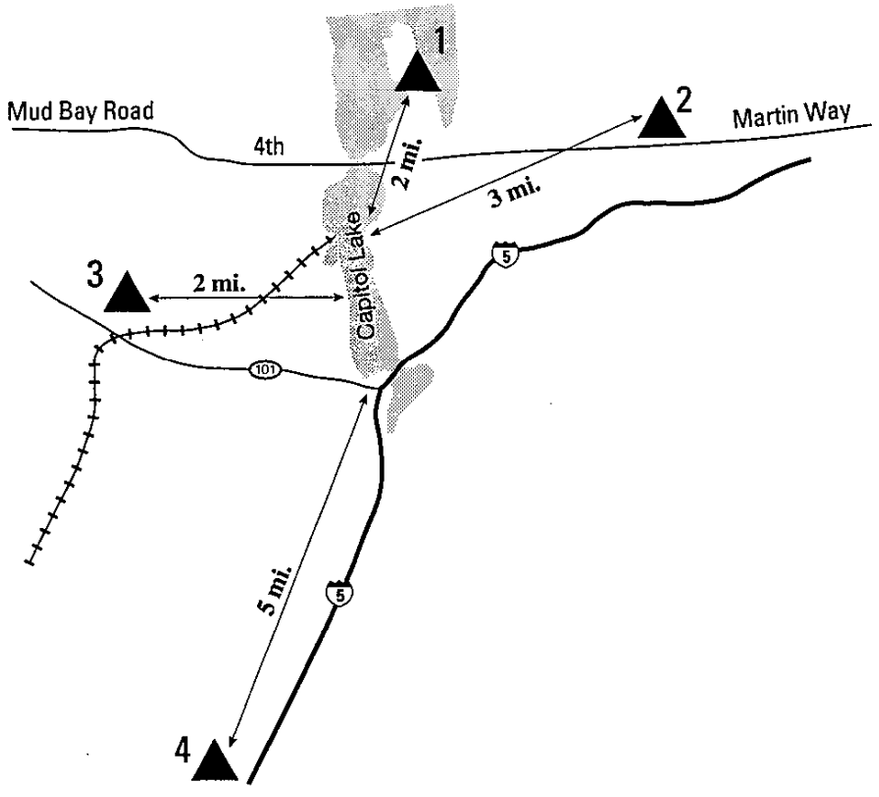
Capitol Lake SEIS

Figure 4
1979 Dredge Areas and Lakeside Disposal Sites



Legend

1. East Bay Marina
2. Martin Way Site
3. Highway 101 Pit
4. DNR Nursery Site

Source: CH2M Hill 1976a (plan implemented in 1979)

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Capitol Lake SEIS

Figure 5
1979 Out-of-Basin Disposal Sites

1.7 1992 SCOPING MEETINGS

Agency and public scoping meetings were originally held in May 1992 to discuss the alternatives and environmental issues that would be addressed in this SEIS.

No public comment was presented at that time. During the 1992 agency scoping meeting, the DGA indicated that a long-range (ten-year) sediment removal plan would be prepared to address sediment removal throughout the middle basin, with the exception of shoreline buffer zones. Agency comments and subsequent decisions by the DGA are summarized below.

- The Squaxin Island Tribe requested that removal of the south basin training groin (originally constructed to facilitate sediment trapping in the south basin) be considered.

  Response: The DGA, in cooperation with the City of Tumwater, removed the training groin and restored the shoreline at the site. This work was accomplished under a separate environmental and permit review and is consistent with the DGA's decision to abandon the south basin sediment trap.

- Requests were made that the DGA continue to be involved in source control efforts in the watershed.

  Response: The DGA has continued to work with the Thurston Conservation District to implement bioengineering river bank erosion control demonstration projects in lower reaches of the Deschutes River.

- Concerns were expressed regarding the effects of sediment removal operations on the wetlands that have developed within the original sediment dewatering area.

  Response: The DGA has: (1) completed a delineation of the wetlands; (2) conducted a pilot dredging/mechanical dewatering project to determine the feasibility of this dewatering alternative approach to avoid wetland impacts; (3) evaluated the feasibility of a marine disposal alternative to avoid wetland impacts; (4) developed a conceptual mitigation plan for impacts to the wetlands for the gravity dewatering alternative; and (5) worked closely with the Corps, Ecology, and the City of Tumwater regarding regulatory status and conceptual mitigation planning. These efforts are addressed in detail in the body of this SEIS.

- Some agency representatives indicated that it might be better to remove greater quantities of sediment during each removal cycle, so as to extend the time period between cycles to more than two years, and thus minimize disruption of recreational and other uses.

  Response: This is probably most feasible for portions of Capitol Lake which are able to meet PSDDA sediment criteria for the marine disposal option addressed in this SEIS, and may also be possible with the mechanical dewatering alternative. However, this approach would be dependent upon appropriate funding

authorization by the legislature and the ability to excavate the material within the December 1 to March 1 time frame. This approach would not be possible with the gravity dewatering option, because the lakeside gravity dewatering facility only has capacity for 60,000 to 70,000 cubic yards of material per cycle.

- Sediment characterization studies were requested by the Thurston County Public Health and Social Services Department.

  *Response: Initial sediment characterization studies were completed in 1994. The results indicated that there are no PCBs and no toxic levels of metals in the sediment, and that there would be no adverse impact to ground or surface waters associated with upland disposal. The PSDDA analyses necessary for marine disposal were completed in 1995. Results indicated that there was no sediment contamination in proposed dredging sectors 1 and 2 (**figure 2**). Other areas of the middle basin contain concentrations of benzoic acid above the PSDDA maximum screening levels, but are not proposed for sediment removal at the present time.*

- In addition to the responses made to the agency comments listed above, the following changes have also been made to the project since the time of the agency scoping meeting: (a) creation of an island in the north basin using sediment materials has been eliminated from consideration due to high cost and engineering challenges; and (b) the marine disposal alternative has been added.

1.8 ALTERNATIVES

The following alternatives are compared in this SEIS:

1. **No Action Alternative**

   Under this alternative, no sediment removal would be performed, and sediment from the Deschutes River would be allowed to fill the south, middle, and north basins of Capitol Lake. In the near term, there would be no significant adverse impacts. However, over a period of 30 to 85 years or more (estimated using present deposition rates), the existing lake would be lost and would be replaced by a riverine delta and freshwater wetland.

2. **Gravity Dewatering Alternative**

   A trackhoe would be used to excavate approximately 60,000 to 70,000 cubic yards of material from the construction (gravity) dewatering area as shown in **figure 2**. These sediments would be transported to one or both of the upland disposal sites: Thurston County Landfill site and/or the Chehalis Western Trailhead site. Then a hydraulic dredge would be used to remove 60,000 to 70,000 cubic yards of new sediments from the two sediment removal sectors in the lake's middle basin (**figure 2**). Sediment would be removed by gravity settling in the existing gravity dewatering area (a two-pond system) in the middle basin's southwest corner (referred

to as the dewatering construction area in **figure 2**). Water from the hydraulic dredging operation would be treated with nontoxic flocculents (see **Appendix E**) and routed through the wetlands in the middle basin's southwest corner to aid settling and reduce turbidity prior to discharging the treated water back to Capitol Lake. The upland disposal sites are the Thurston County Landfill and the Chehalis Western Trailhead site (**figure 1**). This cycle would be repeated, if trap surveys indicate that 75 percent of trap volume is filled within the subsequent five-year period.

3. **Mechanical Dewatering Alternative**

   This alternative would be similar to the Gravity Dewatering Alternative with respect to the method of sediment removal and upland disposal. However, sediments would be dewatered by using a series of mechanical screens and centrifuges rather than sedimentation ponds. The water from the operation would be treated with nontoxic flocculents (see **Appendix E**) and routed through the wetlands in the middle basin's southwest corner prior to discharging the treated water back to Capitol Lake.

4. **Marine Disposal Alternative**

   Under this alternative, dewatering would not be required. The sediment-water slurry (10 to 20 percent solids) from the hydraulic dredge would be routed directly by pipe to a barge at the Port of Olympia in Budd Inlet. Marine barges would then transport the slurry north to an approved deep, open-water marine disposal site between Anderson and Ketron Islands in Pierce County (**figure 1**).

Table 1 presents a summary cost comparison of the three action alternatives. As indicated in **table 1**, marine disposal is the least costly alternative and mechanical dewatering is the most costly. An important consideration with respect to cost is that the upland disposal site operators may be willing to pay trucking costs. This would reduce the cost to DGA, however, the cost for transporting the sediment would be passed on to taxpayers by the disposal site operators in some form of higher prices for products or services. Given the potential beneficial uses for this material at the upland disposal sites, this may be a desirable solution for reducing DGA's costs.

Table 1
Summary of Five-Year Cost Estimates for the Action Alternatives[1]

Alternatives	Estimated Five-Year Cost ($ Millions)[2]
Gravity Dewatering and Upland Disposal ($17 to $21/cubic yard)	2.4 to 2.9
Mechanical Dewatering and Upland Disposal ($23 to $27/cubic yard)	3.2 to 3.8
Marine Disposal ($10/cubic yard)	1.4 to 1.7

1. Assumes two dredge cycles within five-year period.
2. The five-year estimates have not been adjusted to account for inflation.

1.9 SUMMARY COMPARISON OF ALTERNATIVES

1.9.1 Significant Benefits with Marine Disposal

The Marine Disposal Alternative provides six significant benefits over the other action alternatives.

- It is the most cost effective alternative (see **table 1**).
- It has the least impact on Capitol Lake water quality, fish habitat, and fish, because there would be no discharge of treated water from the dredge slurry back into the lake.
- It completely avoids any impact to the wetlands as it does not require a dewatering facility.
- It would not require any measures to control purple loosestrife (as is required for the two dewatering alternatives), since all sediments would be disposed of in deep saltwater where there would be no chance of weed growth.
- It would not require heavy truck traffic as all sediments would be hauled to the Anderson/Ketron Island site by barges.
- It imitates the natural sediment deposit function of the Deschutes River, but it allows the sediment to be disposed of at a selected site rather than where it can impact existing and future port operations.

1.9.2 Impacts to Fish Avoided or Mitigated for All Alternatives

The potential adverse impacts to fish can be mitigated for each action alternative. The most important potential impacts are those that could affect salmon fisheries that use Capitol Lake for passage or rearing. These impacts would be largely avoided by scheduling

sediment removal operations for the period between December 1 and March 1. This is the period of least use by salmonids. Impacts to juvenile fish rearing areas would be avoided by establishing shoreline "buffer" areas where no dredging would occur.

Potential water quality impacts to fish would be mitigated in two ways:

- using nontoxic flocculents to aid in settling suspended sediments prior to discharging the treated water to Capitol Lake (this mitigation applies only to the Gravity Dewatering and Mechanical Dewatering alternatives).
- using silt curtains to control turbidity around the dredge and return flow outlet.

1.9.3 Impacts to Wetlands Greatest with Gravity Dewatering Alternative - But Can Be Mitigated

The Gravity Dewatering Alternative would eliminate up to 3.7 acres of wetlands[1] in the gravity dewatering facility behind the dike in Capitol Lake's southwest corner, near the Capitol Lake Interpretive Center, and would also result in temporary increases in the water level and turbidity of adjacent wetlands. No wetland impacts would occur with the Marine Disposal Alternative. Wetland impacts associated with the Mechanical Dewatering Alternative would be limited to increases in water level and turbidity during dewatering operations.

The U.S. Army Corps of Engineers made the following determination regarding use of the dewatering area in their letter dated September 1, 1995:

> "This area is not considered to be abandoned as a de-watering site. Therefore, a Section 404 permit is not required to discharge dredged material into wetlands on the site during future dredging projects."

A copy of this letter has been included in this SEIS as **Appendix C.**

Although the Corps has indicated that a Section 404 permit will not be required to discharge dredged material into wetlands on the site, Ecology will require a Water Quality Certification permit for work within the wetlands because they are considered waters of the state, and the City of Tumwater will require a wetland permit under their Wetland Ordinance.

Mitigation for wetland impacts under the Gravity Dewatering Alternative would involve the following:

- constructing enhancement scrub-shrub or emergent marsh wetlands in the shoreline "buffer" area of Capitol Lake
- constructing additional dikes to avoid impacts for up to 2.0 of the 3.7 acres of wetlands potentially affected

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1 This wetland has developed since the last dredging operation in 1986. Development of this wetland was partially due to the facility design which retained water in the settling basin.

- designing the outlet structure to minimize wetland water level fluctuations
- restoring areas of riparian habitat in the lower Deschutes River basin

1.9.4 Purple Loosestrife Control for Upland Disposal

Purple loosestrife is a noxious wetland plant targeted for control/eradication in Washington by the Washington State Department of Agriculture. The southern part of Capitol Lake has been identified as a quarantine site for this plant by the Thurston County Noxious Weed Control Agency (TCNWCA). Since each plant can produce up to two million or more viable seeds per year, and since seeds may remain viable for up to eight years, the TCNWCA is concerned that viable seeds may exist in Capitol Lake sediments, and that purple loosestrife could be spread to upland disposal sites.

The risk of purple loosestrife colonization is associated only with the Gravity Dewatering and Mechanical Dewatering alternatives. Therefore, a monitoring and control plan would be needed at the Capitol Lake dewatering area and at each upland disposal site. If any purple loosestrife plants do germinate, they would be hand pulled, double-bagged, and transported to the Thurston County Landfill for disposal.

1.9.5 Significant Benefits with Upland Disposal

Although the Gravity Dewatering and Mechanical Dewatering alternatives have potential impacts which are not associated with the Marine Disposal Alternative, there are also potential benefits associated with these alternatives that would not be realized with the Marine Disposal Alternative. The benefits of upland disposal involve:

- reducing potential groundwater quality impacts at sensitive sites
- providing landscape treatment benefits for parks and trails
- assisting gravel pit reclamation efforts

A primary interest for using Capitol Lake sediments is as a landfill liner material at the Thurston County Landfill. Although additional testing is needed for confirmation, lake sediments may meet the standards for low permeability to qualify for use as a landfill liner material. Materials with low permeability act as a water barrier, and prevent contaminated landfill leachate from reaching surrounding groundwater supplies. For the same reason, lake sediments may also make ideal material for filling abandoned gravel pits. With low permeability and a high clay content, lake sediments would reduce the volume of water passing through to shallow aquifers with sensitive water quality. The sediment also would have a large capacity to absorb any pollutants discharged on the ground surface.

In addition, since most of the material from Capitol Lake consists of a combination of silts, clays, and sands, it is suitable for use as topsoil on trails and park sites. It may also have potential for use in capping contaminated sediments at a hazardous waste site within the Port of Olympia.

1.9.6 Adverse Impacts with the No Action Alternative

Although the additional wetlands that would develop with the No Action Alternative (a total of 270 acres of new wetlands would be created if the entire lake basin was allowed to fill in) might be viewed by some as an important environmental benefit of the No Action Alternative (because of increased bird and wildlife habitat), there would also be some undesirable adverse impacts.

One of the most significant impacts of the No Action Alternative, may involve loss of sufficient open-water habitat to support the rearing of the 7 to 8 million juvenile salmonids that are presently reared in the lake. However, it may be possible to mitigate this impact by releasing the 7 to 8 million juvenile fish along an adequate segment of the Deschutes River upstream from Tumwater Falls. The WDFW and the Squaxin Island Tribe would have to determine if such mitigation would be feasible.

Another adverse impact would involve loss of some existing flood protection along Capitol Lake's northeast shore in the north basin. Under existing conditions, the DGA lowers the lake prior to major rainstorms to increase flood storage capacity. If this is not done, some businesses in Olympia may experience more frequent flooding, and perhaps more severe flooding. While this impact could be mitigated by constructing flood control dikes and stormwater pump stations, this mitigation would result in undesirable modifications to the proposed Heritage Park (a park that would connect the eastern shoreline of the north basin with the Capitol grounds).

Loss of open-water vistas is another adverse impact of the No Action Alternative. When the lake is filled in completely (which could take an estimated 30 to 85 years for the middle basin and up to 100 years for the north basin), it would be transformed into a riverine wetland with some scrub-shrub and forested wetland habitat. This kind of wetland environment may not provide the best fit with the proposed Heritage Park, and also may be less desirable than open-water views to users of Marathon Park and the Capitol Lake Interpretive Center. Existing residential and commercial view properties also would lose major portions of their open-water views, and property values also may be affected. It may be possible to mitigate these potential view and property value impacts to some extent by retaining some open-water habitat in addition to the main river channel. Retaining the entire north basin might provide the necessary mitigation, and at the same time avoid conflicts with the proposed Heritage Park.

1.10 SUMMARY OF IMPACTS AND MITIGATION

A summary of the alternatives' impacts and proposed mitigation is presented for comparison in **table 2** on the following pages.

Table 2
Summary of Impacts and Mitigation

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Earth	***Impacts:*** Capitol Lake would fill with Deschutes River sediment at an annual rate of 30,000 to 35,000 cubic yards (cy) per year. It is estimated that the middle basin would fill in 30–85 years and the north basin in 100 years. Filling both the middle and north basins would reduce flood storage in Capitol Lake and result in limited additional flooding of approximately 0.8 feet. Sediment would also begin to fill Budd Inlet. The Port of Olympia would become responsible for dredging.	***Impacts:*** Dredging would occur over an area of 27 acres (10 percent of total) in two sectors of Capitol Lake's middle basin. Sixty to seventy thousand cubic yards would be removed in one and possibly two dredge cycles over the next five years. Dredging depth would be 1–5 feet in sector 1 and 1–3 feet in sector 2. No toxic or dangerous chemicals were found during sediment testing. Temporary erosion/ sedimentation impacts would occur in the gravity dewatering area in the middle basin's southwest corner during excavation and filling, which would affect 5.75 acres. Also, up to 6.5 acres of bare soil at the Thurston County Landfill and 5.0 acres at the Chehalis Western Trailhead.	***Impacts:*** No impacts at the gravity dewatering area. Similar impacts at the two upland disposal sites as indicated for the Gravity Dewatering Alternative.	***Impacts:*** No impacts to the gravity dewatering area or to any of the upland disposal sites. Sediment and slurry water would be discharged to an approved PSDDA site at Anderson/Ketron Island in Puget Sound. The PSDDA sediment testing confirmed that there were no compounds above the Screening Level in sectors 1 and 2 and that the material would be safe to dispose of in Puget Sound.
	Mitigation: The Port of Olympia would have to increase dredging to maintain marine navigation channels. See mitigation under Water Resources for loss of flood storage volume in Capitol Lake.	***Mitigation:*** Use erosion/sedimentation control measures during and after construction at the dewatering site and each upland disposal site. Runoff would be treated at the existing north retention pond at the Thurston County Landfill. At the Chehalis Western Trail, a biofiltration swale would treat runoff prior to recharge to the groundwater system.	***Mitigation:*** No mitigation would be required at the dewatering area. Mitigation at upland disposal sites would be the same as for the Gravity Dewatering Alternative.	***Mitigation:*** No mitigation would be required, except that post-disposal monitoring would be performed to confirm no impact.

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Noise	***Impacts:*** There would be no change in noise levels with the No Action Alternative.	***Impacts:*** Noise impacts would be associated with dredge operation, earth-moving equipment, and trucks. Truck noise would occur July to October for 65–90 days each dredge cycle. Three trucks per hour would transport sediment during the 11-hour work day. Dredging noise would occur from December 1 to March 1, each dredge cycle. Sensitive receptors at Capitol Lake are residences along the middle basin's east side, and recreational trail users near the gravity dewatering site at the Capitol Lake Interpretive Center. Due to high background noise (I-5 traffic) and distance to residences, impacts are expected to be less noticeable. Rural residents would perceive a noticeable increase in noise on the truck route to the Chehalis Western Trailhead in south central Thurston County.	***Impacts:*** Impacts would be similar to those described for the Gravity Dewatering Alternative.	***Impacts:*** There would be no truck noise associated with this alternative. Noise impacts of the dredging operation would be the same as for the Gravity Dewatering Alternative plus the noise associated with a booster pump at the Port of Olympia loading dock. Minor noise would also be associated with the tug and barge traffic—two per day—but this would be considered a normal and acceptable kind of noise in the Budd Inlet environment.
	Mitigation: None.	***Mitigation:*** Operations would occur from 7:00 a.m. to 6:00 p.m., weekdays only. All construction equipment would have mufflers.	***Mitigation:*** Mitigation would be the same as for the Gravity Dewatering Alternative.	***Mitigation:*** Operations would occur from 7:00 a.m. to 6:00 p.m., weekdays only, and the dredge and booster pump would be equipped with the required muffler.

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Water Resources	***Impacts:*** Long-term impacts: possible increases in water temperature, and algae growth in areas cut off from main river channel circulation, with possible increases in pH and decreases in dissolved oxygen. Such deterioration in water quality would be likely during summer in the north and middle basins' backwater areas, and would be detrimental to fish. Impacts could extend into Budd Inlet with seasonal return of higher flows and flushing of algal material into the Inlet. Flood storage loss would increase the 100-year flood elevation from 10.9 to 11.7 feet, and probably would increase flooding during smaller storms.	***Impacts:*** This alternative would have no flooding impacts. Temporary turbidity would occur near the dredge, and in the dewatering ponds. Some turbidity also would occur where return flows enter the lake. No other water quality impacts expected; sediment tests revealed no contaminants of concern in sectors 1 and 2. Temporary erosion/sedimentation impacts could occur at disposal sites. Impacts at the landfill site would be mitigated by an existing sedimentation basin. Accidental spills of petroleum products and hydraulic fluids from the dredge, trucks, and earth-moving equipment could occur. Placing sediments at the upland disposal sites would reduce risk of groundwater quality impacts.	***Impacts:*** This alternative would have no flooding impacts. The gravity dewatering area would not be excavated, but would experience temporary turbidity due to return flow water. Impacts attributable to dredging, truck hauling, and remote disposal of sediments would be the same as those described for the Gravity Dewatering Alternative.	***Impacts:*** There would be no flooding impacts, no impacts to the gravity dewatering area, and no impacts to the upland disposal sites. Temporary turbidity would occur near the dredge. Turbidity levels would also be temporarily elevated at the Anderson/Ketron Island deepwater marine disposal site. Sediment contaminants were all below the PSDDA screening level criteria and there would be no water quality impact. Accidental petroleum spills also could occur with use of the dredge, booster pump, and tug.
	Mitigation: Water quality mitigation could involve more frequent saltwater flushing of the north and middle basins during summer. If a saltwater flushing barrier is built to protect freshwater wetlands, flushing would be ineffective in the middle basin. It may be possible to increase freshwater exchange by daily raising and lowering of the lake (bumping) by +/- 2 feet.	***Mitigation:*** Nontoxic chemicals (bentonite and chitosan - see **Appendix J**) would be added at the dewatering facility before discharge and silt curtains would be installed around the dredge and return flow pipe to lower turbidity. An erosion/sedimentation control plan would be prepared for disposal sites, including soil stabilization. A biofiltration swale would be used to treat runoff at the Chehalis Western Trailhead site prior to discharge to groundwater.	***Mitigation:*** Nontoxic chemicals would be added to the return flow and routed through undisturbed wetlands at the existing dewatering facility as a means of reducing turbidity at the point of discharge to Capitol Lake. Mitigation would otherwise be the same as for the Gravity Dewatering Alternative.	***Mitigation:*** Silt curtains could be installed around the dredge to control short-term, localized turbidity impacts. Also, the DNR would perform post-disposal sediment and benthic organism monitoring at the Anderson/Ketron Island site.

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Water Resources (Continued)	***Mitigation (Continued):*** Mitigation of flood impacts may require construction of flood control berms along the eastern shore of the north basin and stormwater pump stations.	***Mitigation (Continued):*** Sediment carried onto paved roads by trucks would be shoveled, swept, and washed off. The contractor would prepare and implement a spill prevention plan and emergency spill control and clean-up plan.		***Mitigation (Continued):*** The contractor would prepare and implement a spill prevention plan, and an accidental spill control and clean-up plan.
Plants and Wildlife	***Impacts:*** The existing 270-acre freshwater lake would be replaced (over 30 to 85 years for the middle basin and up to 100 years for the north basin) by freshwater scrub-shrub, emergent and forested wetlands. Most salmon freshwater rearing and feeding habitat in the main lake and Percival Cove would be lost. Some rearing habitat would remain along new river channels and sandbar islands. During summer, backwater areas could experience poor water quality detrimental to fish. Open-water habitat for resident freshwater fish—rainbow trout, largemouth bass and carp—would be lost. New wetlands would provide increased habitat for waterfowl, herons, blackbirds, mink, raccoons, muskrat, and otter. New habitat also would increase the chance of purple loosestrife colonization and the effort to monitor and control it.	***Impacts:*** Impacts to lake shoreline wetlands would be avoided by not dredging within the shoreline buffer area. Potential impacts to salmon would be largely avoided by dredging from December 1 to March 1. Cutthroat trout and steelhead may be residing or moving through the lake at this time, but would be expected to avoid the dredge operation. There could be some loss of resident bass, carp, and minnows if sucked into the dredge. Dredging would remove aquatic plants and bottom-dwelling organisms on about 27 acres (10 percent) of lake bottom, it would be expected to repopulate within six–18 months. Based on WDFW estimates, this would represent only 1 percent of salmon fish food, because natural food sources represent only 10 percent of total food for juvenile salmonids. 90 percent of salmon food is artificially supplied by the WDFW. No adverse impacts are expected to the bald eagle, pileated woodpecker, green-backed heron, or mink.	***Impacts:*** Impacts would be similar to those described for the Gravity Dewatering Alternative, except that there would be no excavation of wetlands at the gravity dewatering facility.	***Impacts:*** In-lake impacts would be the same as those described for the Gravity Dewatering Alternative. Some bottom dwelling organisms would be covered at the 600 foot deep marine disposal site, but these impacts have been addressed under separate PSDDA environmental review. No long-term contamination would be expected, because PSDDA testing showed all contaminants below the screening level.

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Plants and Wildlife (Continued)		***Impacts (Continued):*** Excavation and refilling operations would eliminate up to 3.7 acres of wetlands in the dewatering area and displace associated plants and wildlife. Water level changes and sedimentation in adjacent wetlands could impact shoreline wetland plants, amphibians, and bottom-dwelling organisms (insects, worms, etc.). There would be no impacts to plants or wildlife at the Thurston County Landfill site. At the Chehalis Western Trailhead, five acres of partially vegetated, abandoned gravel pit would be cleared to prepare the disposal site. After placing the sediment, the site would be landscaped and would provide some new wildlife habitat. If there are purple loosestrife seeds in the sediments, colonization could occur in the dewatering area, or at the upland disposal sites.		
	Mitigation: Mitigation could be provided by limiting filling to the middle basin. This would require resumption of dredging in the north basin to retain it for fish rearing and feeding. Also, bumping the lake could mitigate backwater stagnation, improve conditions for fish, and prevent fish from being stranded in backwater areas.	***Mitigation:*** Mitigating in-lake impacts would involve using a silt curtain to keep fish out of dredge areas. Wetland impacts in the dewatering area could be mitigated by using Capitol Lake sediments to enhance wetland habitat within the shoreline buffer zone (1:1 minimum enhancement ratio) and by DGA participating in riparian habitat improvements along the lower Deschutes River (amount of mitigation to be determined in cooperation with Tumwater and Ecology).	***Mitigation:*** There would be no excavation of wetlands within the dewatering area, and no need to mitigate direct loss of wetlands. In other respects, mitigation for in-lake and wetland impacts would be the same as described for the Gravity Dewatering Alternative. Mitigation at upland disposal sites would also be the same as for the Gravity Dewatering Alternative.	***Mitigation:*** Mitigation of in-lake impacts would be the same as those for the Gravity Dewatering Alternative. The DNR would conduct post disposal monitoring of sediments at the Anderson/Ketron Island site.

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Plants and Wildlife (Continued)	***Mitigation (Continued):*** Another possible mitigation measure may involve releasing juvenile salmon in appropriate reaches of the Deschutes River upstream of Tumwater Falls. A purple loosestrife monitoring and control plan would be required for the 270-acre wetland area, once the entire lake basin was filled with sediment unless purple loosestrife controls have previously eradicated the infestation.	***Mitigation (Continued):*** Some wetland impacts could be avoided by constructing a new dike and raising the access road to provide the same sediment storage capacity in a smaller area. This measure would avoid impacts on up to 2 acres of the existing 3.7-acre wetland. Mitigation of water level impacts within the remaining wetland would involve redesign of the outlet structure to limit vertical water level fluctuations. No mitigation would be required at the landfill site. Mitigation at the Chehalis Western Trailhead site would involve hydroseeding and planting after placing sediment. Purple loosestrife mitigation would involve: 1) monthly monitoring at the dewatering site and each upland disposal site April to June each year for eight years following disposal; 2) purple loosestrife plants would be hand pulled, double bagged, and sent to the Thurston County Landfill; 3) a grading plan would be prepared and approved by TCNWCA for the Chehalis Western Trailhead site to minimize wetland habitat favoring purple loosestrife growth; 4) if these measures failed, DGA and TCNWCA would develop a contingency plan.		

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Land and Recreational Uses	***Impacts:*** Long-term impacts (30 to 85 years): residential and commercial properties would lose existing lake views, because riparian wetlands would replace the lake. Capitol Lake also would no longer be a reflecting pool for the Capitol Buildings. Losing the lake would adversely impact lake views from the proposed Heritage Park and existing shoreline parks and trails. Boating and lake fishing benefits would also be lost eventually. Increased vegetation and reduced visibility could lead to more crime and reduced public security and safety. Walking, jogging, and bicycling would be still possible along existing trails. New wetlands would enhance certain aspects of bird and wildlife watching.	***Impacts:*** Capitol Lake recreational users would experience minor impacts due to seeing and hearing dredging, excavation and trucking operations. Truck loading and hauling around the dewatering facility would occur in summer and fall, and lake dredging and dewatering activities December 1 to March 1 once or twice over the next five years. Use of the dewatering facility would be consistent with the Greenbelt zoning of the City of Tumwater, given public review and acceptance. Disposal at upland sites would be consistent with existing and proposed land uses. Based on site capacity (120,000 cy), it would take two dredging cycles to fill the abandoned gravel pit at the Chehalis Western Trailhead site. Also, filling the gravel pit at the Chehalis Western Trailhead would require a change in park use from a BMX track to another use—picnic areas or play fields. No land use or recreational impacts would occur at the Thurston County Landfill site.	***Impacts:*** Impacts would be similar to those for the Gravity Dewatering Alternative, except dredging and trucking activities at Capitol Lake would occur during the same time frame—December 1 to March 1.	***Impacts:*** The dredging equipment, discharge pipeline, and marine barge would be visible to recreational users of Capitol Lake and Percival Landing—December 1 to March 1. Also, minor interference with recreational marine boating could occur from barge traffic in Budd Inlet.

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Land and Recreational Uses (Continued)	***Mitigation:*** Mitigation could involve limiting filling to the middle basin. Dredging could be resumed to preserve the north basin as a reflecting pool and some open-water vistas. Adverse impacts to some view properties and recreational uses in the middle basin would still occur. Also, construction of flood control dikes and stormwater pump stations along the eastern shore of the north basin, if needed, would have adverse impacts to proposed Heritage Park. Increased trail patrols by police could mitigate reduced trail safety and increased crime potential.	***Mitigation:*** Additional landscaping and berm construction could be provided to better isolate recreational trail users from disturbances in the dewatering area. New and improved educational displays also could be provided. No mitigation would be proposed for the upland disposal sites.	***Mitigation:*** Same as Gravity Dewatering Alternative.	***Mitigation:*** No mitigation would be necessary due to the minor nature of impacts.

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Shoreline Use and Critical Areas	***Impacts:*** Filling of Capitol Lake would result in limited additional flooding impacts to the City of Olympia and would not be consistent with the City's Critical Areas regulations without mitigation. Purple loosestrife could spread across the new 270-acre wetland, requiring additional monitoring and control.	***Impacts:*** The gravity dewatering area would be disturbed for 60–90 days during July to October each dredging cycle (excavation of existing sediment to make room for new material) and up to 90 days from December 1 to March 1 with lake dredging and refilling of the dewatering area. The project would be in compliance with the shoreline master program if all mitigation measures specified in this SEIS were implemented. Using the gravity dewatering area once or twice in five years would be considered consistent with the conservancy shoreline designation. A similar use was authorized under a shoreline permit in 1986. Mitigation of wetland impacts would be required as indicated under Plants and Wildlife. Sediment deposits at each upland disposal site would be a positive impact as the fine-grained sediments would reduce risk of groundwater contamination and increase the depth between the ground surface and groundwater table. The Special Management Area requirements of the Thurston County Critical Areas Ordinance would apply to each disposal site, assuming purple loosestrife quarantine boundaries are extended by TCNWCA.	***Impacts:*** Compliance with shoreline and critical areas ordinances would be the same as for the Gravity Dewatering Alternative, except that there would be no wetland excavation, and disruption of the dewatering area would be limited to 90 days each dredging cycle rather than 180 days.	***Impacts:*** The proposed work in Capitol Lake would be consistent with the Shoreline Master Program for the Thurston Region, and depositing sediment at the Anderson/Ketron Island deepwater marine disposal site is authorized under an existing Pierce County shoreline permit through DNR.

Table 2 - Continued

Element of Environment	No Action Alternative	Gravity Dewatering Alternative	Mechanical Dewatering Alternative	Marine Disposal Alternative
Shoreline Use and Critical Areas (Continued)	***Mitigation:*** Flood control dikes and stormwater pump stations could be required to satisfy the City of Olympia Flood Control Ordinance. Also, the DGA would have to maintain a long-term monitoring and control program for purple loosestrife in the new wetlands.	***Mitigation:*** Mitigation wetlands along Capitol Lake's shorelines or lower Deschutes River riparian areas would be consistent with the Shoreline Master Program for the Thurston Region, and local critical areas ordinances. All other mitigation is listed under Water Resources and Plants and Wildlife.	***Mitigation:*** All appropriate mitigation is indicated in the Water Resources and Plants and Wildlife sections, and would be consistent with the Shoreline Master Program for the Thurston Region and local critical areas ordinances.	***Mitigation:*** None required.
Historic and Cultural Resources	***Impacts:*** No historic or cultural resources would be directly impacted. Potential impacts on culturally important salmon are discussed under Plants and Wildlife.	***Impacts:*** No historic or cultural resources would be directly impacted. Potential impacts on culturally important salmon are discussed under Plants and Wildlife.	***Impacts:*** No historic or cultural resources would be directly impacted. Potential impacts on culturally important salmon are discussed under Plants and Wildlife.	***Impacts:*** No historic or cultural resources would be directly impacted. Potential impacts on culturally important salmon are discussed under Plants and Wildlife.
	Mitigation: None.	***Mitigation:*** None.	***Mitigation:*** None.	***Mitigation:*** None.
Transportation	***Impacts:*** There would be no transportation impacts under the No Action Alternative.	***Impacts:*** Truck traffic would occur during July to October (65–90 days) with 33 trucks a day, weekdays only. Traffic congestion and safety problems would occur on Deschutes Parkway near the dewatering facility. Slow moving and turning trucks could interfere with normal traffic. These problems would also occur in the rural area near the Chehalis Western Trailhead, particularly along 89th Avenue SE. Thurston County Landfill would not be impacted as heavy truck traffic can be accommodated with existing road design/capacity.	***Impacts:*** Truck traffic impacts would be the same for the Mechanical Dewatering Alternative as for the Gravity Dewatering Alternative.	***Impacts:*** There would be no significant truck traffic impacts with this alternative. Marine barge traffic would be normal for the route between the Port of Olympia and Anderson/Ketron Island.
	Mitigation: None required.	***Mitigation:*** Mitigation at the construction access location on Deschutes Parkway and 89th Avenue SE would involve traffic flaggers and flashing barricades.	***Mitigation:*** Mitigation for this alternative would be the same as for the Gravity Dewatering Alternative.	***Mitigation:*** None required.

2.0 INTRODUCTION

Capitol Lake is a 270-acre freshwater reservoir located in northern Thurston County within the cities of Olympia and Tumwater (**figure 1**). As of 1973, the lake had an average depth of 9 feet. The lake is at the mouth of the Deschutes River and has a drainage area of 185 square miles. The lake was created to serve as a reflecting pool for the Capitol Buildings and was first envisioned by architects Wilder and White in their conceptual design for the Capitol Campus in 1911. Construction of the lake was authorized by the State Legislature in the late 1930s and funding was authorized to build the tide gate and dam along 5th Avenue in 1947. The project was completed in 1951. The benefits of forming the lake included:

- Elimination of tide flats and associated odors
- A Capitol Campus reflecting pool and improved aesthetics
- Public access and recreational uses such as swimming, boating, and fishing
- Improved flood control for the City of Olympia
- New fish rearing facilities in Percival Cove

Since the lake is an extension of the Capitol Campus, it is managed by the Washington State Department of General Administration (DGA). Management activities have historically been coordinated with the Washington State departments of Ecology, Fish and Wildlife[1], Thurston County, and the cities of Olympia and Tumwater.

As early as 1970, DGA recognized that sediment accumulation in the lake was a major problem and would have to be actively managed to maintain the lake's beneficial uses. Walker and Byrne (**1970**) estimated that 739,000 cubic yards of sediment had accumulated in the lake between 1949 and 1970, or the equivalent of 41,000 cubic yards per year. Since the Walker and Byrne report (**1970**), various investigators have estimated the annual sediment load to the lake between 20,000 to 57,000 cubic yards per year (**Entranco 1990a**).

Based on further studies by Washington State University (**Orsborn et al. 1975**), plans were proposed to remove as much as 360,000 cubic yards of sediment from the lake during an initial sediment removal project, and to construct sediment traps in the south and middle basins. This led to development of the Capitol Lake Restoration and Recreation Plan (**CH2M Hill 1977**).

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1 The former departments of Fisheries and Wildlife have been merged together and are now known as the Washington State Department of Fish and Wildlife.

Recent estimates of sediment accumulation, which compared 1983 and 1991 aerial topographic lake bottom surveys (performed when the lake is drained and most of the lake bottom is exposed), indicate a sedimentation rate of approximately 35,000 cubic yards per year. Based on this average annual rate, it is estimated that a total of 1.5 million cubic yards of sediment have been deposited in the lake since its formation in 1951. Deposition has occurred primarily in the south and middle basins, but also in the north basin.

2.1 CAPITOL LAKE AND ITS BENEFICIAL USES

2.1.1 Aesthetic and Recreational Uses

The residents of Olympia, Tumwater, Lacey, and Thurston County, place a high value on the visual and scenic qualities of Capitol Lake and the surrounding area. The lake and shoreline environment is also highly valued for recreation. The lake itself is used for fishing (salmon, trout, and bass), boating, canoeing, and other aquatic recreation. Shoreline parks include Capitol Lake Park, Marathon Park, Capitol Lake Interpretive Center, and Tumwater Historical Park. These parks are all connected by pedestrian trail linkages along the north and western shorelines of the lake. There is also a pedestrian linkage parallel to the Burlington Northern Railroad crossing that separates the north and middle basins. Walking, jogging, bicycling, bird-watching, picnicking, canoeing, fish-watching (salmon runs at the fish ladder), and other recreational activities are enjoyed at these park facilities. Each year, the lake becomes the center attraction of Lake Fair, a community event that features small hydroplane races in the middle basin and attracts more than 75,000 visitors. Other community events occur in the lakeside parks, including Fourth of July celebrations, the Bon Odoni Japanese Cultural Celebration, state employee picnics, and outdoor concerts (**CH2M Hill 1977, Entranco 1990a**).

The lake will also be the central feature of the proposed Heritage Park. This park concept was part of the original (1911) Capitol Campus plan prepared by New York architects Wilder and White. In recent years, the City of Olympia and the DGA have commissioned studies to determine how this original plan could become a reality (**Jones and Jones 1986, The Portico Group 1994**). These recent plans show much of the area between the existing Capitol Campus and the east and north shores of Capitol Lake's north basin as an expansive park environment. This large park development project is expected to be implemented in phases within the next ten years depending on funding by the State Legislature.

2.1.2 Fisheries

The lake provides fish habitat for various life stages of chinook, coho, sockeye, and chum salmon; steelhead; cutthroat and rainbow trout; largemouth bass; and carp. Anadromous fish pass upstream into the lake from Budd Inlet through a fish ladder at the dam, while downstream migrants pass through the tide gates or over the fish ladder. Each year, seven to eight million chinook fry (juveniles less than one year of age) are planted in Capitol Lake in March and April. The fry are fed by the Washington State Department of Fish and

Wildlife (WDFW) from mid-April to late May or early June. Between late May and early June, the fry begin their migration out to Puget Sound. The WDFW and the Olympic Salmon Club also raise 150,000 yearling chinook (juveniles greater than one year old) in net pens in Percival Cove, adjoining Capitol Lake. The lake is thus an important rearing habitat for commercial and Indian salmon fisheries.

Some rainbow trout planted in Black Lake also migrate down Percival Creek and reside in Capitol Lake along with steelhead and other resident fish such as cutthroat trout, largemouth bass, and carp. This abundance of fish also makes Capitol Lake an important sport fishery (**Entranco 1990a**).

2.1.3 Socioeconomic Values

Capitol Lake is the focus of various social and recreational activities that contribute to the local economy. Sport fishing contributes to the economy through the sale of licenses, boats, motors, and other fishing gear. Hatchery, net pen, and feeding operations support commercial, sport, and Native American salmon fishing operations and are a very important source of economic support to both the state and local economy. Jogging trails and parks around the lake also mean that running shoes, clothing, and picnic supplies are needed and supplied by local merchants. Tourists and visitors to the state capitol, along with local residents, participate in the annual Lake Fair. This fair also stimulates the local economy through sales of gas, food, lodging, crafts, souvenirs, etc.

These activities contribute to the sense of community shared by the residents of Olympia and provide the means of rest and relaxation that are important to the health and welfare of the residents of Olympia, Lacey, and Thurston County.

2.1.4 Flood Control

Capitol Lake tidegates provide limited flood control for the City of Olympia. Tidegates prevent high tides from flooding downtown Olympia (from tidal action) and river discharge. Flooding can occur near the northeast shore of Capitol Lake under conditions of high tide and concurrent, high winter Deschutes River discharge. However, Capitol Lake is managed by the DGA to mitigate flood impacts. As needed, the tide gates at the Capitol Lake dam are opened to lower the lake level and provide additional flood storage prior to major rainstorms. The lake is lowered during a low tidal cycle, providing additional flood storage during the period when high tides prevent discharge from the lake. Although flooding can still occur during extremely large flood events, like the 100-year storm, flooding can be reduced or prevented for flows of lower magnitude (**Entranco 1990a**).

2.2 ORIGINAL RESTORATION AND RECREATION PLAN AND ENVIRONMENTAL IMPACT STATEMENT

The Final Environmental Impact Statement (FEIS) for the Capitol Lake Restoration and Recreation Plan was issued by the DGA in May 1977 (**CH2M Hill 1977**). The project at that time included sediment removal from the south and middle basins of the lake and recreational improvements such as those completed at the Capitol Lake Interpretive Center, located at the southwest corner of the middle basin. According to the FEIS (**CH2M Hill 1977**) the project's original purpose was expressed in the following goal statement:

> "The goal of the proposed restoration and recreational development program is to improve the lake's recreational and visual resources, improve its fish production, and preserve its biological and wildlife resources."

The recommended restoration plan included the following elements:

1. Construct two deep (12 feet deep) sediment traps - one in the south (upstream) basin, and one in the middle basin.

2. Remove sediment in the river channels approaching the south basin trap.

3. Construct a training groin in the south basin to divert the river over the south basin trap during high flows.

4. Remove sediment from the mouth of Percival Cove.

5. Remove shallow sediments selectively that have accumulated in the middle basin outside the proposed trap zone.

6. Construct a dike across the southwestern corner of the middle basin for disposal of lake sediments behind the dike at fill number 4 (**figure 4**).

7. Identify two additional in-lake disposal sites (east shore of Percival Cove and east bank of the middle basin near the Power Plant) and one near-lake disposal site (the Percival Cove Gravel Pit).

8. Perform maintenance removal of 50,000 to 60,000 cubic yards of sediment every two years for a period of 20 years.

The improvements originally approved with the FEIS are shown in **figure 4**, and amounted to a cumulative sediment removal of 257,000 cubic yards. It should be noted, however, that the only fill site used was fill site number 4. Fill sites 1, 2, and 3 (**figure 4**) were never used.

The original restoration plan also evaluated 10 upland disposal sites and selected four potential out-of-basin (remote) disposal sites for ultimate disposal of sediments removed during maintenance operations (**figure 5**). These included the East Bay Marina, Martin Way

site, Highway 101 Pit, and the Washington State Department of Natural Resources (DNR) Nursery site. The DGA planned to acquire right-of-way, pipe, and booster pumps to transmit dredge slurry from maintenance hydraulic dredging operations (every two years or as sediment trap accumulation required) to a remote (out-of-basin) disposal site, to be located within two miles of Capitol Lake. Thus the original intent was to permanently fill area number 4 during the initial 1979 dredging operation. This area was not intended to be used as a temporary gravity dewatering and sediment storage area for long-term maintenance dredging operations, as it has since been used.

The original FEIS indicated that the fill area in the southwest corner of the lake was to become a recreation area. However, it was the intent of the DGA to continue to refine and coordinate development of the recreation plan with the cities of Olympia and Tumwater, and the Washington State Department of Ecology (Ecology). To ensure this coordination, Ecology placed a condition of approval on the water quality certification permit for the project that, "Plans and specifications for the design and maintenance of the disposal sites are to be submitted to the Department for review and approval." Thus, the FEIS noted that the design concept for the fill area in the middle basin's southwest corner had not been finalized, and that continued coordination with the cities of Olympia and Tumwater, and Ecology would need to occur.

2.3 SUBSEQUENT REFINEMENT OF THE MIDDLE BASIN DEWATERING SITE AND AGENCY COORDINATION

Detailed design and operational plans for using the fill area in the middle basin's southwest corner were provided in subsequent reports by Richard Carothers Associates (**1981**) and Brown and Caldwell (**1984**). Richard Carothers Associates (**1981**) provided an assessment of the out-of-basin pumping of dredge slurry (the long-term maintenance disposal concept proposed in the FEIS involving purchase of roadway right-of-way and construction of a pipeline), and made it clear that this was not an acceptable alternative for the following reasons:

1. The nearest (least cost) site, the U.S. Highway 101 gravel pit site (identified in the original FEIS), could not be obtained because it had been purchased by private development interests.

2. Using Percival Creek as a conveyance system for dredge slurry return flows from the Highway 101 gravel pit was an environmentally unacceptable solution.

3. The cost of developing the Highway 101 gravel pit site and providing both delivery and return flow pipes to Capitol Lake were estimated at more that $1.3 million in 1981 dollars.

Since it would be even more costly to develop out-of-basin disposal sites which are farther from Capitol Lake, DGA decided not to pursue the long-term maintenance disposal

concept outlined in the FEIS. Instead, DGA and their consultant decided to design the fill area in the middle basin's southwest corner to serve two purposes:

- accommodate temporary settling and dewatering of dredged sediments
- provide recreational uses and public shoreline access to Capitol Lake (**Richard Carothers Associates 1981**)

Portions of the Richard Carothers Associates Report are reproduced in **Appendix A**; this information reflects the design refinement and agency coordination that was originally referenced in the FEIS. The description of the "Development Recommendation" shows that DGA planned to provide a facility that would include two settlement ponds comprising 7.5 acres, and other improvements that would result in 0.5 acre of marsh and 8.7 acres of dry land. The "Development Recommendation" presented in the 1981 report was constructed in 1984. The resulting recreational facilities were subsequently identified as the Capitol Lake Interpretive Center.

2.4 1986 MAINTENANCE SEDIMENT REMOVAL OPERATIONS AND AGENCY COORDINATION

Additional maintenance removal of sediment was conducted in 1986 (**Ebasco 1986**). This work involved removal of approximately 50,000 to 60,000 cubic yards of sediment from the sediment dewatering facility at the Capitol Lake Interpretive Center (**Appendix B**) and refilling this area with 57,000 cubic yards of sediment removed from the middle lake basin trap. This work was authorized after review and approval of the following:

1. A Shoreline Substantial Development Permit reviewed by the City of Olympia, Thurston County, and Ecology, Shorelands Management Section.
2. A SEPA Environmental Checklist and Declaration of Non-Significance for the proposed maintenance dredging operations and "disposal in the preplanned disposal site constructed for that purpose adjacent to the dredging area."
3. A Section 10 and 404 permit from the U.S. Army Corps of Engineers (issued 1977).
4. A Hydraulics Permit from the Washington State Department of Fisheries (now WDFW).
5. Grading and filling permits from Thurston County and the cities of Olympia and Tumwater.

As a condition of approval for the Shoreline Substantial Development Permit, Thurston County and the city of Olympia requested the DGA to continue working to reduce sediment loading to Capitol Lake from the Deschutes River Watershed. In response, DGA directed the completion of the *Erosion/Nonpoint Source Pollution Control Plan for the Deschutes River/Capitol Lake System* (**Entranco 1990**) as an interim control plan prior to

completion of the watershed action plan by Thurston County. The DGA has continued to be involved in sediment load reduction efforts as described in Chapter 4 of this Supplemental EIS (SEIS).

Maintenance sediment removal operations have not occurred since 1979, due to funding and priority constraints. For example, during the 1989 to 1991 biennium, the legislature authorized completion of a wetland development feasibility study (**Entranco 1990**) to determine if it would be possible to interrupt sediment removal from Capitol Lake over a period of time and allow the middle basin to revert to a riverine wetland. Based on the findings of this study, the legislature decided that wetland development, although feasible, would not be in the best interest of the State and authorized additional sediment removal.

Sediment removal to date totals 314,000 cubic yards. This means that a net accumulation of approximately 1.2 million cubic yards of sediment (1.5 million minus 300,000) has been deposited in the lake since 1951, and that each lake basin has become increasingly shallow. This net sediment accumulation represents a reduction in average lake depth of approximately 2.7 feet. Actual sediment accumulation is greatest in the south basin and southern end of the middle basin, and is least in the remainder of the middle basin and north basin. This is because the Deschutes River enters from the south and fills the lake from south to north.

2.5 1992 SCOPING PROCESS

Agency and public scoping meetings were held in May 1992 to discuss the alternatives and environmental issues that would be addressed in this SEIS. No public comment was made. During the agency scoping meeting, the DGA made it clear that their intent was to develop a long-range (ten-year) sediment removal plan that would include removal of sediments throughout the middle basin, with the exception of shoreline buffer zones. Agency comments and subsequent decisions by the DGA are presented below.

2.5.1 South Basin Training Groin

Although an evaluation of alternatives and impacts of the south basin training groin were originally proposed as part of this SEIS and were discussed in the 1992 agency scoping meeting, the DGA and the City of Tumwater subsequently decided to remove the training groin, which had been damaged by flooding, from the south basin and to discontinue sediment removal operations there. This decision was consistent with requests made by the Squaxin Island Tribe during the agency scoping meeting, and consistent with the City of Tumwater policies in the Deschutes Special Area Management Plan (**1994**) to "encourage the natural ecological succession of the south basin of Capitol Lake". The training groin was removed in 1995 and the natural shoreline restored under separate environmental and permit review.

2.5.2 Deschutes Watershed Sediment Loading Reduction

Another issue addressed in the 1992 agency scoping meeting was the need for the DGA to pursue actions that would reduce sediment loading from the Deschutes River watershed. The actions pursued by the DGA are summarized in Chapter 4 of this SEIS.

2.5.3 Dredged Sediment Use

The concept of using dredged sediments to create an island in the middle of the north basin of Capitol Lake, a concept that was presented in the agency scoping meeting, has since been discarded as too expensive and of questionable engineering feasibility. Therefore, this concept is not addressed in this SEIS. The evaluation of three upland disposal sites, as presented in this SEIS is consistent with the plans of the DGA at the time of the 1992 agency scoping meeting.

2.5.4 Gravity Dewatering

During the 1992 scoping meeting, it was indicated that there was a need to evaluate the effects of proposed sediment removal operations in the gravity dewatering area behind the dike. In response, the DGA directed that a wetland delineation be performed to determine the extent of wetlands behind the dike. The results of the delineation by Adolfson Associates, Inc. (**1994**), including associated wetland buffers, are addressed in the Plants and Wildlife section of this SEIS.

In an effort to determine the cost and effectiveness of options to gravity dewatering in the area behind the dike in the middle basin, the DGA also authorized an evaluation of mechanical dewatering (**Entranco 1995**). Based on the results of a pilot dredging/mechanical dewatering operation conducted February 27 and 28, 1995, the DGA concluded that mechanical dewatering was feasible, but that it likely would cost significantly more than other dewatering/disposal options. Even though this method of dewatering is more costly than gravity dewatering, it is included in this SEIS as a reasonable alternative.

2.5.5 Sediment Removal Operations

There were some agency representatives in the May 1992 scoping meeting who thought it might be advisable to consider the removal of larger amounts of sediment (quantities not specified) during each sediment removal operation so that the effects of each sediment removal operation would be spread out over longer intervals. While this was considered, it was determined not to be feasible for the gravity dewatering alternative (see Chapter 3) due to capacity constraints of the dewatering area. Removing greater amounts of material may be feasible with the Mechanical Dewatering and Marine Disposal alternatives, but would be dependent upon capacity of dredging and disposal equipment, timing (December 1 to March 1), permits, and funding authorization by state legislators. Legislators have the

authority to fund more sediment removal during each cycle, assuming that appropriate mitigation is provided.

2.5.6 Sediment Characterization Studies

Sediment characterization studies, requested by the Thurston County Public Health and Social Services Department, were completed in 1994 and are summarized in the Earth section of this SEIS. These initial sediment characterization studies were aimed at evaluating the feasibility of upland disposal of Capitol Lake sediments and did not include the extensive list of chemical parameters required for marine disposal (see below). Results of the initial sediment testing did show that there would be no concern regarding surface or groundwater contamination with upland disposal.

2.5.7 Marine Disposal

Marine disposal was not considered at the 1992 agency scoping meeting, but has since been added as another disposal alternative in this SEIS. The marine disposal alternative described in detail in Chapter 3. As a part of this alternative, it was necessary to conduct additional sediment characterization studies under the Puget Sound Dredged Disposal Analysis process. Additional sediment samples were collected the week of September 18, 1995 and were sent to a laboratory for analysis. The results of testing are described in the Earth section of Chapter 5 and **Appendix I**.

2.6 DECEMBER 1995 AGENCY SCOPING MEETING

A public Draft SEIS was issued October 10, 1995, and agency and public comment meetings were held on October 25, 1995. Several important issues were raised by local and state agencies and the public with both oral and written comments. The comments indicated a desire to reduce the scope of maintenance dredging and to initiate a separate planning process that would involve multiple agencies and provide a public forum for defining optimal lake management. In view of these comments, a new agency scoping meeting was held on December 19, 1995, in which a revised dredging scope was presented. Major changes included limiting the extent of dredging to sectors 1 and 2, instead of 1-10, and limiting dredging to a maximum of twice in five years rather than once every two years. A detailed description of scope changes is provided in Chapters 1 and 3.

3.0 PROPOSED NEW FIVE-YEAR SEDIMENT REMOVAL PLAN

A new five-year sediment removal plan is proposed on an interim basis to maintain Capitol Lake and associated beneficial uses. It is understood that the need for long-term maintenance dredging will be addressed during the development of the Capitol Lake Management Plan (CLMP) as described in Chapter 1.

Sediment removal operations would cover two areas in the middle basin of Capitol Lake (sediment removal sectors 1 and 2, **figure 2**). A hydraulic dredge would be used as the preferred method of sediment removal as recommended in the 1977 Final Environmental Impact Statement (FEIS) (**CH2M Hill 1977**). Depth of sediment removal would be 5 to 6 feet for sector 1, and 2 to 3 feet for sector 2 so that post-dredging water depths would be approximately 12 feet in sector 1 and would range from 3 to 8 feet in sector 2.

This new plan would involve sediment removal of 60,000 to 70,000 cubic yards during one, and possibly two, dredging cycles over the next five years. The first dredging cycle would occur between December 1, 1996 and March 1, 1997. The second dredge cycle would be performed at the time that 75 percent of the middle basin trap is filled with sediment. This would be determined by periodic field surveys. A typical section of the existing lake bottom and proposed depth of dredging is shown in **figure 3**.

A shoreline buffer zone (100 to 300 feet wide) would be retained to avoid impacts to juvenile chinook salmon rearing habitat and shoreline aquatic plant beds (**figure 2**). This buffer zone may also be used to enhance shoreline emergent wetlands (mitigation) in the event that the Gravity Dewatering Alternative is selected (see Chapter 5 under Plants and Wildlife for related discussion).

A small amount of dredging is also recommended periodically, just south of the Interstate 5 (I-5) freeway bridge on the western shore, to maintain access to the lake's only boat launch. The river has formed a small sand bar that could limit boat access to the main river channel and the remainder of the lake unless it is removed. This access would also be needed to launch the hydraulic dredge into the lake.

No sediment removal operations would be performed elsewhere in the south basin. This is because the south basin sediment trap became non-functional over time due to the pattern of sediment deposition following its construction. Also, sediment removal operations can be performed in a more cost-effective manner in the middle basin, without disturbing fish and wildlife habitat in the south basin. Elimination of dredging operations in the south basin is also consistent with the *Deschutes River Special Area Management Plan* (**City of Tumwater 1994**), which encourages "the natural ecological succession of the south basin of Capitol Lake".

Alternative methods of sediment dewatering considered in this SEIS are:

- gravity settling in the original sediment dewatering basin at the Capitol Lake Interpretive Center in the middle basin's southwest corner
- mechanical dewatering using a combination of screens and centrifuges

Upland disposal options for the dewatered sediment include hauling by truck to upland disposal sites at the Thurston County Landfill and the Chehalis Western Trailhead site (**figure 1**).

Another disposal option evaluated in this SEIS is piping the dredge slurry to a barge mooring site at the Port of Olympia, and subsequently transporting and discharging it to a deep, open-water, marine disposal site in the vicinity of Anderson and Ketron Islands in the Puget Sound (**figure 1**).

Although not specifically evaluated in this SEIS, it is also the intent of the Washington State Department of General Administration (DGA) to consider "beneficial uses" of Capitol Lake sediments at upland disposal sites other than those described in this SEIS. Such uses may involve using clean Capitol Lake sediments to cap contaminated sediments at freshwater or marine sites within reasonable proximity to Capitol Lake (the Cascade McFarland Pole site at the Port of Olympia is one possible site). Capitol Lake sediments may also be used as topsoil for park lands, and/or to assist in the reclamation of abandoned or active gravel pit sites. Such uses would be pursued subject to separate environmental and permit review, and if economically viable.

3.1 NO ACTION ALTERNATIVE

Under the No Action Alternative there would be no sediment removal, allowing the entire lake (south, middle and north basins) to fill with sediment and become a freshwater marsh and river channel. The following information about the No Action Alternative has been reproduced from the original Draft EIS (**CH2M Hill 1976**):

> "With alternative C [the No Action Alternative], no effort would be made to remove accumulations of sediment in Capitol Lake. The positive impacts of this plan include:
>
> - Saving fuel from discontinuing drag boat races and reducing boat noise.
> - No immediate disruption of the lake's environment.
> - No cost to the taxpayer for dredging, although maintenance expenses for the lake related to weed control and similar problems would probably continue.
> - Eventual creation of marsh habitat for wildlife."
>
> "The major negative impacts of no action are covered in the Capitol Lakes Coordinating Committee's report, 'Saving a Beautiful Lake':

- The upper basin [south basin - south of I-5] will become more completely filled with sediment, debris, and brush, and cease to function as a sediment trap for the rest of Capitol Lake.
- The sediment load, which would have been dropped in the upper basin, will accumulate in the middle basin, and more sediment will be transported into the lower basin as the middle basin fills.
- As all parts of the lake become shallower, weed and algae growth will increase.
- The rate of degradation of Capitol Lake will be accelerated due to the fact that an average annual inflow of sediment will decrease the remaining volume in the lake by a larger and larger percentage each year.
- The salmon rearing program would be curtailed.
- Boating and lake fishing opportunities will be lost.
- Without the sediment removal and maintenance system in the upper basin, Deschutes Way Park's [Marathon Park] attractiveness and usefulness as a freshwater access site and water-oriented recreational resource will be greatly diminished.
- Eventually the lake will, for all practical purposes, completely fill with sediment. The present situation in the upper basin will be repeated in the middle and lower [north] basins, gradually building up land areas and vegetation. The entire lake will be filled, leaving the Deschutes River to wind its course through the basins in much the same manner as before the dam was constructed.
- Failure to provide state funds for reclaiming the lake could adversely affect any applications directed to the Interagency Committee for Outdoor Recreation.
- Burlington Northern has indicated that without a reclamation program for the lake, it would be difficult to justify an investment of several million dollars for lake shore development.[1] "

The No Action Alternative was not selected as the preferred alternative in 1977, because the DGA considered Capitol Lake to be a resource of state and local value, which supported beneficial uses that could not be replaced or replicated elsewhere in the community.

3.2 GRAVITY DEWATERING ALTERNATIVE

Under this alternative, lake sediments would be excavated using an 8- to 10-inch hydraulic dredge (**figure 6**) with a production capacity of approximately 1,000 to 1,500 gallons per

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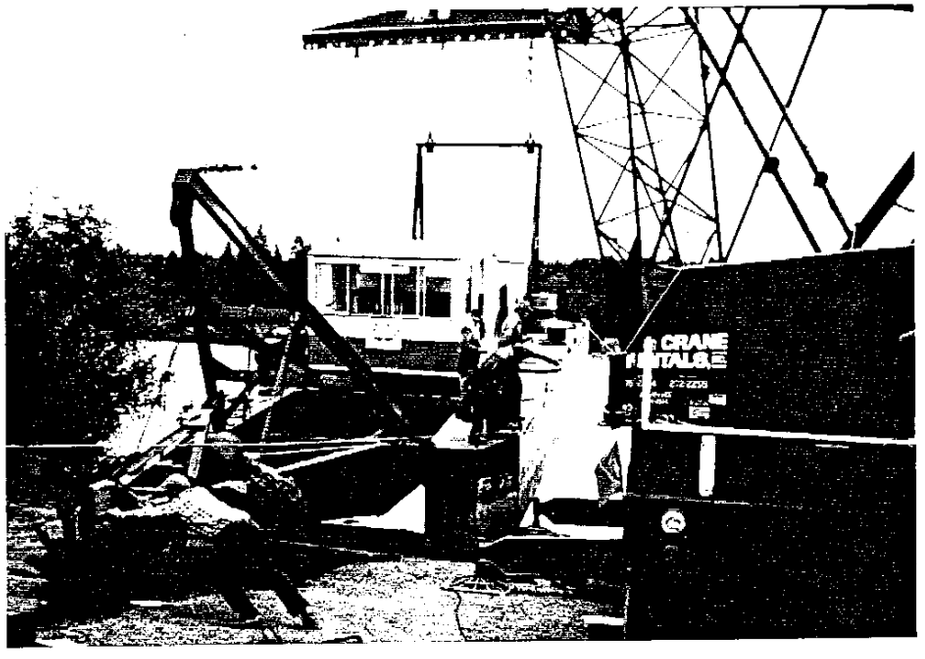
1 Burlington Northern's project manager, in a letter to the Capitol Lake Executive Committee dated 16 October 1974 stated: "Reclamation of the lake and providing public amenities will generate interest for private development because of the visual quality and the appeal of park-like atmosphere...Capitol Lake and its preservation is one of the keys to Olympia's future."

Figure 6
Hydraulic Dredge



minute. The sediment-water slurry produced by the hydraulic dredge would be conveyed from the two sediment removal sectors (1 and 2) by a floating pipe to the dewatering area.

Lake sediments from sectors 1 and 2 would be dewatered by gravity settling in the original facility constructed for this purpose near the Capitol Lake Interpretive Center, behind the dike in the middle basin's southwest corner (**figure 2**). Existing sediments, located in the dewatering construction area (**figure 2**), would be excavated sometime between July and the end of November. The excavated area would then be refilled with sediment taken from the lake during the following dredging period—December 1, 1996 to March 1, 1997.

The sediment-water slurry would be discharged first within the dewatering construction zone (**figure 2**) for primary settling. Then it would flow over the existing weir where nontoxic flocculents (**Appendix J**) would be added to aid subsequent settling of suspended solids in the wetland/pond to the north. Treated water would then re-enter Capitol Lake at the return flow discharge pipe.

Limited hand clearing of vegetation would occur in the channel between the footbridge and the wetland to the north. This would improve hydraulic capacity and would affect an area approximately 20 feet wide and 50 feet long.

This gravity dewatering scenario would be consistent with the original design and function of the Capitol Lake Interpretive Center (**Richard Carothers Associates 1981**), and has also been recognized for continued operation in recent correspondence from the U.S. Army Corps of Engineers (**Appendix C**).

Under this alternative, a land survey of the temporary sediment stockpile/dewatering site would be required after each excavation and filling operation as a basis for measuring the quantity of sediment removed from the lake.

All excavated sediments would be transported by truck to one or two optional upland disposal sites: the Thurston County Landfill (**figure 7**) and the Chehalis Western Trailhead (**figure 8**). Each optional upland disposal site is described below.

The preliminary cost estimate range for the Gravity Dewatering Alternative is $2.4 to $2.9 million during the five-year period ($17 to $21 per cubic yard—see **table 1**). This is a preliminary planning level cost estimate, which assumes two dredging cycles, intended only for comparison of alternatives.

3.2.1 Thurston County Landfill Site

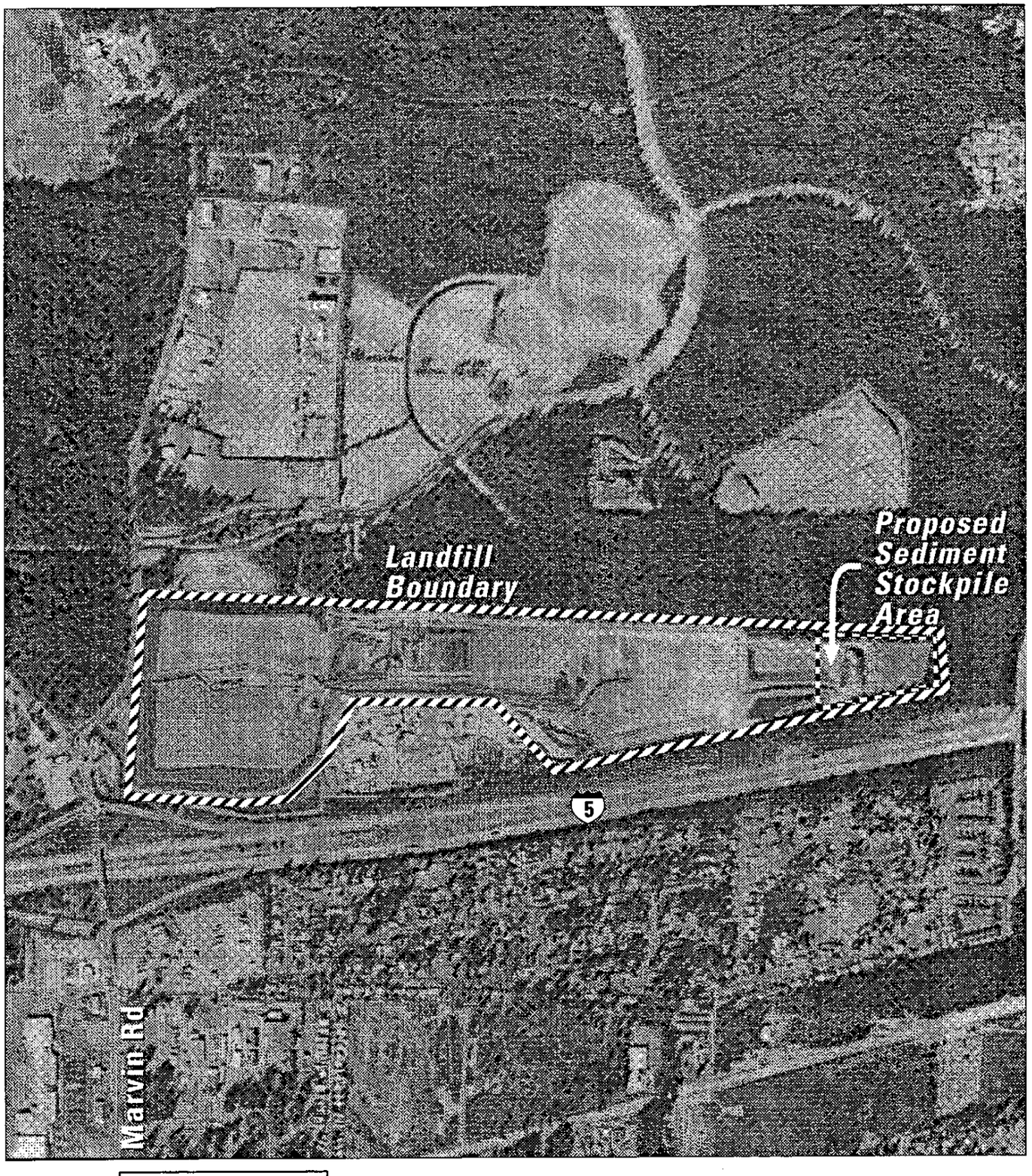
The Thurston County Landfill is approximately nine miles from Capitol Lake (**figures 1 and 7**). Thurston County is anticipating a need of approximately 50,000 to 100,000 cubic yards of relatively finely-graded material, over the next six to 10 years. This material would be used as a liner to prevent landfill leachate from reaching the groundwater system. There is sufficient space available at the eastern end of the landfill (approximately 6.4 acres) to temporarily stockpile Capitol Lake sediment to a depth of about six feet. Therefore, this site has sufficient capacity to stockpile about 60,000 cubic yards, if the sediment is found suitable for liner material. To meet Washington State Department of Ecology (Ecology) and County criteria for use as a liner material, the sediment must be relatively dry (25 percent moisture) and have a low water permeability (1×10^{-5} cm/sec).

Further material testing would be required before the County would make a final decision on using Capitol Lake sediments for this purpose. Therefore, the use of the landfill for a upland disposal site is contingent upon material conformance and County approval.

3.2.2 Chehalis Western Trailhead Site

The southern trailhead of the Chehalis Western Trail is approximately eight miles southeast of Capitol Lake (**figures 1 and 8**). The entire trailhead site covers 20 acres and is mostly forested except for the 5-acre abandoned gravel pit in the northeast corner of the site (**Thurston County Parks and Recreation Department 1994**). The gravel pit has sufficient capacity to stockpile approximately 120,000 cubic yards of sediment.

A draft report for the Chehalis Western Trail indicates that a possible use of the gravel pit is for a BMX track (**Thurston County Parks and Recreation Department 1994**). However, if the pit is to be filled with Capitol Lake sediments, some other use would have to be considered—a possibility would be playfields for soccer or other outdoor field sports. At this time, the Thurston County Department of Parks and Recreation is uncertain about when the trailhead would be constructed and how much sediment they may be interested in receiving at the site. Therefore, use of the site would be contingent upon further discussion and approval by the Thurston County Department of Parks and Recreation.



Legend

- Landfill boundary
- Proposed sediment stockpile area

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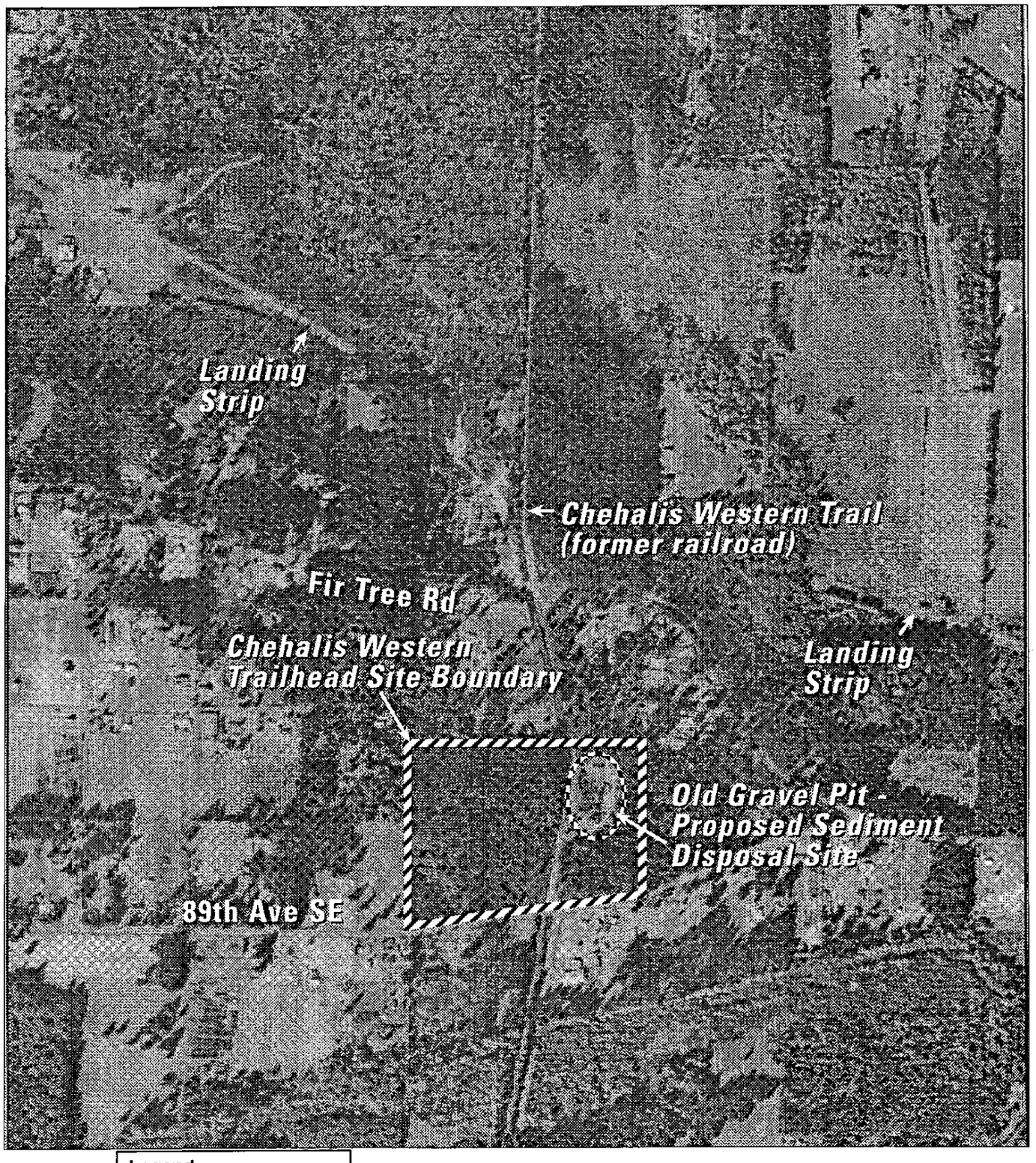
Figure 7
Thurston County Landfill Site



Legend

- Chehalis Western Trailhead boundary
- Proposed sediment disposal area

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Capitol Lake SEIS

Figure 8
Chehalis Western Trailhead Site

3.3 MECHANICAL DEWATERING ALTERNATIVE

Under this alternative lake sediments would be excavated using a hydraulic dredge, but sediments would be dewatered using a system of mechanical screens and large centrifuges (**figures 9 through 12**). The screens would separate sands from silts and clays prior to routing the sediment-water slurry into the centrifuges where the silts and clays would be dewatered. This sorting may offer some advantages over the gravity settling method, because sand materials could be taken to local sand and gravel companies and sold to offset some of the sediment removal cost. It might also make it easier to obtain the fine grained silt and clay materials needed to meet the low permeability criteria for the Thurston County Landfill.

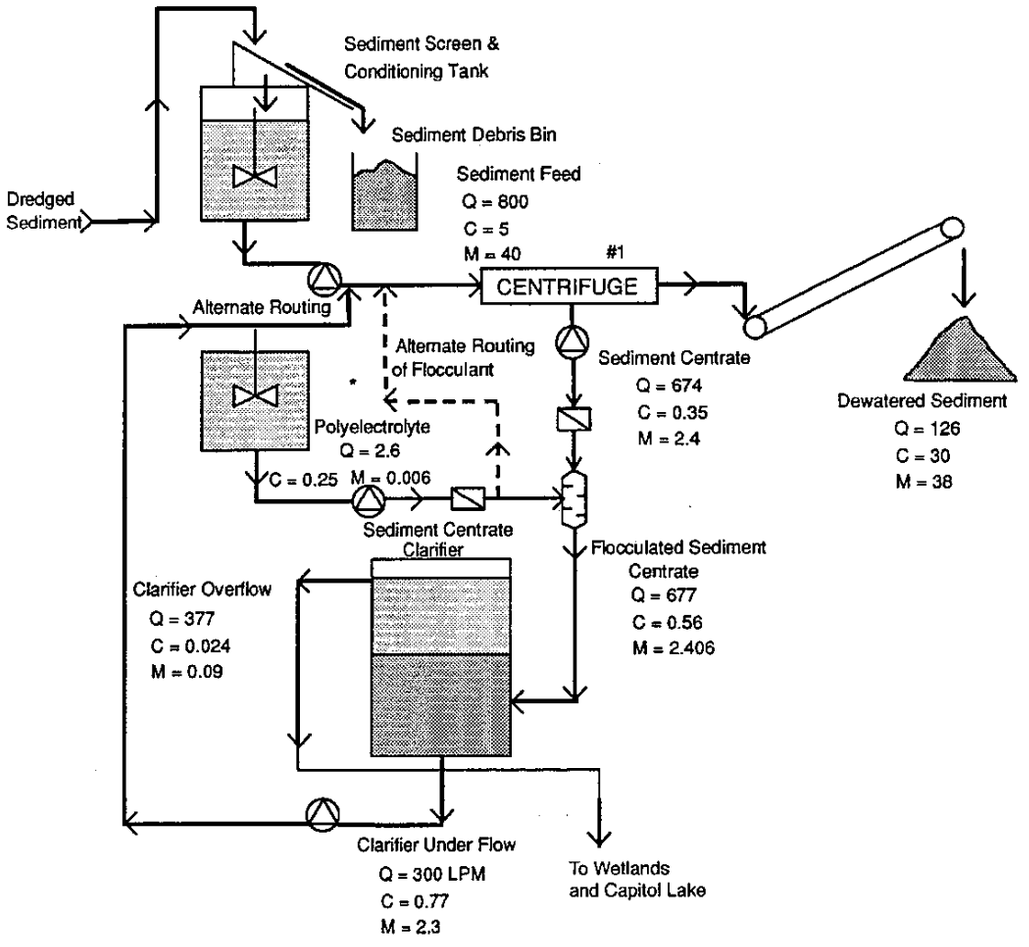
Based on analyses of 16 surface sediment cores taken from Capitol Lake's middle basin (**CH2M Hill 1977**), four had 0–10 percent sand, six had 10–20 percent sand, two had 20–30 percent sand, one had 30–40 percent sand, two had 70–80 percent sand, and one had 80–90 percent sand. Average sand content of the 16 samples was 26 percent. These limited data suggest that up to 18,200 cubic yards of sand could be recovered using mechanical dewatering. If sorted and sold to sand and gravel companies, the sand would have to be sold on the condition that it would not be placed in conditions conducive to germinating purple loosestrife seeds (that is, non-wetland sites). The purple loosestrife management measures described in **Appendix D** also would have to be followed.

Dewatered silty/clay sediments would be 60–70 percent solids and could be loaded by conveyor belt directly into trucks, and transported to one or both of the upland disposal sites as described in Section 3.2, Gravity Dewatering Alternative.

One of the main differences between this alternative and the Gravity Dewatering Alternative, is that the Mechanical Dewatering Alternative would require no excavation of wetlands behind the dike in the vicinity of the Capitol Lake Interpretive Center. This is because mechanical dewatering equipment requires a very small space for set up and operation (approximately one acre) and could be performed in the existing upland area behind the dike. Another difference is that there would be no lakeside purple loosestrife management requirements, because sediment would be loaded directly to trucks. Therefore, any purple loosestrife seeds contained in the sediment would not have an opportunity to germinate until they reached the upland disposal site. Another difference is that land survey would not be needed to measure production rate, but a portable truck scale would be set up on the site and trucks would be measured to determine the tonnage of sediment removed. Truck weights would be adjusted as needed based on measurements of percent solids in the dewatered sediment, based on an average of eight sediment samples collected per day.

Return flows from the gravity dewatering operation would be routed through the wetlands behind the dike in the middle basin's southwest corner. The potential impacts of fluctuating water levels and short-term sedimentation on these wetlands is addressed in Chapter 5.

With respect to upland disposal, this alternative would be similar to the Gravity Dewatering Alternative.



* Polyelectrolyte dosage = 0 - 10 ppm
Q = Flow (liters per minute)
C = Consistency (% Total Solids) (w/w)
M = Mass (k/min)

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Figure 9
Schematic Diagram of Mechanical Dewatering Process

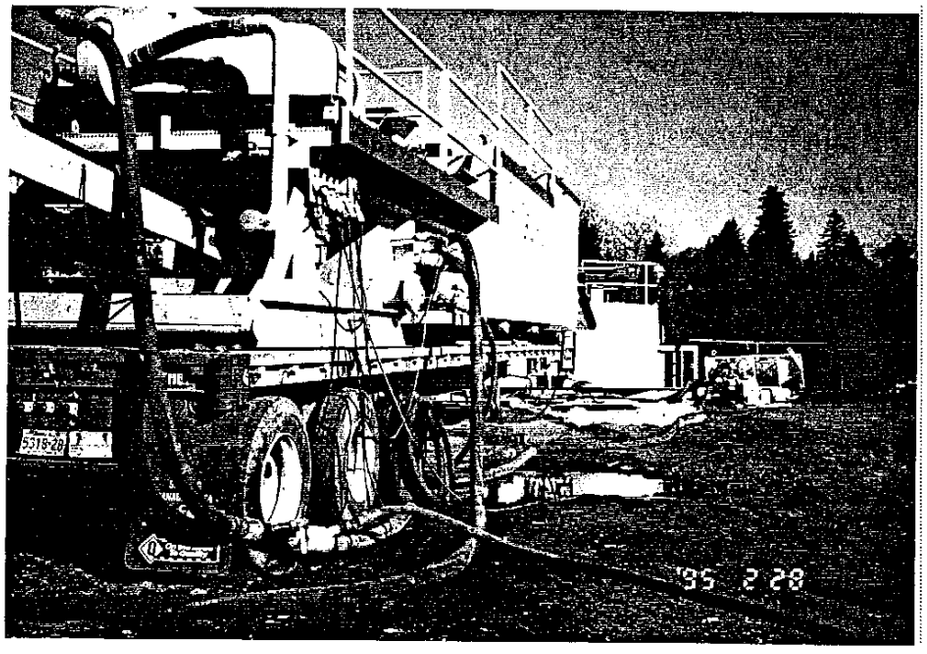


Figure 10
Centrifuge and Associated Equipment

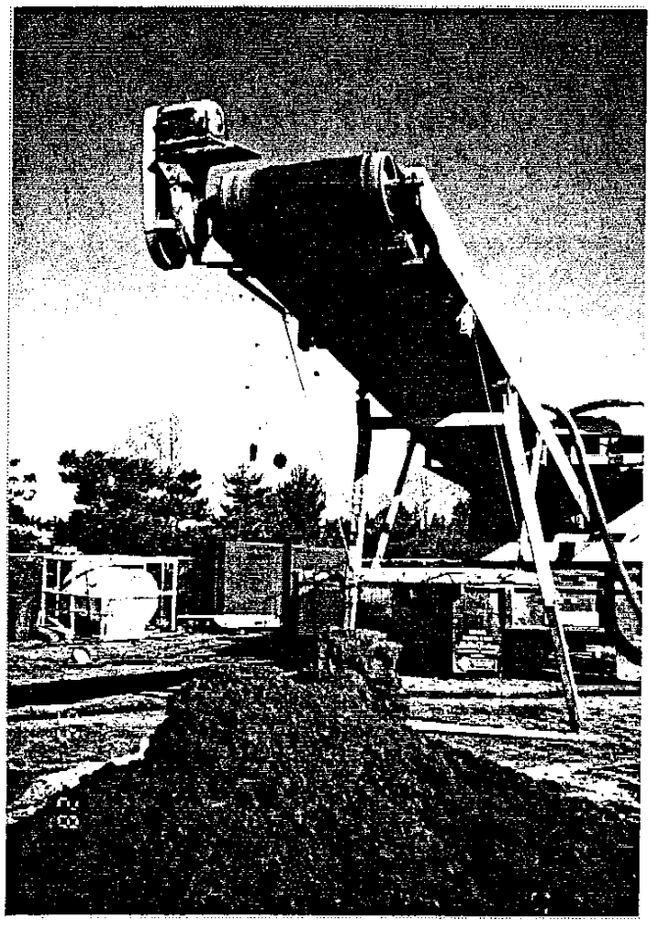


Figure 11
Conveyor and Sediment Storage

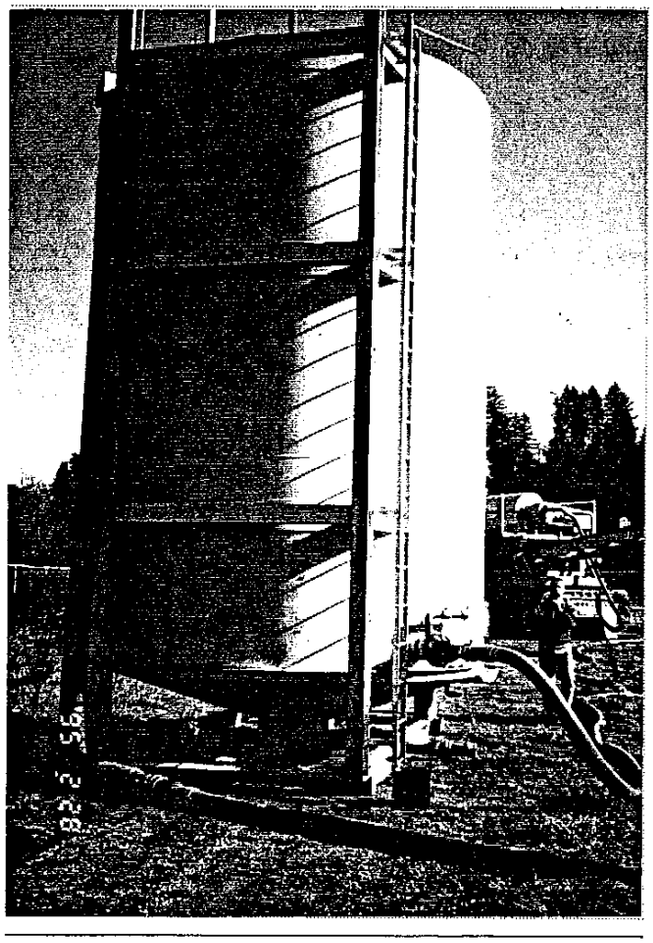


Figure 12
Clarifier Tank

The preliminary cost estimate range for the Mechanical Dewatering Alternative is $3.2 to $3.8 million for the five-year planning period ($23 to $27 per cubic yard). This is a preliminary planning level cost estimate, which assumes two dredging cycles, intended only for comparison of alternatives.

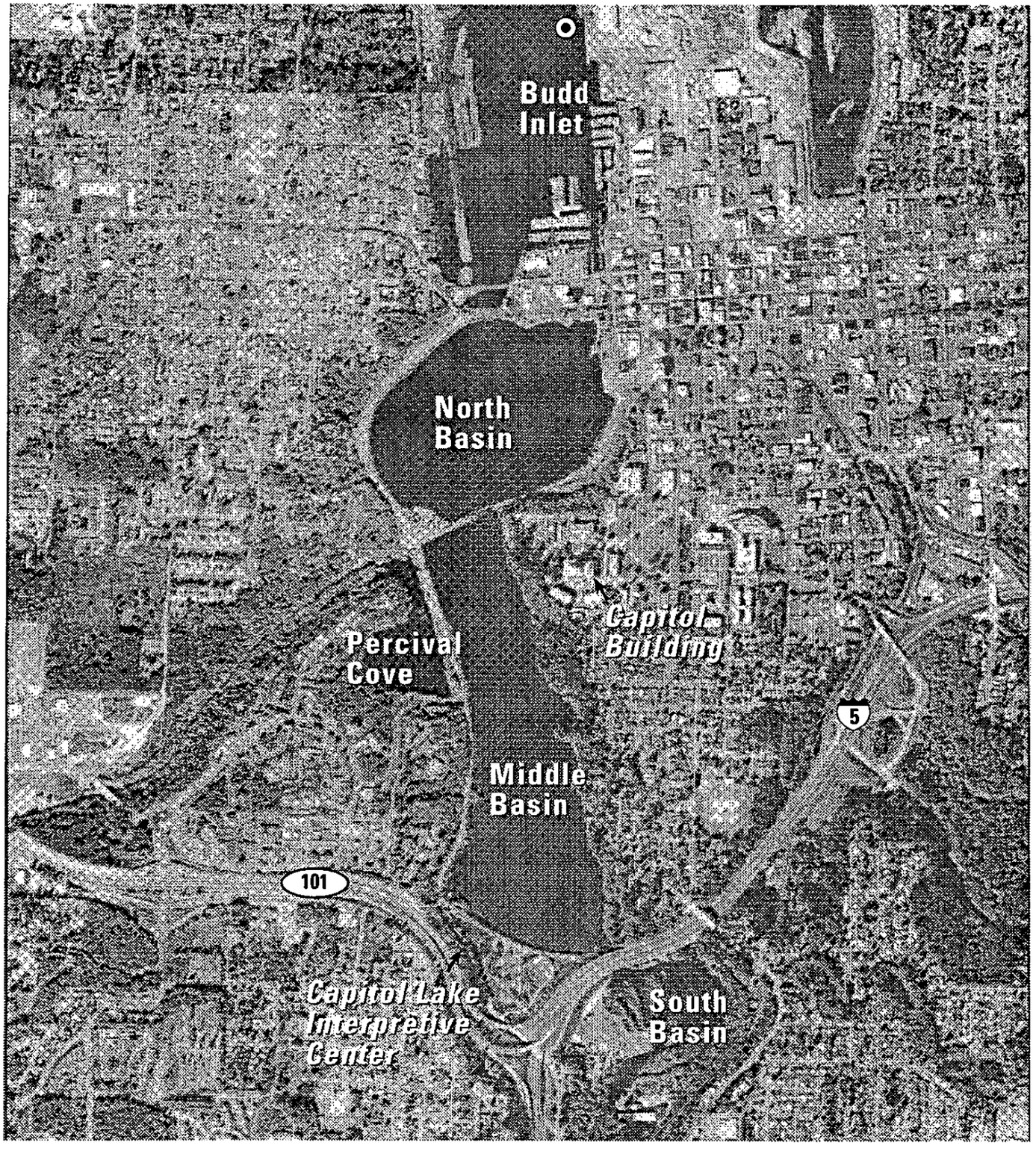
3.4 MARINE DISPOSAL ALTERNATIVE

Under this alternative, lake sediments would be excavated using a hydraulic dredge. The sediment-water slurry from the dredge would be piped north across the surface of Capitol Lake and then along the bottom of Budd Inlet to a marine barge mooring site at the Port of Olympia (**figure 13**). The sediment-water slurry would be discharged directly to a barge (4,000 cubic yard capacity) and transported (two barges per day) to an approved deep, open-water, marine disposal site located between Anderson and Ketron Islands in Puget Sound (**figures 1 and 14**). This site has an existing total capacity of 750,000 cubic yards. Distinct advantages of the Marine Disposal Alternative are that:

- it would not require purple loosestrife control
- it would not impact existing wetland habitat areas behind the dike in Capitol Lake's middle basin
- it would not have return flow water quality impacts in Capitol Lake, since the entire dredge slurry (water and sediments) would be pumped to the transport barge and disposed of at the Anderson/Ketron Island disposal site
- there would be no truck traffic or truck noise impacts

The Marine Disposal Alternative is the least costly approach. Estimated construction costs, would be $ 1.4 to 1.7 million for the five-year planning period, or approximately $10 to $12 per cubic yard. This is a preliminary planning level cost estimate, which assumes two dredging cycles, intended only for comparison of alternatives.

Before sediments can be disposed at the Anderson/Ketron Island site, sediment testing must be performed and approved by Ecology, Department of Natural Resources (DNR), EPA, and U.S. Army Corps of Engineers under PSDDA program guidelines. The PSDDA sediment sampling was conducted on September 20, 1995, and sediment samples were delivered to a certified laboratory for testing. Test results are presented in the Earth section of Chapter 5 and **Appendix I**.



Legend

Optional marine barge mooring sites

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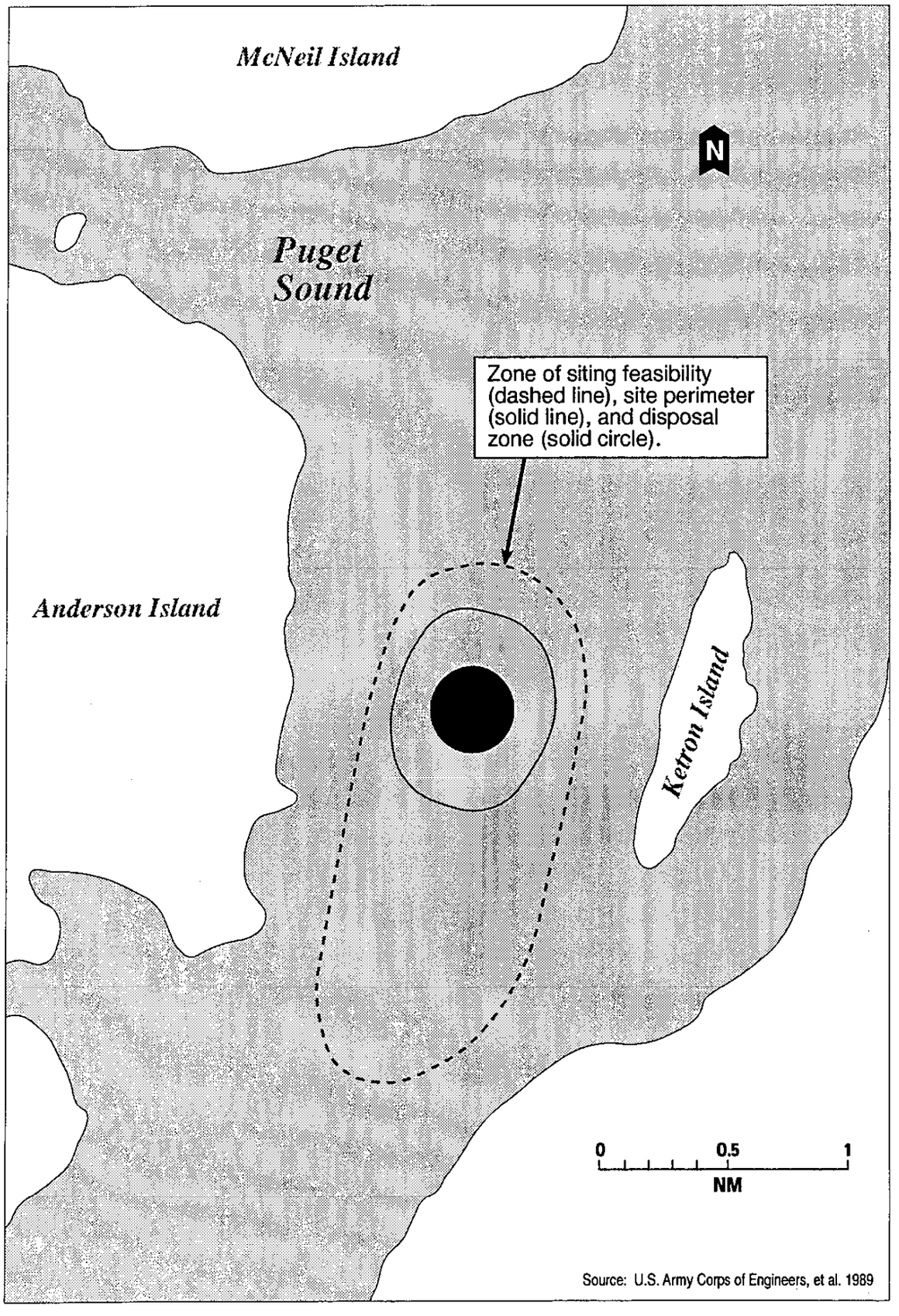
Figure 13
Marine Barge Mooring Site



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Capitol Lake SEIS

Figure 14
Anderson/Ketron Island Site

3.5 OTHER ALTERNATIVES CONSIDERED

3.5.1 Alternatives from the Original EIS Not Reconsidered

The following alternatives were considered in the original EIS, but were not reconsidered in this SEIS:

- ***Alternative A.*** Alternative A in the Draft EIS (**CH2M Hill 1976b**) involved the same dredging as the original recommended alternative illustrated in **figure 5** in the middle basin and Percival Cove, but proposed extensive dredging in the south basin, including removal of existing forested wetland islands. Under this alternative, the 1949 bottom contours would have been re-established in the south basin. This alternative was rejected due to the degree of adverse impact to wetlands and fish and wildlife habitat in the south basin.

- ***Alternative B.*** Alternative B in the Draft EIS (**CH2M Hill 1976b**) involved the excavation of a larger sediment trap in the middle basin, and avoided dredging altogether in the south basin. This alternative is similar to the Gravity Dewatering and Mechanical Dewatering alternatives as presented in this SEIS, with respect to the elimination of dredging in the south basin. However, this alternative did not include dredging throughout the middle basin as is presently desired.

- ***Removal of the Fifth Avenue Dam Gate.*** Removal of the Fifth Avenue Dam Gate would have allowed the Capitol Lake area to return to a tidal estuary. This was an additional alternative evaluated in the FEIS (**CH2M Hill 1977**). The following positive and negative aspects of this alternative were presented in the FEIS:

  Positive: "(1) Elimination of the need for a dredging program with attendant costs; (2) Elimination of other costs and problems, such as aquatic weed growth related to the maintenance of an artificial freshwater system; (3) Elimination of energy needed for the dredging and pumping equipment; (4) Elimination of the possibility of a diesel oil spill during dredging operations; (5) Avoidance of engine emissions and noise associated with the dredging and pumping equipment; (6) Potential revitalization of shellfish culture in estuary waters."

  Negative: "(1) An aesthetically less desirable setting for the Capitol Campus; (2) Loss of recreational opportunities associated with a freshwater environment; (3) Loss or substantial reduction in the artificial salmon-rearing program in Percival Cove and the lake; (4) Shifting of the sedimentation problem to the Port of Olympia."

  To the above list of negatives, the authors of the SEIS would add, (5) reduction in property values of residential and commercial view properties surrounding Capitol Lake, (6) loss of Lake Fair and its associated community benefits, and (7) serious impact on proposed Heritage Park with the loss of the lake as a central feature of the park.

  The DGA considers the negative impacts to greatly out-weigh the positive impacts of this alternative.

3.5.2 The Wetland Feasibility Analysis

3.5.2.1 River Delta Freshwater Wetlands

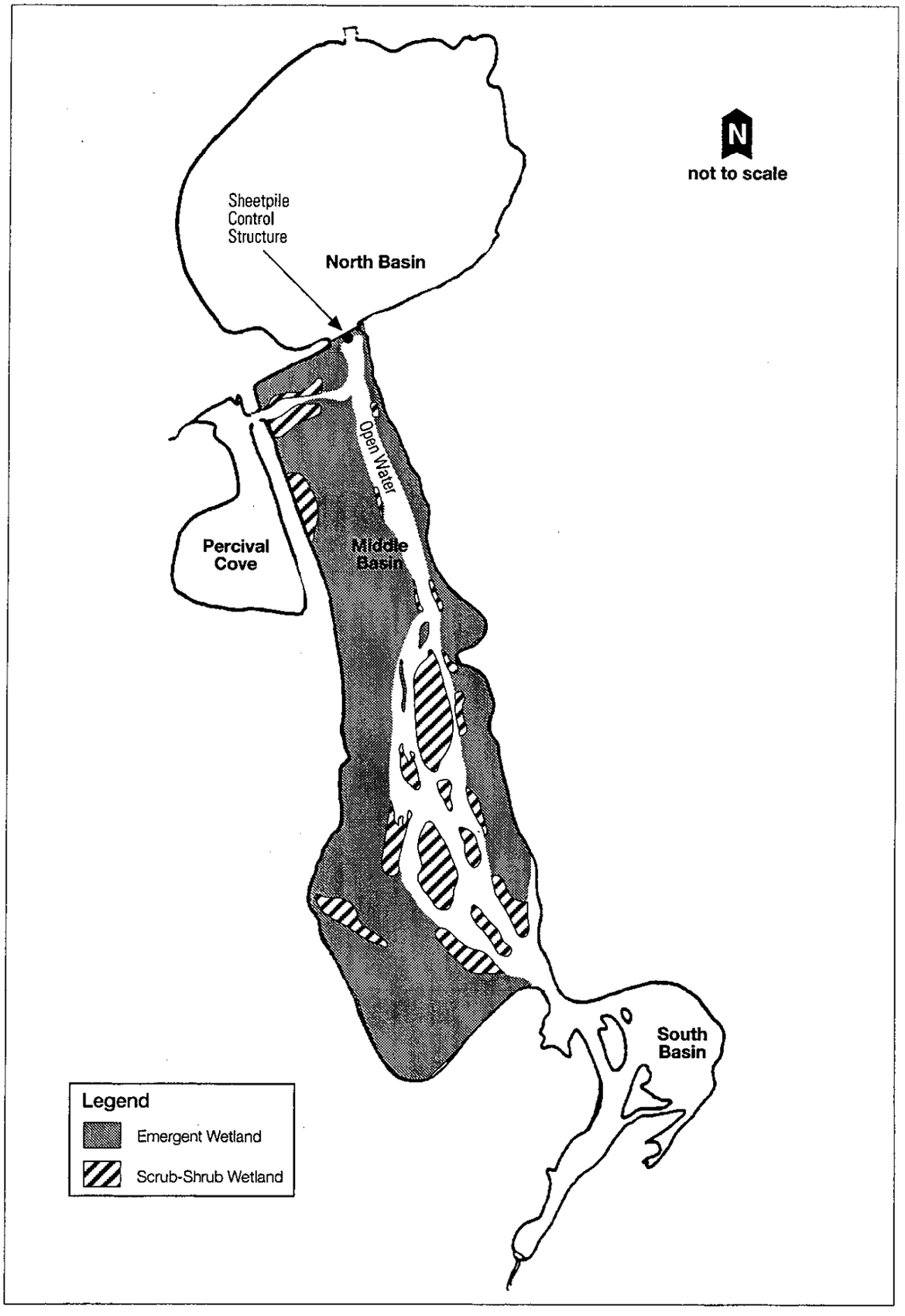
In 1989 the Washington State Legislature directed DGA to conduct a Wetland Development Feasibility Study. The study was performed under the hypothesis that the middle basin could be allowed to fill and become a wetland, and that the wetland would produce significant water quality benefits for the remaining north basin, which would be preserved as an open-water environment and continue to serve as a reflecting pool for the Capitol Buildings (**Entranco 1990a**). Under this concept, the north basin would also provide an open-water environment for fishing, boating, and other recreational activities. It also would preserve the freshwater habitat needed for the salmon rearing program.

A plan view of this "River Delta Freshwater Wetland" is shown in **figure 15**. It shows the combination of emergent and scrub-shrub wetland that would develop eventually in the middle basin. Under this concept, it was estimated that the time to fill the middle basin would be 30 to 85 years. During much of this filling period, maintenance sediment removal operations could be suspended, thus eliminating, for a time, the cost of sediment removal. Ultimately, sediment removal operations would have to be resumed to prevent infilling of the north basin.

Advantages of this concept would include the following:

- Sediment removal in the middle basin would not be performed, saving the State an estimated $20 million over 60 years.[2]
- Wetland habitat would be increased for waterfowl, shorebirds, mammals, and other wildlife.
- There would be potential for enhanced wetland trails, observation platforms, and educational displays.
- There would be opportunity to plant and cultivate wetland plants suitable for traditional Native American cultural uses.

2 Note: $20 million was the estimate given in the 1990 report. The cost would be $21 to $57 million based on cost per yard for the various alternatives considered in this SEIS (see **table 1**).



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Capitol Lake SEIS

Figure 15
River Delta Freshwater Wetland

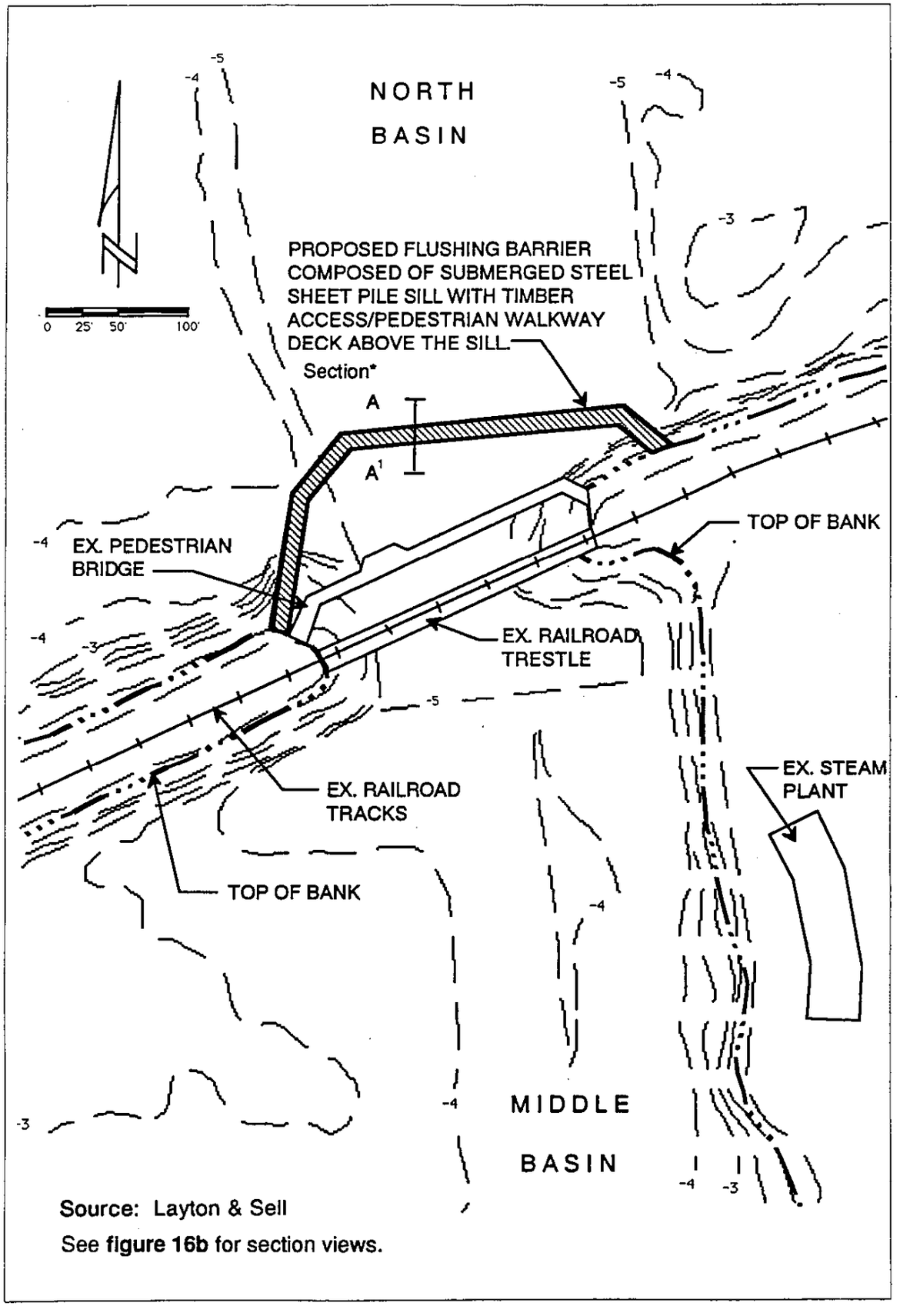
A disadvantage of this concept was that a saltwater control weir would be required in the vicinity of the railroad trestle separating the north and middle basins (**figures 16a and 16b**). This would be required to preserve freshwater wetlands in the middle basin during drawdown of the north basin. During the past 15 to 20 years, the entire lake has been drawn down annually (emptied - by opening the tide gates) to (1) control freshwater algae blooms and aquatic plant growth (as recommended by **Orsborn et al. 1975**), (2) facilitate the movement of juvenile fish from Capitol Lake to Budd Inlet, and (3) facilitate lake maintenance activities. Following drawdown, the lake is initially refilled with saltwater from Budd Inlet. The saltwater kills most of the freshwater plants and algae, thus preventing them from becoming an aesthetic and recreational nuisance. Therefore, the saltwater control weir would be needed to prevent saltwater from killing freshwater wetland plants in the middle basin if saltwater flushing is continued.

In addition, a dike would be required along the entire eastern shoreline of the north basin to mitigate more frequent and limited additional (0.8 feet) flooding impacts that would otherwise occur in downtown Olympia with the loss of flood storage in the middle basin. In conjunction with diking, pump stations would have to be constructed to pump stormwater over or through the dike during storm events. Additional diking might also be required along Tumwater Historical Park to prevent flooding there. Estimated cost of the saltwater flushing barrier was given as $1.4 million in 1990 (**Entranco 1990a**). Diking and stormwater pump station construction likely would be a multimillion dollar effort, however, no construction cost estimates have been made.

Another potential disadvantage of the wetland development concept was that backwater wetland areas would likely have poor circulation, poor water quality (high temperatures and low dissolved oxygen), and could result in loss of fish because they may be cut off from the main river channel as lake levels fluctuate.

The Wetland Development Feasibility Study ultimately concluded that it was feasible to defer dredging to allow lake filling and wetland formation, but that there would be no significant water quality treatment benefits associated with the wetland, and that major mitigation efforts would be required to prevent additional flood impacts to Olympia and retain freshwater wetlands in the middle basin. Water quality benefits would not be significant because (1) the incoming concentration of nutrients is already low, (2) the number of acres of wetlands would be too small to provide adequate treatment time for the large flow coming down the Deschutes River, even during the lower flow summer months.

Following completion of the *Capitol Lake Wetland Development Feasibility Study* (**Entranco 1990a**), the State Legislature made a decision to continue maintenance sediment removal in Capitol Lake. This decision was based on the need to maintain existing beneficial uses of the lake as described above. Their decision was also influenced by a petition filed by local residents who have lake views and who were strongly opposed to allowing the middle basin to fill and become a wetland.



Source: Layton & Sell

See **figure 16b** for section views.

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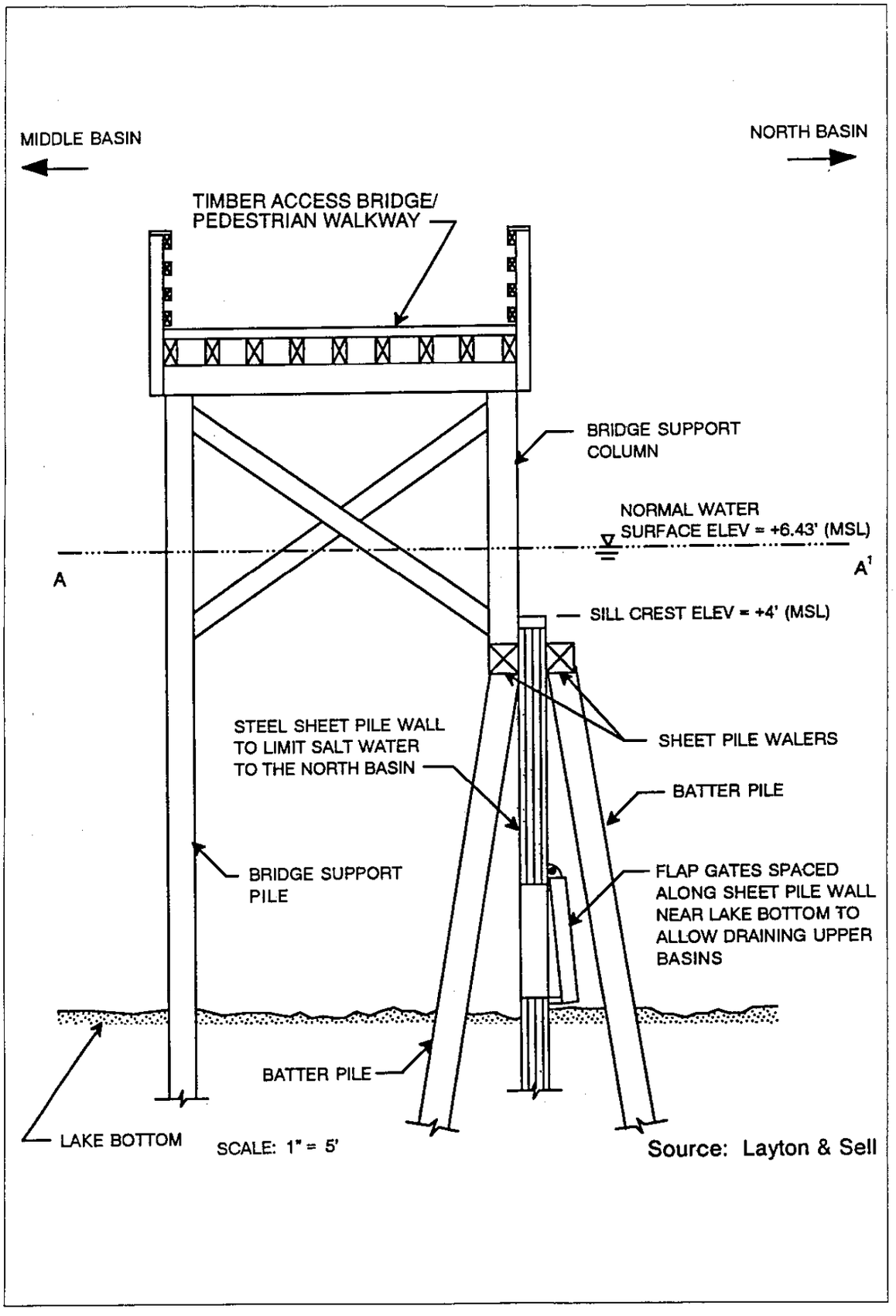
Figure 16a
Saltwater Flushing Barrier - Plan View



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Capitol Lake SEIS

Figure 16b
Saltwater Flushing Barrier - Section View

3.5.3.2 Diked Freshwater Wetlands

Diked Freshwater Wetlands was another alternative addressed in the *Capitol Lake Wetland Development Feasibility Study* (**Entranco 1990a**). This alternative was the same as the River Delta Freshwater Wetland concept described above, except that it would have involved using dredge and fill activities to enhance wetland water quality treatment benefits in the middle basin. However, the *Capitol Lake Wetland Development Feasibility Study* (**Entranco 1990a**) concluded that this alternative was non-viable because added water quality treatment benefits would be negligible, while added dredging and diking costs would be much greater than those associated with the River Delta Freshwater Wetland concept. Therefore, this alternative was not reconsidered in this SEIS.

3.5.3.3 Estuary Salt-Tolerant Wetlands

Estuary Salt-tolerant Wetlands was another alternative addressed in the *Capitol Lake Wetland Development Feasibility Study* (**Entranco 1990a**). Under this concept, the Fifth Avenue tide gate would be retained and would be set to allow daily tidal flushing of the present Capitol Lake area with saltwater. This would convert the freshwaters of Capitol Lake into a modified tidal estuary. Daily water elevation changes would be limited to approximately 3 feet so that exposed shoreline sediment area would be limited, perhaps exposing about 20 to 30 acres of shoreline sediment surface.

As with the River Delta Freshwater Wetlands concept, described in Section 3.5.2.1, this alternative would stop sediment removal operations in the middle basin, with attendant cost savings over a period of 30 to 85 years. Over this same time period, estuarine emergent marsh habitat would be expected to develop in the middle basin. In addition, aesthetic and odor problems associated with total sediment exposure would not occur.

Water quality affects would be both positive and negative, with lower summer temperatures, lower algae growth and improved visibility, but lower dissolved oxygen levels likely with increased marine water flushing. This assessment is based on comparing historical data for Budd Inlet and Capitol Lake as shown in **table 3**:

Unlike the River Delta Freshwater Wetlands concept, a saltwater barrier would not have to be constructed at the railroad trestle between the north and south basins. However, dikes and stormwater pump stations may be necessary to mitigate additional flood impacts to properties on the eastern side of the north basin and possibly also in the vicinity of Tumwater Historical Park. Also, various shoreline improvements would likely be needed to control increased shoreline erosion action under this alternative. As with the River Delta Freshwater Wetlands concept, this alternative would eventually eliminate the middle basin as a part of the reflecting pool for the Capitol Buildings. Eventually, maintenance sediment removal operations would have to be resumed to keep the north basin from filling.

Table 3
Comparison of Select Water Quality Parameters in Budd Inlet and the North Basin of Capitol Lake[1]
(April through August)

Parameter	Budd Inlet	North Basin, Capitol Lake
Temperature (C°)	13.0–16.5	12.7–22.0
Dissolved Oxygen (mg/l)	5.5–11.2	8.9–17.5
Turbidity (NTUs)	1.6–2.8	2.2–6.6
Chlorophyll a (µg/l)	2.8–18.6	3.5–42.6

1. Data sources: Entranco Engineers (1984) and WDOE Ambient Water Quality Data (1984–1990).

It is anticipated that fish rearing activities could be maintained in Percival Cove with construction of a stop log flow control structure at the Deschutes Parkway Bridge. However, there could be concerns with: (1) the 7–8 million fingerlings that are held presently in the freshwater lake each spring before release to Budd Inlet, and (2) loss of freshwater fishing habitat.

As with other wetland development alternatives, there would be the aesthetic impacts of allowing the wetland to develop, and the potential for loss of property values for residential and commercial view properties surrounding Capitol Lake. Mitigation would also be needed for flood control, which would require construction of flood control dikes and stormwater pump stations.

For these reasons, and because the State Legislature decided against this alternative in 1990, DGA did not reconsider the alternative in this SEIS.

4.0 WATERSHED CONTROLS FOR EROSION AND SEDIMENTATION CONTROL

Recognizing that the rate of sediment delivery to Capitol Lake is partially determined by land and water use management activities in the watershed, the Washington State Department of General Administration (DGA) contracted work to identify and mitigate erosion in the watershed (**Thurston County Conservation District 1984, Entranco 1990b, Department of Ecology 1993**). Timber practices historically involved clearcutting and construction of erodable logging roads. These practices were believed to have a significant influence on erosion and changing hydrology in the watershed. Other sources of erosion/sedimentation were livestock trampling of river/stream banks and clearing and grading activities associated with urban development.

The DGA cooperated with various state and local agencies to develop an interim erosion/nonpoint source pollution control plan for the Deschutes River in 1990 (**Entranco 1990b**). This plan relied heavily upon information contained in a Deschutes River watershed inventory report prepared for Thurston County (**USDA Puget Sound Cooperative River Basin Team 1990**) and on other early action watershed plans prepared by the County for the Henderson and Eld Inlet watersheds (**Henderson Inlet Watershed Management Committee 1989, Eld Inlet Watershed Management Committee 1989**).

A recent investigation of erosion/sedimentation concerns in the Deschutes River was completed by Collins (**1994**) on behalf of the Squaxin Island Tribe and the Thurston County Conservation District, in which the following conclusions were drawn regarding reductions in sediment loading to Capitol Lake:

> "While it is worth reducing land-use sources of erosion as a means to reducing sedimentation to the lake (and for meeting other objectives such as improving aquatic habitat by improving riparian conditions), it may be more sound for the watershed's overall habitat to emphasize dredging rather than a widespread program of bank protection, and the tradeoffs between the two need to be evaluated."

This comment was supported by an assessment of the relative contributions of natural and man-induced erosion/sedimentation problems in the watershed, in which Collins (**1994**) also concluded that natural sources of erosion/sedimentation were considered greater than those due to man-related activities such as forestry and agriculture.

The DGA is also involved in cooperative efforts with the Thurston Conservation District, Washington State Department of Ecology, Washington State Department of Fish and Wildlife, and other organizations to install bioengineering improvements—river bank stabilization efforts involving vegetation plantings and related work—on a total of seven upstream reaches of the Deschutes River. This is referred to as the Upper Deschutes River Sediment Reduction Project. Three of these improvements were installed in 1993

(**Thurston Conservation District 1994**) and four were installed in 1994 (**M. Turner, personal communication**). Several farm management plans were also developed and implemented as a part of the sediment reduction project.

These efforts, and the efforts of other state, federal, local, and tribal interests are expected to reduce Capitol Lake's sedimentation rate in the years ahead. The amount of sediment load reduction expected from these efforts is uncertain. However, it is clear that some degree of erosion and sedimentation will continue, primarily due to natural causes, despite the benefits of improved control efforts in the watershed. Therefore, the maintenance sediment removal of Capitol Lake is expected to be a long-term, on-going need, even with the best watershed management practices in place.

4.1 DESCHUTES RIVER WATERSHED ACTION PLAN

A long-term Watershed Action Plan for the Budd Inlet-Deschutes River watershed has recently been completed by Thurston County (**Thurston County Advance Planning and Historic Preservation 1995**). The plan recognizes the problem of erosion/sedimentation in the Deschutes River and the associated filling of Capitol Lake. Among the 18 action recommendations aimed at improving river ecosystem management, the following recommendations are particularly relevant to long-term control of sediment loading to Capitol Lake:

SED 1 - The Washington State Department of Natural Resources (DNR) and/or private landowners should conduct a Watershed Analysis in the upper watershed to determine changes in sediment transport and hydrology over time.

SED 3 - Local jurisdictions and the Thurston Conservation District (CD) should secure funding for re-establishing riparian vegetation.

SED 4 - Thurston County should conduct a "reach scale analysis" to identify the best location for new flooding, bank erosion, and sedimentation control projects.

SED 6 - The CD should secure funding for implementation of the its program to reduce bank erosion through revegetation and bioengineering as the preferred method of stream channel and bank stabilization.

SED 7 - Local jurisdictions should require new developments to preserve and, where appropriate, restore riparian vegetation.

SED 8 - The CD should make protection and re-establishment of vegetation along stream banks a priority when developing new farm management plans.

SED 9 - The Squaxin Island Tribe should monitor the status of riparian vegetation in the Deschutes River system and assess related water quality effects such as stream temperature and large woody debris recruitment.

SED 10 - The city of Tumwater should secure funding to carry out restoration of riparian vegetation along the Deschutes River in Tumwater as identified in the Deschutes River Riparian Habitat Plan (**City of Tumwater 1993**).

SED 11 - The Squaxin Island Tribe should identify and map off-channel salmonid rearing areas in the floodplain of the Deschutes River and its tributaries. It should also evaluate the effects of nonpoint pollution and related land use activities on these waterbodies.

SED 12 - Thurston County, in cooperation with the CD and other state or federal resource agencies, should develop wetland and stream restoration guidelines which improve water quality and habitat values while still providing for economic uses of the land.

SED 16 - The DNR should continue to evaluate stream bank stability prior to authorizing forest practices within the Deschutes River watershed.

As indicated by these action recommendations, the intent is to minimize erosion and sedimentation in the Deschutes River watershed to the extent feasible using available local, state, tribal, and federal resources. Depending on the degree of success, and the funding availability for implementation, these actions are expected to result in some reduction in sediment loading to Capitol Lake over time. However, since the majority of river sediment loading is due to natural processes, continued maintenance dredging of Capitol Lake will be needed in the future.

CHAPTER 5
AFFECTED ENVIRONMENT, SIGNIFICANT IMPACTS, AND MITIGATION

5.0 INTRODUCTION

This chapter describes the affected environment for each element of the environment and then addresses the impacts and proposed mitigation associated with each alternative.

The scope of this environmental impact statement (EIS) was determined through a scoping process. Scoping is intended to eliminate from study those impacts that are not significant. Initial agency and public scoping meetings were held in May 1992 to discuss the alternatives and environmental issues that would be addressed in this Supplemental Environmental Impact Statement (SEIS). A second agency scoping meeting was held on December 19, 1995 to revise the scope of the project as explained in Chapter 1 of this SEIS. Based on comments received during the scoping process, this SEIS addresses these elements of the environment: earth, noise, water resources, plants and wildlife, environmental health, land and recreational use, shoreline use and critical areas, historic and cultural resources, and transportation.

5.1 EARTH

5.1.1 Affected Environment

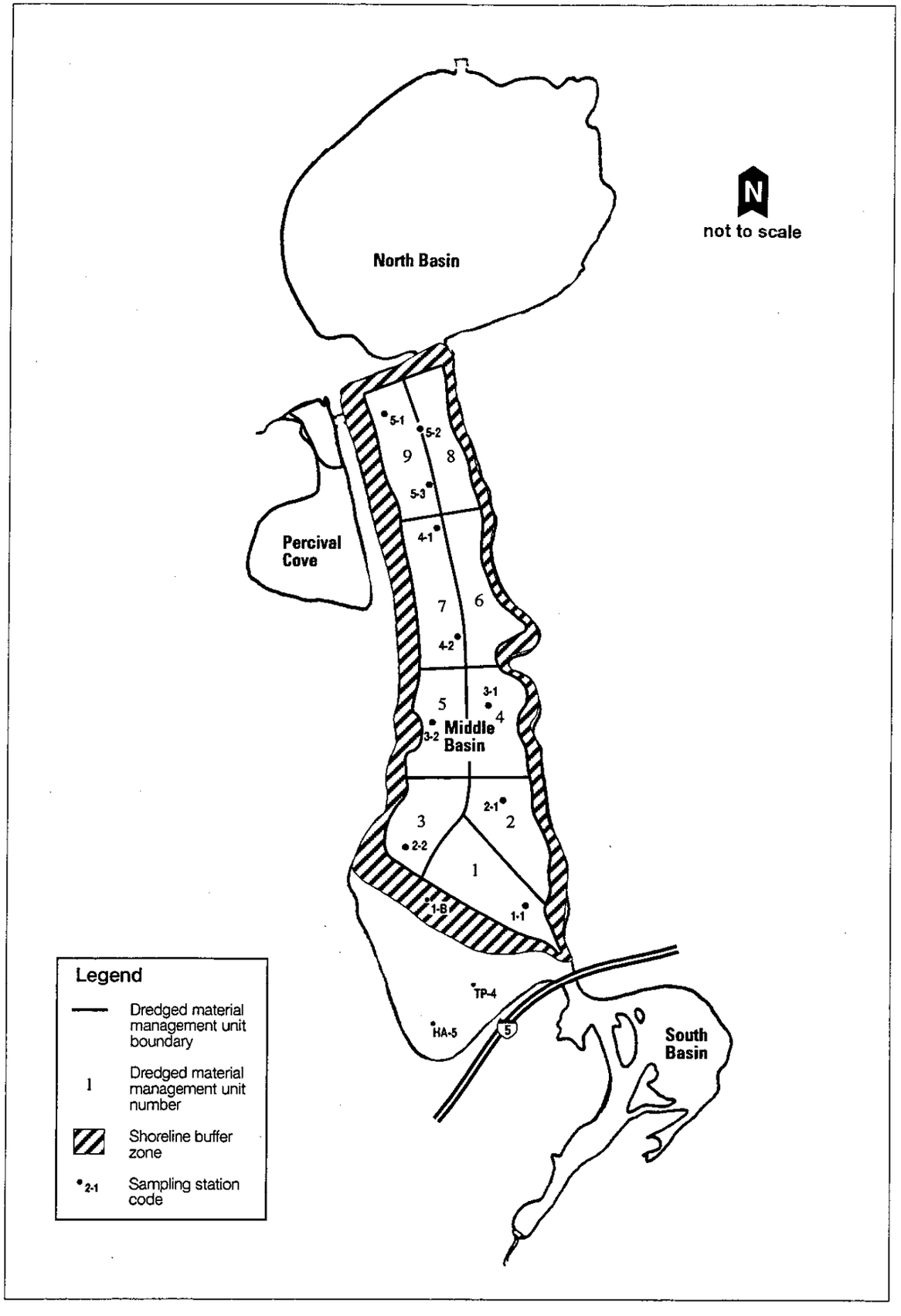
5.1.1.1 Capitol Lake

Based on the average of 15 sediment cores taken throughout the middle basin, the grain size distribution of surface sediments (0 to 3 feet) is highly variable, but the sediments are typically composed of silts (60 percent), sands (27 percent), and clays (13 percent) (**CH2M Hill 1976 and Hong West 1994**). Some natural sorting of material occurs in the middle basin—sands have a tendency to drop out in the upper portion of the basin in the sediment trap, and finer silts and clays have a tendency to accumulate elsewhere throughout the lake's middle and north basins.

Alluvial material—sand, gravel material, and cobbles—is transported to Percival Cove by Percival Creek. Most of this material drops out in Percival Cove just west of the Deschutes Parkway bridge.

The annual deposition rate for Capitol Lake (including Percival Cove) is estimated at 30,000 to 35,000 cubic yards per year or a total of 150,000 to 175,000 cubic yards every five years.

Chemical analysis of lake sediments sampled in 1994 (**figure 17**) indicates that sediments are free of toxic levels of arsenic, cadmium, copper, lead, mercury, zinc, polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (**Entranco 1994**). This determination was based on two samples collected from two stations in Capitol Lake, and six samples collected from two stations at the middle basin dewatering site (**figure 17**).



A705 92007-61 SEIS (9/29/95) AGT

Capitol Lake SEIS

Figure 17
Sediment Sampling Sites - 1994

Testing confirmed that there would be no risk to aquatic life from disturbing sediments within the lake, or from chemicals leaching out of sediments disposed of at upland remote disposal sites. Levels of PCBs and six metals (arsenic, cadmium, copper, mercury, lead, and zinc) in the sediment were below the maximum allowable concentrations under the *Washington State Dangerous Wastes Regulations* (**WAC 173-303**) and were also below *High Risk Waste Evaluation Guidelines* (**Thurston County 1991**). Therefore, they are considered inert or nontoxic with respect to upland disposal.

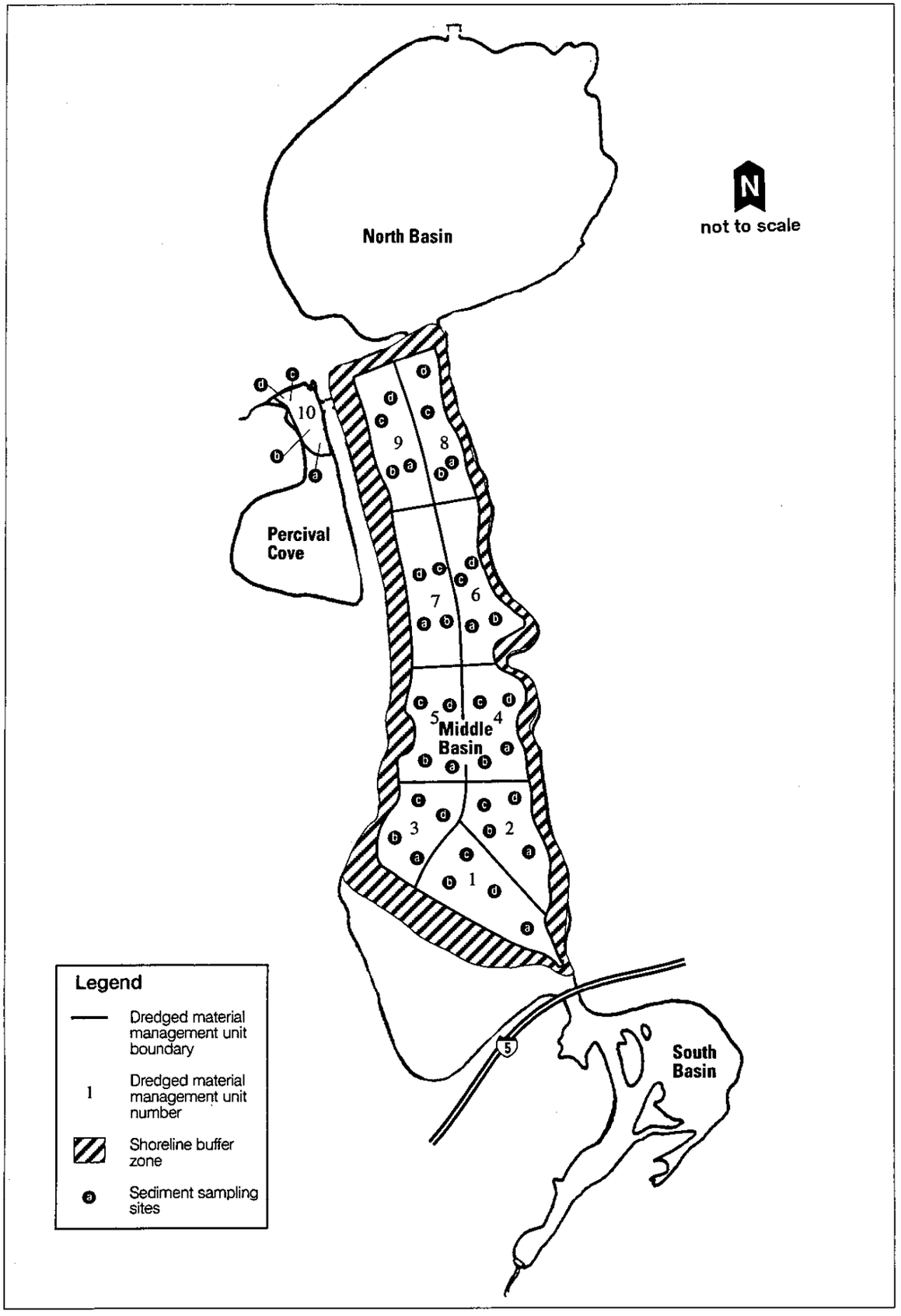
Puget Sound Dredged Disposal Analysis (PSDDA) sediment sampling was conducted on September 20, 1995 at the sites shown in **figure 18** to determine if sediments are suitable for disposal at the deep, open-water marine disposal site located between Anderson and Ketron Islands (**figure 1**). The four cores from each sector were composited into one sample for analysis of the PSDDA required parameters (**Appendix I**). The results of the laboratory analyses indicated that the sediments are suitable for marine disposal. All compounds were below the PSDDA Screening Levels (**Appendix I**). Other sites in the middle basin, outside of sectors 1 and 2, which showed elevated levels of benzoic acid, are no longer being considered for sediment removal within the scope of this SEIS.

5.1.1.2 Thurston County Landfill Site

Soils underlying and surrounding the Thurston County Landfill site are composed of Everett gravelly, sandy loam and Spanaway gravelly, sandy loam (**figure 19**). Water movement is rapid in the Everett soils, moderately rapid in the upper layers of the Spanaway soils, and very rapid at greater depths in the Spanaway soils. Both soil types have low erosion potential (**USDA Soil Conservation Service 1990**).

5.1.1.3 Chehalis Western Trailhead Site

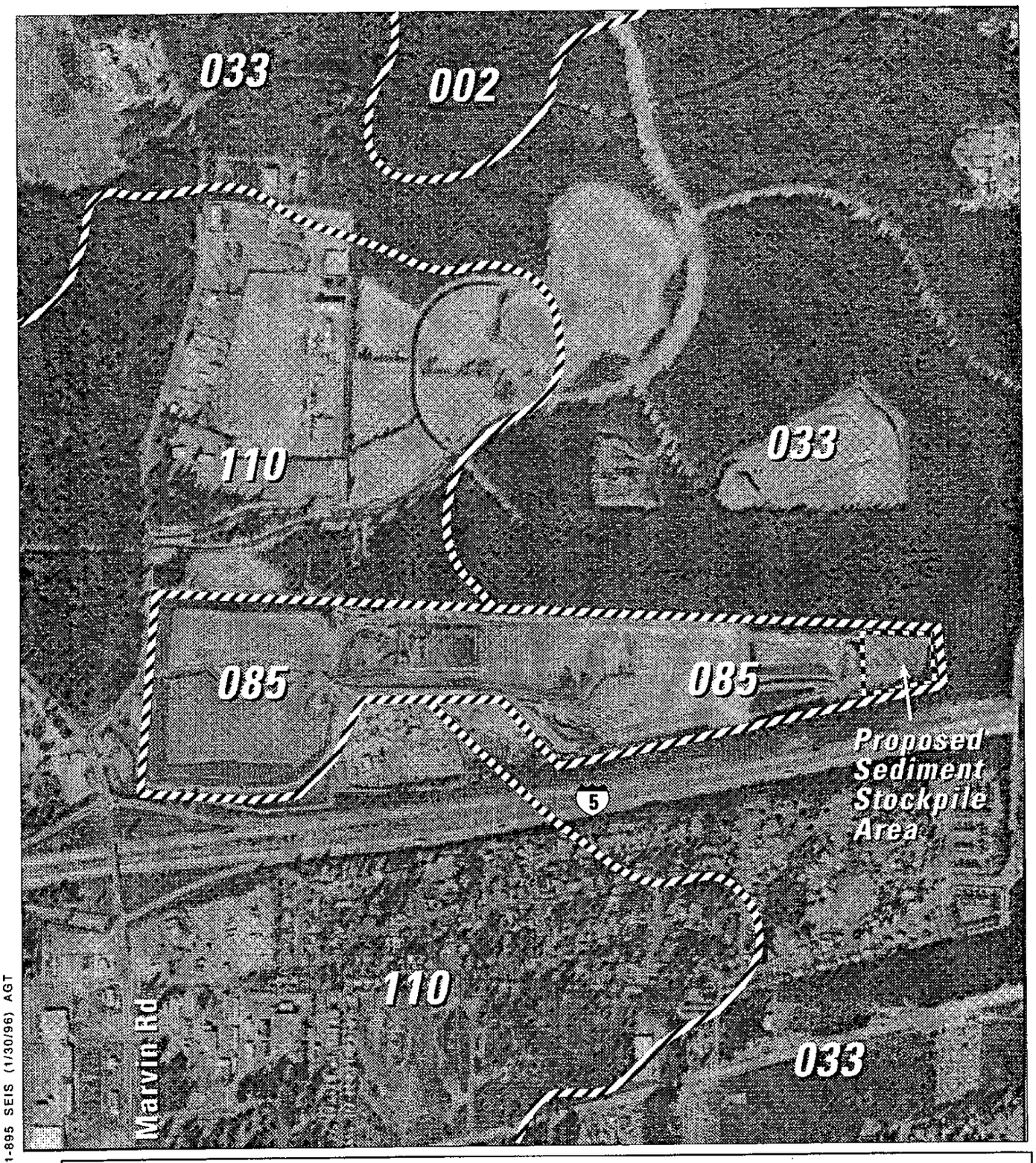
Soils underlying and surrounding the Chehalis Western Trailhead site are composed of Everett gravelly, sandy loam, which has rapid permeability. Somewhat to the north of the site there is a formation of Alderwood gravelly, sandy loam (**figure 20**). This latter soil has loose material at depths of 20 to 40 inches with moderately rapid permeability; below this level hardpan is encountered, which has very low permeability. Both soil types have low erosion potential (**USDA Soil Conservation Service 1990**).



A690 92007-61 SEIS (9/27/95) AGT

Capitol Lake SEIS

Figure 18
PSDDA Sediment Sampling Sites - 1995



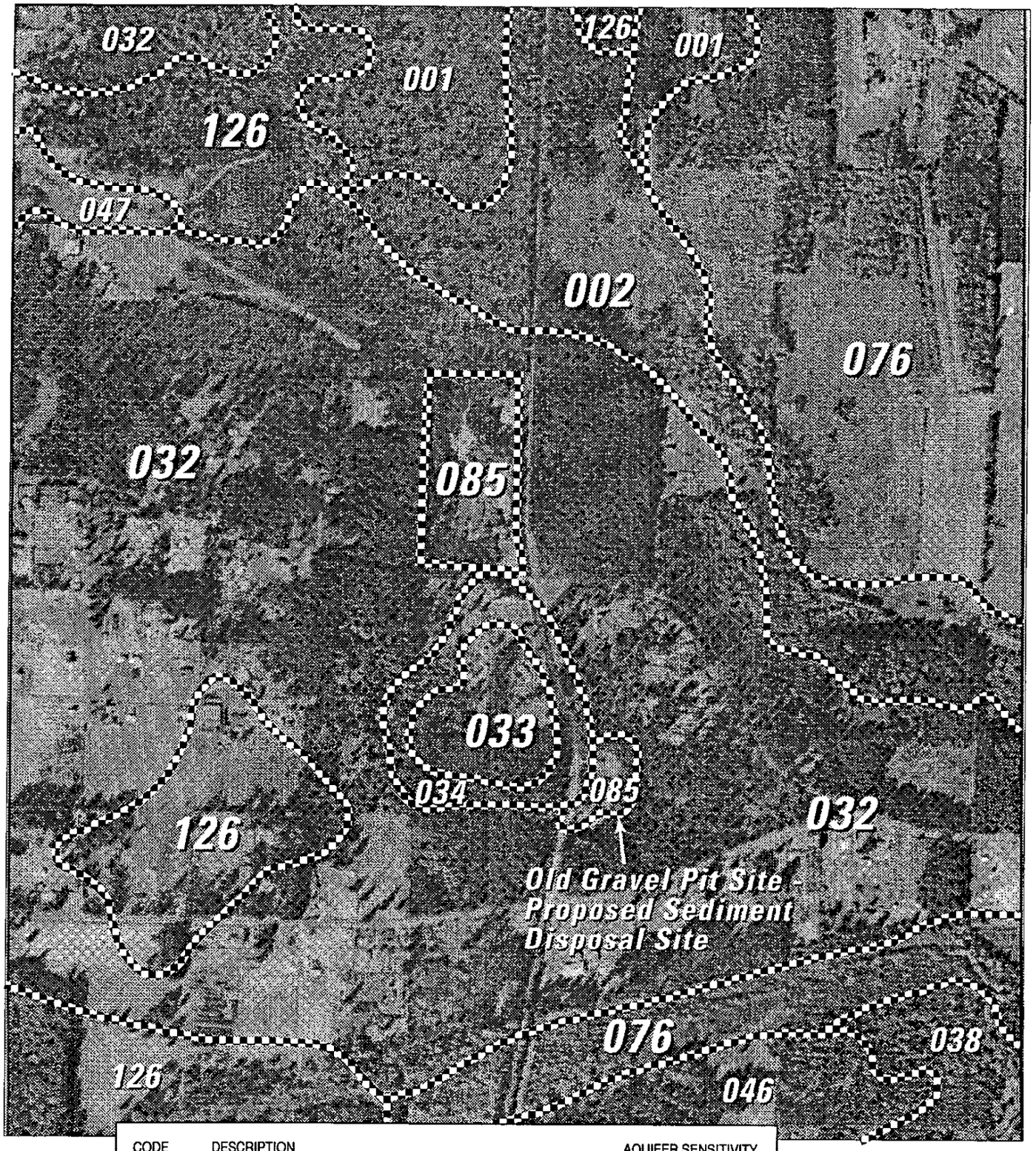
Legend			
CODE	DESCRIPTION	AQUIFER SENSITIVITY	
002	Alderwood gravelly sandy loam, 3 to 15 percent slope	HIGH	Proposed sediment stockpile area
033	Everett v. gravelly sandy loam, 3 to 15 percent slope	EXTREME	
085	Gravel pits	EXTREME	N
110	Spanaway gravelly sandy loam, 0 to 3 percent slopes	EXTREME	not to scale

Source: Adapted from SCS Maps, USDA Soil Conservation Service 1990

A687 92007-61-895 SEIS (1/30/96) AGT

Capitol Lake SEIS

Figure 19
Soils Map and Aquifer Sensitive Areas for Landfill Site



CODE	DESCRIPTION	AQUIFER SENSITIVITY
001	Alderwood gravelly sandy loam, 0 to 3 percent slope	HIGH
002	Alderwood gravelly sandy loam, 3 to 15 percent slope	HIGH
016	Everson clay loam	MODERATE
032	Everett v. gravelly sandy loam, 0 to 3 percent slope	EXTREME
033	Everett v. gravelly sandy loam, 3 to 15 percent slope	EXTREME
034	Everett v. gravelly sandy loam, 15 to 30 percent slope	EXTREME
085	Gravel pits	EXTREME
126	Yelm fine sandy loam, 0 to 3 percent slope	EXTREME

N

not to scale

Source: Adapted from SCS Maps, USDA Soil Conservation Service 1990

A688 92007-61-895 SEIS (1/30/96) AGT

Capitol Lake SEIS

Figure 20
Soils Map and Aquifer Sensitive Areas for Chehalis Western Trailhead Site

5.1.1.4 Anderson/Ketron Island Disposal Site

The sediments at the Anderson/Ketron Island open, deepwater marine disposal site consist of a mixture of silt, clay, and very fine to fine sand (**PTI Environmental Services 1989**). Thus, there is little difference physically between the sediments found on most of the bottom of Capitol Lake and those at the marine disposal site. At the Anderson/Ketron Island site, sediment testing revealed that one metal, zinc, exceeded the screening level for marine water disposal by 1.7 times (a level that is not supposed to be exceeded by sediments deposited at the site). Crustaceans are the most common variety of bottom-dwelling marine life found at this site. None of the stations tested using bioassays (where live organisms are exposed to the sediment and any toxic agents it may contain), failed the Site Condition II (test criteria established by PSDDA agencies) for amphipod mortality, oyster larvae mortality, and Microtox bioassays (**PTI Environmental Services 1989**). However, the amphipod bioassay conducted with sediments collected from the center of the Anderson/Ketron Island site had higher mortalities (but less than 30 percent higher) than those from a comparison site at Carr Inlet.

5.1.2 Impacts

5.1.2.1 No Action Alternative

5.1.2.1.1 Short-term Impacts. It is anticipated that there would be no short-term (next five years) sediment impacts to Capitol Lake from the No Action Alternative. Sediment would continue to accumulate at a rate of 30,000 to 35,000 cubic yards per year.

5.1.2.1.2 Long-term Impacts. Sediment would continue to accumulate in Capitol Lake at an average annual rate of approximately 30,000 to 35,000 cubic yards per year. The lake's south and middle basins would fill over an estimated period of 30 to 85 years and up to 100 years for the north basin (**Entranco 1990**), depending on the rate of sediment loading from the watershed. Some fish rearing, flood control, recreational, and aesthetic benefits would be lost or impaired. If sediment removal was not resumed, sediment would eventually fill the north basin as well, and then begin to accumulate in Budd Inlet. Ultimately, navigation would be impaired in Budd Inlet for both commercial cargo vessels and marine pleasure craft. Sediment removal would probably become a necessity for the Port of Olympia. Filling the lake also would result in the loss of some flood storage; refer to the Water Resources section for additional discussion.

5.1.2.2 Gravity Dewatering and Upland Disposal

Excavation and fill activities would occur once in 1996–1997 at the gravity dewatering construction area (primary settling pond) behind the dike in the middle basin's southwest corner. Depending on the rate of sediment filling, another round of maintenance dredging may occur in the winter of 1999–2000 or 2000–2001. Under this alternative, a total area of 5.75 acres would be excavated behind the dike (see **figure 2**) to receive approximately 60,000 cubic yards of material with each dredging cycle. During excavation and refilling,

there would be temporary erosion/sedimentation impacts to the gravity dewatering area and 3.7 acres of wetlands would be lost.

At the Thurston County Landfill upland disposal site, there would be temporary erosion/sedimentation impacts associated with stockpiled sediment (sediments may be stockpiled about six feet deep, until they are ready to be used for landfill liner material) which would be exposed temporarily over an area of about 6.4 acres.

At the Chehalis Western Trailhead site, approximately five acres of land occupied by an abandoned gravel pit would be filled with lake sediment. This site would accommodate an estimated 120,000 cubic yards of sediment. There would be potential erosion/sedimentation impacts at the time of sediment transport and grading, but it is unlikely that there would be any off-site impacts because the sediment would be deposited in the gravel pit. It is assumed that the finished grade would have a gradual slope so as to accommodate future park uses and reduce erosion potential.

Without mitigation, exposed sediments at the dewatering site could wash off into the adjacent wetland resulting in temporary turbidity and/or loss of aquatic habitat (refer to Water Resources later for a more in-depth discussion of potential water quality impacts). Lesser turbidity impacts could occur in Capitol Lake at the point of discharge for return flows. These potential impacts exist only at the dewatering site wetlands and at Capitol Lake, since there are no surface water resources at the landfill site or the Chehalis Western Trailhead site. Also uncontrolled soil erosion could result in the partial or total filling of the drainage course under the timber footbridge separating the two wetlands in the dewatering area, as well as the return flow pipe connecting the northern-most wetland with Capitol Lake. Other potential impacts might involve covering of bottom-dwelling fish food organisms, or smothering of amphibian egg masses in the adjacent wetland (see the Plants and Wildlife section for further discussion).

Potential off-site impacts include spillage of sediments on truck haul routes, with possible water quality impacts to receiving waters, and/or possible blockage of drainage pipes or drainage courses. The later impacts could lead to localized flooding problems.

5.1.2.3 Mechanical Dewatering and Upland Disposal

Under this alternative, there would be no significant disturbance of soils in the dewatering area behind the dike in the southwest corner of Capitol Lake's middle basin. There would be no significant erosion/sedimentation impacts to surface water resources in the vicinity of the Thurston County Landfill site or Chehalis Western Trailhead site because site runoff would infiltrate into the ground through highly permeable soils on these sites.

5.1.2.4 Marine Disposal

Under this alternative, there would be no disturbance of the area behind the dike in the southwest corner of Capitol Lake's middle basin and no impacts to any of the upland disposal sites. In addition, there would be no significant impacts to the marine waters of Puget Sound, assuming that disposal operations are carried out in accordance with PSDDA guidelines (**U.S. Army Corps of Engineers et al. 1989**). No significant impacts are anticipated because the sediments in sectors 1 and 2 in Capitol Lake would result in no chemical contamination of existing marine sediments at the Anderson/Ketron Island disposal site.

5.1.3 Mitigation

5.1.3.1 Mitigation of Impacts Associated with the No Action Alternative

5.1.3.1.1 ***Short-term Mitigation.*** Since there would be no significant short-term impacts, there would be no need for mitigation under the No Action Alternative.

5.1.3.1.2 ***Long-term Mitigation.*** Under the No Action Alternative, dikes and stormwater lift (pump) stations might be required along the eastern shore of Capitol Lake's north basin to avoid more frequent flooding of the city of Olympia that would otherwise occur with the loss of flood storage in Capitol Lake. Eventually, maintenance sediment removal operations would have to be resumed by the Washington State Department of General Administration (DGA) in Capitol Lake's north basin, or by the Port of Olympia in Budd Inlet.

5.1.3.2 Mitigation Common to All Action Alternatives

A dredging operations plan and disposal operations plan—including removal and disposal of stumps, logs, and other debris excavated during dredging—would be prepared by DGA and approved by the U.S. Army Corps of Engineers (Corps), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) prior to contracting for sediment removal.

5.1.3.3 Mitigation of Impacts to the Gravity Dewatering Area - Gravity Dewatering Alternative Only

Mitigation would be partially addressed by implementing the Water Quality Management Plan as described in **Appendix E.** The Water Quality Management Plan would provide measures to:

1. Control sediments carried by trucks to and from the upland disposal sites.

2. Aid in the precipitation and settling of suspended solids in the return flows to the wetlands in the gravity dewatering area and Capitol Lake.

3. Control erosion/sedimentation impacts at upland disposal sites.

Mitigation of wetland impacts would involve one or more of the following components:

- Construction of an additional dike to reduce wetland area impacts to an amount less than 3.7 acres,
- Construction of a minimum of 3.7 acres of enhancement wetlands in the buffer area of Capitol Lake,
- Participation in the Deschutes Riparian Habitat Rehabilitation Plan (**Thurston Regional Planning Council 1990**), or
- Development of a wetland mitigation plan in coordination with the Corps, Ecology, Washington State Department of Fish and Wildlife (WDFW), and the City of Tumwater.

5.1.3.4 Mitigation of Impacts to Upland Disposal Sites - Gravity and Mechanical Dewatering Alternatives

Mitigation would be provided largely by implementing the Water Quality Management Plan as described in **Appendix E**. Note that any runoff from the Thurston County Landfill stockpile area would be routed to the existing north retention pond (**Thurston County 1993**). Any runoff at the Chehalis Western Trailhead site would be routed through a biofiltration swale prior to groundwater recharge at the site.

5.1.3.5 Mitigation for the Marine Disposal Alternative

In addition to mitigation described under section 5.1.3.2, a navigation positioning quality control plan would also be prepared and approved by the PSDDA agencies prior to awarding the sediment removal contract. This plan would help in keeping sediments within the approved disposal zone (**figure 16**).

Under the PSDDA program, the Corps and Ecology have collected baseline sediment data for physical, chemical, and biological parameters at the site. These data would be compared with post-disposal data collected by the Corps and the Washington State Department of Natural Resources (DNR). If post-disposal data shows no significant changes from pre-disposal conditions, the site would continue to be used for marine disposal. However, if post-disposal monitoring showed significant changes compared to baseline monitoring results, the following management options would be considered, in order of increasing significance (**U.S. Army Corps of Engineers et al. 1989**):

"1. Analysis of the remaining archived samples for the other monitoring parameters to determine the extent and the ecological significance of the changes.

2. Off-site investigations to verify the presence of dredged material and to determine the extent and ecological significance of the effects.

3. Program adjustments, such as modification of site use or amendment of disposal guidelines to bring the site management into Clean Water Act requirements of not allowing unacceptable adverse impacts.

4. Major program responses such as site relocation or mitigation at the existing site."

5.2 NOISE

The human ear responds to a very wide range of sound intensities. The decibel scale used to describe sound is a logarithmic rating system that accounts for the large differences in audible sound intensities. This scale accounts for the human perception of a *doubling* of *loudness* as an increase of 10 decibels, so a 70-decibel sound level is twice as loud as a 60-decibel sound level. People generally cannot detect differences of one decibel, while under ideal conditions, differences of two or three decibels can be detected. In the outside environment such as near roads, a change of two or three decibels would not be noticeable to most people, while a five decibel change would be expected to be perceived under normal listening conditions.

5.2.1 Affected Environment

5.2.1.1 Capitol Lake

The primary sources of noise in the vicinity of Capitol Lake are automobile and truck traffic on Deschutes Parkway, Interstate 5 (I-5), and State Route (SR) 101 (**figure 1**). Existing truck volumes and noise levels are quite high on I-5 and SR 101. Additional traffic noise is generated in the vicinity of 4th Avenue and 5th Avenue at the north end of the lake and Lakeridge Drive along Percival Cove. There are periodic increases of noise during the hydroplane races which occur during Lake Fair each summer. The highest noise levels occur from 7:00 to 9:00 a.m. and from 4:00 to 6:00 p.m. These are the periods with the highest traffic volumes. Typical automobile traffic noise is about 70 dBA at speeds of 50 mph and a distance of 50 feet. However, highway truck traffic is likely to produce noise levels as high as 90 dBA, at 50 feet.

The impacts of traffic and construction noise on sensitive receptors is exempt from regulation under the Washington State Administrative Code (WAC 173-60), except that construction noise must occur only between 7:00 a.m. and 10:00 p.m. in residential areas, and noise from large trucks must be limited to 86 dBA at a distance of 50 feet.

The City of Olympia's Noise Ordinance incorporates, by reference, WAC Chapter 173-60. Therefore, traffic and construction noise impacts are exempt, with the same exceptions as described above.

The existing City of Tumwater Noise Ordinance restricts construction operations to the hours of 7:00 a.m. and 6:00 p.m. during weekdays only.

Typical noise levels from construction equipment measured at 50 feet from the source are displayed in **table 4**. Sounds from construction equipment (a point source) decrease about six dBA for each doubling in distance from the source, if there are no obstructions between the receptor and the equipment. For example, a bulldozer creating 80 dBA at 50 feet would have a predicted sound level of 74 dBA at 100 feet and 68 dBA at 200 feet. This noise attenuation rate is for upland environments. Noise attenuation is not as great over water, as would be the case for noise generated by dredging, dewatering, and trucking activity on and around Capitol Lake.

Table 4
Typical Construction Equipment Noise Levels
(dBA)

Construction Activity	Estimated L_{eq} at 50 feet	Types of Equipment	Range of Noise Levels at 50 feet
Clearing	83	Bulldozer	77–96
		Dump Truck	82–94
Grading	75-88	Scraper	80–93
		Bulldozer	77–96
Paving	72-88	Paver	86–88
		Dump Truck	82–94

Source: US EPA (**1971**)

For purposes of this SEIS, it was assumed that the hydraulic dredge and associated equipment would generate a noise level of 69–87 dBA, which is comparable to that for a pump, generator, or compressor.

5.2.1.2 Thurston County Landfill Site

Automobile and truck traffic on I-5 and Marvin Road are the primary sources of noise in the vicinity of the Thurston County Landfill. Existing truck volumes and associated noise levels are quite high on I-5 and Marvin Road, in part, due to the large volume of truck traffic entering and leaving the landfill area. Also, the truck route for hauling sediments between Capitol Lake and the Thurston County Landfill would primarily use I-5, a route that already has a relatively high volume of large truck traffic and associated noise.

5.2.1.3 Chehalis Western Trailhead Site

The trailhead site is in a rural area of Thurston County about eight miles southeast of Capitol Lake. Undeveloped land adjoins the site on the south and east sides. Farms are located to the north and west. Existing noise sources include light automobile and truck traffic on 89th Avenue SE, farm machinery, and low flying, single-engine airplanes that use the Kari Airstrip northwest of the site and the Flying Carpet Airstrip to the northeast.

5.2.1.4 Anderson/Ketron Island Marine Disposal Site

Existing noise sources include commercial marine tugs, tankers, and recreational boat motors.

5.2.2 Impacts

5.2.2.1 No Action Alternative

There would be no noise impacts under the No Action Alternative.

5.2.2.2 Impacts Common to All Action Alternatives

An 8-inch or 10-inch (pipe diameter) hydraulic dredge would be located on Capitol Lake during one or two dredging cycles in the next five years. Work would occur during a 60- to 90-day period between December 1, 1996 and March 1, 1997, and a second period to be determined in 1999–2001. The dredge most likely would be diesel powered and would be equipped with an appropriate muffler. Time of operation would be between the hours of 7:00 a.m. and 6:00 p.m. on weekdays only, which is consistent with City of Tumwater and City of Olympia ordinances. Hours of operation may change if either city adopts a new noise ordinance.

Dredging operations are expected to create sound levels between 69 and 87 dBA, a level similar to that produced by pumps, generators, and compressors (**table 4**) at a distance of 50 feet. The nearest residences (two homes) located on the east side of the lake at the very southern end of the middle basin, approximately 500 feet away from the nearest dredging operation, would experience sound levels between 51 and 69 dBA, or slightly greater because a portion of the noise transmission would be carried over water. Noise levels would be 45 to 63 dBA at other residences elsewhere along the east bluff at times when the dredge is working closest to the east shore. This noise would occur during the winter for approximately 60 to 90 days during each dredge cycle. It is anticipated, however, that the noise from the dredging equipment would not be particularly noticeable given the relatively high level of existing background traffic noise (70–90 dBA at 50 feet) in the vicinity of the lake's south end.

Noise from dredging operations probably would be most noticeable to recreational trail users along the lake's west side. However, trail use is expected to be relatively light during the winter dredging period.

5.2.2.3 Gravity Dewatering and Upland Disposal

Truck hauling operations would occur once or twice during the five-year planning period, between July and October, and would involve three trucks per hour from 7:00 a.m. to 6:00 p.m., weekdays only, for a total of 33 trucks per day. Temporary truck noise would be about 91 dBA within 50 feet of the construction site or haul routes, and would be most noticeable to recreational trail users in the vicinity of the Capitol Lake Interpretive Center, in the middle basin's southwest corner, and along the rural roads between Capitol Lake and the Chehalis Western Trailhead site. Truck noise probably would ***not*** be noticeable at the Thurston County Landfill site because of the high number of trucks already operating in this area. Bulldozers and loaders would also produce noise (89–91 dBA) at 50 feet from the lakeside dewatering site and the upland disposal sites. Noise levels would decrease by 6 dBA for every doubling of distance, and would be approximately 60 dBA at about 1,600 feet from the construction site or haul route.

5.2.2.4 Mechanical Dewatering and Upland Disposal

Under this alternative, a diesel generator and as many as seven centrifuges would operate in the construction dewatering area (but not in the wetland) behind the dike in the middle basin's southwest corner. Expected noise levels would be in the range of 69–87 dBA within 50 feet of the site, and down to about 51 to 69 dBA at 400 feet. Noise levels would be even lower along the lake trail near the construction site, because the existing earth berms located between the main trail and the dewatering site would provide some noise reduction benefit. The time of operation would be the same as for the dredging equipment. Temporary noise increases would be most noticeable to recreational trail users in the proximity of the equipment. Based on observations during the pilot project (**Entranco 1995**), noise levels are not expected to be much higher than existing environmental noise from I-5 and the Deschutes Parkway.

Truck noise at the dewatering site and along the haul route would be the same as described above for the Gravity Dewatering Alternative, except that it would occur at the same time as dredging—December 1 through March 1.

5.2.2.5 Marine Disposal

In addition to the dredge, the Marine Disposal Alternative would include one booster pump located in the Port of Olympia (**figure 13**). Noise from the booster pump would be similar to the dredge. There would also be a minor amount of noise associated with barge traffic—two barge trips a day. These sources of noise are not expected to produce

noticeable increases over existing environmental noise (automobile traffic, truck traffic, and marine traffic) in the vicinity of the Port of Olympia or on Puget Sound.

5.2.3 Mitigation

All machinery would be equipped with appropriate mufflers, and all construction work would be limited to weekdays only from 7:00 a.m. to 6:00 p.m., in a manner consistent with City of Tumwater and City of Olympia ordinances. No additional mitigation is proposed.

5.3 WATER RESOURCES

5.3.1 Affected Environment

5.3.1.1 Capitol Lake

Since its formation in 1951, Capitol Lake has experienced high levels of algae and aquatic plant growth, periodically high fecal coliform levels,[1] and a high sedimentation rate (**Orsborn et al 1975**). As a result of continued high fecal coliform levels, the city of Olympia closed the swimming beach on the northeastern shore of the north basin in 1985 (**Entranco 1990**). Davis, Berg, and Michaud (**1993**), indicate that urban runoff, point sources, and agricultural runoff are possible sources of fecal coliform loading to the lake.

Since 1971, marine saltwater back flushing has been used as a means of limiting summer algae blooms and freshwater aquatic plant growth in the lake. This is possible because of the tide gates at the north end of the north basin, which normally maintain a barrier between the freshwater of Capitol Lake and the marine waters of Budd Inlet. It is customary for the DGA to draw the lake down at least once during summer, and to refill it with marine water. This practice is requested by WDFW to assist juvenile salmon to migrate out of the lake and into Budd Inlet. Saltwater flushing also helps to control the growth of freshwater plants and algae since many freshwater species die when exposed to marine water because of its salt content.

Lake sedimentation problems were first documented in 1970. Recent estimates indicate that the lake is filling at a rate of approximately 30,000 to 35,000 cubic yards per year, and that the middle basin could fill completely within 30 to 85 years at this rate (**Entranco 1990**). Refer to section 2.1 of this SEIS for a more complete discussion of the history of sedimentation problems and past control efforts.

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1 Fecal coliform bacteria come from the intestinal tracts of warm-blooded animals and are indicators of the possible presence of water-borne diseases. Farm animals upstream in the Deschutes River Basin contribute to the fecal coliform levels in Capitol Lake.

Water temperature, pH, dissolved oxygen, and turbidity values typically occur within optimal ranges for fish and other aquatic life (see **table 5**), as specified for Class A Waters of the State (Water Quality Standards for Surface Waters of Washington State [WAC 173-201A, 1992]), especially in the lake's main longitudinal channel where the river flow maintains relatively good water quality conditions even during late summer and early fall periods.

Table 5
Summary Water Quality Data for Capitol Lake - March to August 1983[1]

Parameter	Range	Mean	State Standard - Class A
Water Temperature (degrees C°)	8.5-21.0	15.6	Not to exceed 18.0 C°. No increases above 0.3 C°, when natural temperature is above 18.0 C°.
pH	7.3-8.6	8.0	6.5 to 8.5 and human-caused variation less than 0.5.
Dissolved Oxygen (mg/l)	7.8-12.8	10.2	Shall exceed 8.0 mg/l.
Turbidity (NTUs)[2]	2.8-23.0	5.8	Not to exceed 5 NTU over background

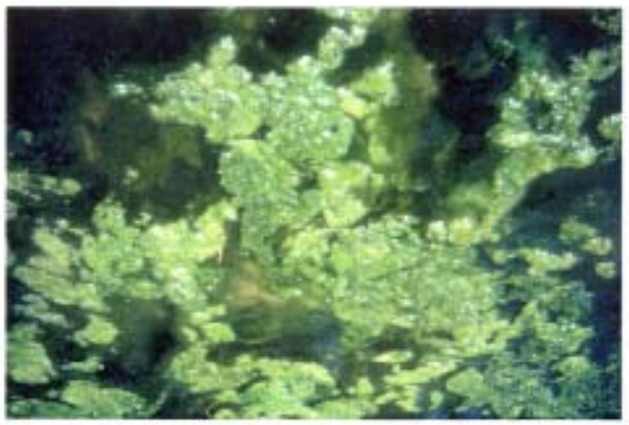
1. Entranco 1984.
2. Nephelometric Turbidity Units. Also note that turbidity levels have been measured as high as 87 NTU during flood conditions (**Davis, Berg and Michaud 1993**).

However, poor water quality conditions (i.e., low dissolved oxygen, high temperature, etc.) are known to occur seasonally during the late summer and early fall months, especially in the south basin (**CH2M Hill 1978**). This is believed to be due to a combination of factors, including reduced river dilution at this time of year, poor water circulation in some backwater areas of the south basin, elevated nutrient concentrations, and development of floating algae scum (**figure 21**). It is also suspected that reduced dissolved oxygen levels may occur in backwater areas where there is limited mixing with river water at the time of decomposition of the algal mats. Water quality data collected by CH2M Hill (1978) indicated that dissolved oxygen levels in the south basin fell to a range of 50-75 percent of saturation between the middle of September and early November 1977.

October 1975

August 1983

August 1983



July 1984

Figure 21
Algal Mats in the South Basin

The possibility of reduced dissolved oxygen levels in the south basin during late summer and early fall is a concern to WDFW, because large numbers of adult salmon returning to the Capitol Lake/Deschutes River system typically congregate in the south and middle basins. In large congregations of fish, oxygen consumption can be substantial and result in dissolved oxygen levels that are, "several parts per million lower than the surrounding water (**Orsborn et al. 1975 - page 213**)." Therefore, there is a potential for fish kills in the lake at this time of year (**K. Keown, personal communication**). The problem of reduced levels of dissolved oxygen with large numbers of fish has been a consideration in determining the number of fish that could be successfully raised in Percival Cove in the past. It is also the reason why WDFW used flow diversion baffles to reduce short-circuiting and enhance overall circulation of Percival Creek water within Percival Cove.

Flooding occurs periodically along the northern and eastern shores of the north basin, when the right combination of high precipitation, high river flow, and corresponding high tides occur (see **Appendix F** for a map of Capitol Lake's 100-year floodplain and for a discussion of existing water level management and a detailed flood impact analysis assuming complete sediment in-filling of the middle basin only). The maximum recorded river flow is 6,650 cubic feet per second (cfs) (**Entranco 1990a**). This is compared to typical summer and winter flows of 100 and 850 cfs, respectively. When flood flows occur at the same time as high tides, Capitol Lake accumulates water from the Deschutes River and other tributaries until the lake elevation slightly exceeds the tide elevation. During some high tides, lake elevation can reach an approximate flood elevation of 11.4 feet (the 100-year flood), compared to the normal winter lake elevation of 5.4 feet mean sea level (MSL). Flooding affects the north shore parking lot (elevation 8.0 feet MSL), east shore railroad tracks (9.0 feet MSL), Water Street (9.5–10.5 feet MSL), Columbia Street (10.0 feet MSL), and 5th Avenue (11.0 feet MSL) (see **Appendix F**). Some flooding of commercial buildings occurs at the 100-year flood elevation of 11.4 feet MSL.

The DGA, in coordination with WDFW, lowers the lake elevation prior to, or during, major precipitation events to provide as much flood storage as possible. The lake can be lowered all the way to the tide gate sill elevation (-7.7 feet) prior to a flood event, if necessary. Lowering the lake in response to heavy rainfall can avoid or mitigate flood impacts to some degree, depending on the size of the storm.

This kind of reservoir management provides the greatest benefit for the lower flow, higher frequency flood events, such as storms with a probability of recurrence of 5, 10, and 25 years, but provides limited benefits during large storms such as those with a probability of recurring of once in 100 years (see **table 6**). For example, complete drawdown (emptying to elevation -7.7) of Capitol Lake prior to a 100-year storm would result in a maximum lake elevation of 10.9 feet, compared to an elevation of 11.4 feet (a 0.5-foot difference) that would occur with no lake drawdown during the same 100-year storm.

Table 6
Predicted Flood Flows for the Deschutes River
(USGS 1985)

Recurrence Interval in Years	Flow (cubic feet per second)
1	1,878
2	3,803
5	4,926
10	5,644
25	6,529
100	7,813

5.3.1.2 Thurston County Landfill Site

There are no surface water resources in the vicinity of the landfill site. This is due to the high permeability of the soils in the area, which are primarily composed of gravelly, sandy loams. A review of well log records within a 2 square mile area around the landfill (Sections 1 and 2 of Township 18 north, Range 1 west), indicates the presence of two aquifers. Five of the area's 16 wells occur in an aquifer of moderate depth ranging from 80 to 100 feet from the ground surface. Ten wells occur in a deeper aquifer at depths ranging from 140 to 230 feet from the ground surface. One shallow well had a depth to water surface of 16 feet.

According to the Pacific Groundwater Group (**1992**), the two area aquifers are known as the Upper and Sea Level Aquifers, respectively, and are separated by a relatively impermeable layer or "aquitard". Most of the Upper Aquifer in the vicinity of the Thurston County Landfill apparently flows to the west toward a "window" in the aquitard that connects the Upper and Sea Level Aquifers, near the west end of the landfill. As groundwater from the Upper Aquifer reaches this window, it flows downward through the window to the Sea Level Aquifer. The Sea Level Aquifer, in the vicinity of the landfill, apparently flows to the east, southeast, or south (**Pacific Groundwater Group 1992**).

According to the Thurston County Health Department (**1992**), the aquifers in this area are extremely sensitive to contamination (**figure 19**). This is primarily due to the soil's high infiltration rates and the area's moderate- to high-yielding aquifers. Historical groundwater quality data has indicated low level contamination of groundwater resources in the vicinity of the landfill, which subsequently led to corrective actions. The older portion of the landfill was capped and newer portions of the landfill were lined, to reduce infiltration of rainfall through the landfill, with the intent to reduce landfill leachate to the aquifers

below. Long-term monitoring is being conducted to track the expected benefits to groundwater quality (**Pacific Groundwater Group 1992**).

5.3.1.3 Chehalis Western Trailhead Site

There are no surface water resources in the vicinity of the gravel pit site. This is due to the high permeability of the soils in the area, which are primarily composed of gravelly, sandy loams. A review of well log records in a three square mile area surrounding the site (section 16 of Township 17 north, Range 1 west), indicates the presence of three aquifers. Nine of the area's 88 wells occur in a very shallow aquifer at depths ranging from 5–20 feet from the ground surface. The majority of wells in the area (65 wells) occur in a shallow aquifer at depths ranging from 20–50 feet from the ground surface. Fourteen wells occur in a moderately deep aquifer ranging in depth from 50 to 100 feet below ground surface.

Based on regional groundwater contours and flow direction maps, it appears that the site is in the vicinity of a groundwater divide, so that groundwater may flow either northeast toward Pattison Lake, or northwest toward Chambers Creek and the Deschutes River (**U.S. Geological Survey 1994a**). A review of limited groundwater quality data in the same report indicates no wells with bacterial or organic contamination in the area. Only one well in Township 17N, Range 1W, Section 16, showed evidence of methylene active blue substances. These are chemicals found in laundry detergents and are indicators of mild groundwater contamination by septic tank/drainfield systems. It should be noted that no bacterial contamination (from animal or human waste) or high levels of nitrate nitrogen (from human waste, animal waste or fertilizer) were reported in the same well. However, zinc concentrations for the same well were 44 µg/l, slightly higher than the median value of 36 µg/l from the 47 wells sampled for metals. The most likely source of zinc is from galvanized metals used in well construction and plumbing. Finally, the well in Section 16 had the highest level of radioactivity from naturally-occurring radon, of the 47 wells tested (**U.S. Geological Survey 1994a**).

According to the Thurston County Health Department (**1992**) the aquifers in this area are extremely sensitive to contamination (**figure 20**). This is primarily due to the soils' high infiltration rates and the moderate to high-yielding aquifers.

5.3.1.4 Anderson/Ketron Island Site

All baseline monitoring at the Anderson/Ketron Island Disposal site has involved physical, chemical and biological testing of bottom sediments. No water quality data was reported as part of the monitoring (**PTI Environmental Services 1989**). However, water quality at the site is rated Class AA and is expected to be excellent (WAC 173-201A).

5.3.2 Impacts to Water Resources

5.3.2.1 No Action Alternative

5.3.2.1.1 Short-term Impacts. Over a period of 5–10 years, without maintenance dredging, there would be no significant changes in water quality in Capitol Lake.

5.3.2.1.2 Long-term Impacts. Under the No Action Alternative, Capitol Lake's middle basin would fill in with sediment over a period of 30 to 85 years. The north basin would take longer to fill—up to 100 years. In time, sand bar formation in the middle basin could create stagnant water areas where exchange with river water would be reduced or eliminated, especially during low-flow summer months. Under such conditions, higher water temperatures would be expected along with higher levels of algae growth.

Floating algae mats could form in the middle and north basins, as they presently do in the south basin during summer, resulting in lower dissolved oxygen levels in backwater areas, especially during summer evening hours, when photosynthetic oxygen production stops, and bacterial decomposition of organic matter (increased by increased algae growth) consumes oxygen at higher rates. Poorer water quality might also occur in the north basin, and Budd Inlet, with some increase in algal production and biochemical oxygen demand from decaying algae cells. Poorer water quality conditions could be detrimental to fish rearing operations in the lake, depending on the extent to which fish would utilize backwater areas and the extent of impaired water quality.

Because the middle and north basins would fill in, flood elevations would increase from the existing 10.9 feet MSL (with drawdown to elevation -7.7 feet prior to flood) to 11.7 feet, an increase of 0.8 foot, under the 100-year flood condition (**Entranco 1990a - refer to Appendix F for technical information**)[2]. This would cause limited additional flooding in the City of Olympia along the northern and eastern shores of the north basin. Increased frequency and/or magnitude of smaller, more frequent floods would also be expected to occur with the loss of flood storage in the middle and north basins .

5.3.2.2 Impacts Common to All Action Alternatives

There would be no short-term (five-year) change in flooding impacts with any of the action alternatives, because the middle basin's existing flood storage capacity would be retained by maintenance sediment removal operations.

Increased turbidity (cloudiness) would occur temporarily in the vicinity of the dredge during the two- to three-month sediment removal operation. Depending on the location of the dredge, and the magnitude of river/lake currents, turbid water may remain close to the

2 Note: The flood elevation of 11.7 feet is based on a flood analysis that assumed filling of the middle basin only. Therefore, it is probable that the flood elevation would be somewhat higher with the No Action Alternative, because the north basin also would eventually be filled with sediment.

bottom, with little visible impact. There was minor visible turbidity in the immediate vicinity of the four-inch dredge used during a pilot dredging/mechanical dewatering project in February 1995 (**Entranco 1995**). However, the visible impact only extended approximately 25 to 30 feet away from the dredge.

Suspended sediment created by the dredging operation would result in some sedimentation on the lake bottom downstream of the dredge site, and some bottom-dwelling organisms may be covered. However, such sedimentation is common in the lake because of the large amount of sediment discharged to the lake each year by the Deschutes River. Therefore, this is not expected to be a significant impact when compared to natural sedimentation rates.

Based on sediment quality studies performed for this project (**Entranco 1994**), there are no toxic levels of any compounds in the sediments in sectors 1 and 2, and there would be no adverse impacts to aquatic life due to the disturbing the sediments.[3]

5.3.2.3 Gravity Dewatering Alternative

With the Gravity Dewatering Alternative, return flows from the dredging operation would be discharged to that portion of the primary settling pond/wetland remaining after excavation (up to 2.0 acres), and subsequently discharged to the secondary settling pond/wetland (3.7 acres). There would be temporary high turbidity in both settling pond/wetlands behind the dike in the middle basin's southwest corner, and associated sediment accumulation. Pilot dredging tests conducted in the spring of 1995 showed that turbidities as high as 500 to 1,500 NTUs (nephelometric turbidity units: a measure of increased light scatter due to increasing particle concentration in the water) could occur without mitigation. These levels were obviously much higher than the acceptable lake water quality standard of 8 NTU measured on the same day. However, at the point of discharge to the wetland treatment ponds behind the dike, adding nontoxic flocculents dropped turbidity levels to 320 NTU. Treating the return flow by adding flocculents between the first and second ponds and providing for settling of suspended solids in the second pond, turbidity levels would be expected to be much closer to the 8 NTU standard at the point of discharge to Capitol Lake. Therefore, no adverse impacts on fish or other aquatic life would be expected in Capitol Lake. However, increased turbidity (an indicator of increased suspended solids) and subsequent sedimentation within the wetland could cover some bottom-dwelling organisms. It is uncertain whether this would result in loss of bottom-dwelling organisms, or if they would be able to burrow through the new layer of

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3 As a part of sediment characterization studies, elutriate tests were performed for PCBs, arsenic, cadmium, lead, mercury, copper, and zinc. The test procedure involves mixing a standard amount of water and sediment together, allowing the sample to sit for a standard period of time for settling of the majority of solids, and then testing the concentration of contaminants in the overlying water. Elutriate test results can then be compared directly with water quality standards to determine if impacts to aquatic life would be likely. Elutriate test results for Capitol Lake sediments indicated that the concentrations of all contaminants would be well below state water quality standards.

sediment. If loss of organisms did occur, this would be a temporary impact, which would also reduce the food supply for amphibians, fish, and birds.

No impacts would be expected on temperature, dissolved oxygen, or pH, based on test results from the dredging/mechanical dewatering test conducted in February 1995 ((**Entranco 1995**). These tests indicated temperature, dissolved oxygen, and pH levels in return flows were the same as undisturbed lake water, even when no flocculating agents were added to reduce high turbidity.

There are potential erosion/sedimentation impacts that could occur at the upland disposal sites. However, off-site impacts are not likely at either the Thurston County Landfill or Chehalis Western Trailhead sites. This is because there are no surface waters in the vicinity of either site, and the topography and soil conditions are such that water and sediment would be separated at the edge of the disposal area as water infiltrated into native soils.

Because of the low permeability of Capitol Lake sediments compared to native soils in the vicinity of the landfill site and the Chehalis Western Trailhead site, it is likely that long-term groundwater recharge would be reduced over the 5 to 6 acres where soils would be deposited. This would be the intent at the landfill site, since the material would be used as a liner, if the sediment has sufficiently low permeability and moisture content for the intended use. However, the loss of recharge is not expected to have a significant impact on groundwater level or quantity since the landfill contributes a very small portion to the total recharge for the aquifer in this portion of northern Thurston County.

At the Chehalis Western Trailhead site, runoff from the low permeability sediments would be recharged back to the aquifer along the perimeter of the fill. As with the landfill site, the Chehalis Western Trailhead site also represents a very small area compared to the total groundwater recharge area in the site vicinity. Therefore, there would be no significant impact on groundwater level or quantity in the area.

Based on sediment testing performed for this project, there would be no adverse impacts to ground water quality due to leachate of any chemicals from Capitol Lake sediments.

5.3.2.4 Mechanical Dewatering Alternative

Return water impacts on the primary and secondary settling ponds behind the dike in the middle basin's southwest corner would be similar to those described for the Gravity Dewatering Alternative. However, water quality treatment is likely to be superior with the Mechanical Dewatering Alternative (lower turbidities are likely at the point of discharge back into Capitol Lake), because all of the existing wetlands between the point of discharge and the lake would remain undisturbed, thus providing better wetland treatment than with the Gravity Dewatering Alternative, which would require removal of up to 3.7 acres of wetlands. As with the Gravity Dewatering Alternative, temporary impacts may occur to bottom-dwelling insects, with subsequent reduction in food supply for amphibians, fish, and birds.

Potential water resource impacts at the upland disposal sites would be the same as those described above for the Mechanical Dewatering Alternative.

5.3.2.5 Marine Disposal Alternative

Under the Marine Disposal Alternative, there would be no impacts to the dewatering construction area, because it would not be used with this alternative. In addition, there would be no impacts to wetlands or Capitol Lake associated with the discharge of return flows, because the entire sediment-water slurry would be discharged directly to barges and transported to the Anderson/Ketron Island disposal site.

There would be no impacts at the barge mooring site, since no barge overfilling would be allowed, and barge seals would be checked and repaired, if necessary, prior to excavation/ loading to avoid leakage of the sediment-water slurry to Budd Inlet. However, there would be temporary turbidity impacts in the marine waters of Puget Sound in the disposal zone and possibly in the site perimeter of the Anderson/Ketron Island disposal site (**figure 14**).

The proposed method of dredging (hydraulic dredging) and disposal (disposal of the entire sediment-water slurry) would be expected to have a greater temporary impact on marine water quality than would occur with clamshell dredging. This is because the volume of turbid water would be considerably greater with the hydraulic dredging approach. Also, since the turbid water is freshwater, and is less dense than the marine water into which it would be discharged, mixing time would be somewhat longer, and there may be a tendency for the lighter, turbid freshwater to "float" on the surface of the marine water prior to complete mixing.

In nature this kind of freshwater/marine water interaction occurs commonly at the mouth of every freshwater river that enters the Puget Sound. Disposal of the freshwater sediment-water slurry is not substantially different than this natural process, except that it is much smaller in scale. It is estimated that the daily production volume of sediment-water slurry would represent only 0.3 percent of the daily discharge volume of the Deschutes River. Thus, the impact is not considered significant.

Turbidity impacts would be short-term, probably lasting no more than one to two hours after each barge dumping operation, and would be consistent with identification of this site as a marine disposal site by the Corps, the EPA, Ecology, and DNR (**U.S. Army Corps of Engineers et al. 1989**).

No other water quality impacts would be expected based on the fact that no compounds were found above the Screening Level in connection with PSDDA sediment testing in dredging sectors 1 and 2.

5.3.3 Mitigation

5.3.3.1 Mitigation for the No Action Alternative

Mitigation of water quality impacts due to backwater stagnation might involve more frequent routine bumping (sequential lowering and raising of lake levels to enhance circulation) of the lake, or saltwater flushing during the 30 to 85 years prior to complete filling of the middle basin and up to 100 years for the north basin. Lowering and raising the lake to increase water exchange would require modification of tide gate operation, with an increase from +/- 1 foot to +/- 2 feet. However, this practice would not necessarily mitigate potential impacts on Budd Inlet, if additional nutrients and/or water with lower dissolved oxygen levels is discharged into it from the lake.

Mitigation of flood impacts could involve construction of dikes and pump stations along the northern and eastern shores of Capitol Lake's north basin (**Entranco 1990a**). However, this would conflict with future City of Olympia and Washington State plans to construct Heritage Park, a large park that would extend from the Capitol grounds down to and encompassing the eastern and northern shores of Capitol Lake's north basin (**Jones and Jones 1986, and The Portico Group and the SWA Group 1994**).

5.3.3.2 Mitigation Common to All Action Alternatives

The first element of mitigation would involve the design and implementation of a water quality monitoring plan to track water quality at the dredging site. The monitoring plan would be developed in cooperation with Ecology and WDFW. Monitoring parameters would include turbidity, suspended solids, temperature, dissolved oxygen and pH. If monitoring results indicated that turbidity plumes extended too far away from the dredge site, a silt curtain would be installed in the dredging operation vicinity (minimum 150-foot radius around the dredge) to provide additional control for turbidity. The silt curtain would encircle the dredge and would extend from the lake surface to one or two feet off the lake bottom. It would contain turbid water and provide increased time to settle small particles.

5.3.3.3 Mitigation Common to the Gravity Dewatering and Mechanical Dewatering Alternatives

A water quality monitoring plan would be prepared and implemented to track water quality conditions at the point where return flows enter Capitol Lake. Primary mitigation for return flow water quality impacts would involve adding nontoxic flocculents prior to discharging flows to wetlands behind the dike in the middle basin's southwest corner. Additional mitigation for return flow treatment could involve installing a silt curtain at a 150-foot radius, in a semi-circle around the outfall pipe on the lake side of the dike in the middle basin's southwest corner, if monitoring results indicate that addition of flocculents is not sufficient to meet acceptable water quality standards. No monitoring would be needed at the upland disposal sites apart from monitoring programs already established.

Groundwater monitoring is being conducted at the Thurston County Landfill. Potential erosion/sedimentation impacts at the upland disposal sites would be mitigated by implementing the Water Quality Management Plan described in **Appendix E** of this SEIS. This plan addresses water quality control for runoff during and following excavation, and includes provisions for spill prevention and emergency spill response for the contractor.

5.3.3.4 Mitigation for the Marine Disposal Alternative

A barge dumping control plan would be prepared prior to implementation. The plan would address the best timing and location of dumping based on tides, winds and currents. This plan would help in confining turbidity impacts to the approved disposal zone (**figure 14**).

5.4 PLANTS AND WILDLIFE

5.4.1 Affected Environment

5.4.1.1 Capitol Lake

5.4.1.1.1 Plant Life. Plant communities along the eastern shoreline of Capitol Lake include mature deciduous and conifer forest stands which extend along the entire length of the steep slope which drops down to the lake's edge. These forested areas are interrupted by single-family homes at the top of the bluff, and by the DGA power plant located just a few feet above flood elevation on the eastern shore at the far north end of the middle basin. Plant communities along the western shoreline—between Deschutes Parkway and the lake—include cattail, emergent wetland grasses and sedges; planted grass; shrubs such as blackberry and immature red alder trees; and some ornamental tree plantings. Like the steep slopes of the middle basin's east side, the steep portions of the west side (upslope of the Deschutes Parkway) also contain mixed conifer/deciduous forest.

Existing wetlands and wetland buffers, located behind the dike in the middle basin's southwest corner, are shown in **figure 2**. These wetlands cover approximately 7.5 acres and include up to 3.5 to 4.0 acres of open water depending on the time of year. The margins of open-water areas are vegetated with cattail, rush, and sedge species. Willow species, red alder, and other associated species, form another band of wetland vegetation outside the emergent vegetation zone (**Adolfson Associates, Inc. 1994**). These wetlands occupy the area specified as the primary and secondary sedimentation ponds for dredged material dewatering during maintenance sediment removal operations (**Richard Carothers and Associates 1981**). The southern lobe of this wetland, which occupies approximately 3.7 acres of the primary sedimentation pond area, was excavated in conjunction with sediment removal operations in 1986 (**DGA 1986**). However, despite its removal, the wetland plant community has re-established itself in this area, without any human restoration or mitigation action.

It is important to note that the Thurston County Noxious Weed Control Agency (TCNWCA) placed portions of the Capitol Lake environment under quarantine because of the presence of the noxious plant, purple loosestrife (*Lythrum salicaria* and *L. virgatum*), which inhabits shoreline wetland habitats of Capitol Lake's south and middle basins, including the wetlands described above. The quarantine has been in effect since 1993 and DGA has been working cooperatively with the TCNWCA to monitor and eradicate this plant.

Aquatic plants inhabiting Capitol Lake include *Potamogeton pectinatus, Potamogeton crispus, Potamogeton foliosus* (all the *Potamogeton* species are referred to by the common name "pond weed"), *Elodea canadensis* (water weed), and *Lemna gibba* (duck weed) (**Orsborn et al. 1975**). A more recent survey by Thurston County (**Thurston County Department of Water and Waste Management 1995**) identified *E. canadensis, Lemna minor, P. crispus, P. pectinatus, P. zosteriformis,* and *P. pusillus* in Capitol Lake. These plants occur in the shallow water areas around the margins of the middle basin, south basin, and to a lesser degree, along the shallow margins of the north basin. These plants occur at relatively low densities compared to the densities of the same or similar plants in some other area lakes. This may be due largely to the long-term practice of annual saltwater flushing in Capitol Lake, but may also partially due to the higher water currents in Capitol Lake compared to other area lakes. Nevertheless, these plants are of ecological significance, providing food for waterfowl, habitat for fish and aquatic insects, and oxygen to the water column during the summer growth period (daytime only).

While aquatic plants do provide ecological benefits, they can also have drawbacks. They can contribute to oxygen depletion and nutrient cycling as they decay in late summer and early fall months. In addition, high plant densities can also impede oxygen transfer by restricting air and water circulation within the plant bed. They can also interfere with fishing and other recreational activities, and may provide conditions that favor stunted warm-water fish populations. There are also wetlands in the south basin of Capitol Lake, and estuarine habitat in Budd Inlet to the north of the lake, but there would be no project activity in the vicinity of these resources that would pose a significant risk of impact.

A search of the DNR Natural Heritage Information System revealed no records for endangered, threatened, or sensitive plants in the vicinity of Capitol Lake.

5.4.1.1.2 Animal Life. The U.S. Fish and Wildlife Service (USFWS) reports that bald eagles have been observed in the south basin of Capitol Lake near Tumwater Historical Park (**J. Michaels, personal communication**). It also was noted that the birds occasionally seen there are accustomed to the relatively busy environment, given the proximity of the I-5 freeway and human activity at the park. The USFWS did not think that these birds would be adversely impacted by the proposed dredging work in the middle basin's south end.

A review of WDFW's *Priority Habitats and Species List* (**1995**), indicates that there are **no rare, threatened, or endangered species** inhabiting the area. Species of concern include the pileated woodpecker, which is known to breed in the area; the green-backed heron, which also breeds in the area; the great egret; and mink. The pileated woodpecker is a

candidate species, which means that WDFW is sufficiently concerned about the status of this species that it is conducting additional studies to determine if it should be listed as a rare, threatened, or endangered species. The green-backed heron is a state-monitored species, which means that it is being monitored by WDFW to preclude it from becoming a rare, threatened, or endangered species. The great egret has also been observed in the Budd Inlet vicinity and is a state-monitored species. Data is kept on mink because they are still commercially important. It is also probable that a variety of amphibians (frogs and salamanders) live within the associated wetlands and along the shorelines of Capitol Lake.

5.4.1.1.3 Fish Life. Various fish use Capitol Lake, including coho, chinook (fall run), chum, and sockeye salmon; steelhead (winter run); cutthroat trout (coastal searun and coastal resident) and rainbow trout; largemouth bass; carp; sculpin; and western brook lamprey (**Entranco 1990a**). Adult and juvenile salmon, steelhead, and cutthroat trout migrate through Capitol Lake. Juvenile salmon also spend some time rearing in the lake prior to entering Budd Inlet and the greater Puget Sound. The majority of the juvenile salmonids spend a relatively short period in the lake prior to outmigration to the sound in the spring and early summer. However, some juvenile coho and sockeye salmon, steelhead, and cutthroat trout can be found rearing in the lake year round.

The WDFW also uses the lake as a rearing facility for hatchery-produced juvenile chinook salmon (**Entranco 1990**). Each year in mid-April, WDFW releases 7 to 8 million chinook fry and feeds them until late May or June, when they find their way out to Budd Inlet. These fish rely primarily on the artificial feeding program sponsored by WDFW, and only a small portion of their diet is made up of natural food sources within the lake.

A net pen in Percival Cove is cooperatively operated by WDFW and the Olympic Salmon Club. The net pen operation yields about 150,000 yearling chinook at the end of the October to May growing season. These fish, and other fish supplied to area hatcheries and to the Squaxin Island Tribe for use in their marine water net pens, are grown from chinook eggs taken at the Tumwater Falls fish trap, just upstream of Capitol Lake.

Capitol Lake supports an important sport fishery for the various species of salmon, trout, bass, and carp.

Coho salmon have been listed by the USFWS as a candidate species in Puget Sound and elsewhere in Washington State under the Endangered Species Act. Special studies are underway currently to determine if there is sufficient evidence that this species of salmon should be listed as rare, threatened, or endangered. A listing decision is expected by July 1996. If coho does become a listed species, special measures may be invoked by the USFWS and WDFW to protect the fish. Until a decision is made, no special considerations, apart from those already proposed for the protection of all fish, would need to be considered in connection with this project. It is noteworthy that coho have been listed as a threatened species in both California and Oregon.

Based on communication with Washington State Department of Fisheries biologist R. Noble, Orsborn et al. (**1975**) indicated that bottom-dwelling organisms accounted for

about 10 percent of fish food associated with salmon rearing in Capitol Lake. Orsborn et al. (**1975**) identified 11 different bottom-dwelling organisms in the south and middle basins of Capitol Lake, with densities ranging from 344 to 3,999 organisms per square meter (0.9 to 74.6 grams per square meter) based on samples collected in June and October of 1975 and again in January 1975. Represented in the sampling results were chironomids, marine polychaetes, amphipods, and ostracods. The mean density for all samples collected was 19.0 grams per square meter and compared favorably with the 17.8 grams per square meter reported by Engstrom-Heg in 1955.

According to Orsborn et al. (**1975**), the data indicate that saltwater flushing resulted in an increase in species diversity in the lake, and no overall decline in the density of bottom-dwelling organisms. This is based on the fact that the bottom-dwelling organisms were almost entirely Chironomid (blood worm) larvae at the time of the Engstrom-Heg survey, 1955, prior to saltwater flushing, while the later survey, which was performed during a year in which saltwater flushing was practiced, included a greater variety of organisms (including some marine organisms).

5.4.1.2 Thurston County Landfill Site

5.4.1.2.1 Plant Life. The proposed sediment stockpile area is surrounded by mature conifer trees on three sides (**figure 7**). However, there is no vegetation on the proposed site, as it has already been cleared and graded for landfill purposes.

A search of the DNR Natural Heritage Information System revealed no records for endangered, threatened, or sensitive plants in the vicinity of the Thurston County Landfill site.

5.4.1.2.2 Animal Life. A review of WDFW's data files (**1995**), indicates that there are no rare or endangered species inhabiting the area. However, a threatened species, the Western gray squirrel, has been sighted within one mile of the landfill site. A state-threatened species is "native to Washington State, that is likely to become endangered in the foreseeable future throughout a significant portion of its range within the state without cooperative management or the removal of threats. Threatened species are legally designated in WAC 232-12-011." (**WDFW 1991**). No other species of concern are known to exist in the area.

5.4.1.2.3 Fish Life. There are no surface water resources in the vicinity and therefore, no fish.

5.4.1.3 Chehalis Western Trailhead Site

5.4.1.3.1 Plant Life. The Chehalis Western Trailhead site is partially forested, partially covered by shrubs such as Scot's broom, and partially barren (**figure 8**). The barren areas are due to the past use of a 5-acre portion of the site as a gravel pit. However, pioneering

cottonwoods and Douglas fir are recolonizing the abandoned gravel pit site. There are no wetlands on the site.

A search of the DNR Natural Heritage Information System revealed no records for endangered, threatened, or sensitive plants in the vicinity of the Chehalis Western Trailhead site.

5.4.1.3.2 Animal Life. A review of WDFW's *Priority Habitats and Species List* (**1995**) was made, and it was determined that there are no known animal species of importance in the area.

5.4.1.3.3 Fish Life. There are no surface water resources in the vicinity and therefore, no fish.

5.4.1.4 Anderson/Ketron Island Disposal Site

Benthic animal life is abundant on the bottom of Puget Sound in the vicinity of the Anderson/Ketron Island Disposal site according to baseline monitoring conducted by PTI Environmental Services (**1989**). Water depth at this site is approximately 600 feet deep. The total abundance of crustaceans, polychaetes, and mollusks ranged from 2,433 to 3,950 organisms per square meter. Crustaceans were most abundant, followed by polychaetes and mollusks. No fish or plant life were observed at the benchmark station and the one transect for which data were collected and analyzed.

5.4.2 Impacts

5.4.2.1 No Action Alternative

5.4.2.1.1 Short Term Impacts. There would be no significant short-term change in environmental conditions in the absence of maintenance dredging activities.

5.4.2.1.2 Long-Term Impacts. Under the No Action Alternative, it has been estimated that the entire middle basin would fill in with sediment over a period of 30 to 85 years, and that the north basin would fill in within 100 years. Eventually the entire lake would be transformed into a riverine wetland with emergent, scrub-shrub and forested wetlands (**figure 15**). Similar wetlands would develop in Percival Cove without maintenance sediment removal. The net effect would be the replacement of open-water habitat with wetland habitat, a shift that would tend to provide enhanced habitat value for birds and mammals, enhanced riparian habitat for fish, but reduced open-water habitat for fish.

Purple loosestrife is known to inhabit riparian areas of the lower Deschutes River and the south and middle basins of Capitol Lake. Therefore, without mitigation, these undesirable plants could infest other areas of the middle and north basins as they are transformed into wetlands, under this alternative. Monitoring and control efforts over the newly formed 270-acre wetland area would be required.

Some habitat changes may enhance habitat for fish, such as the likely increase in shoreline edge effect that would result with the formation of sandbar islands (**figure 15**). However, loss of open-water habitat could result in displacement of WDFW fish feeding operations in the lake. The juvenile salmon rearing capacity of a riverine wetland system could be significantly lower than the existing open-water system and it is not certain that there would be enough remaining physical habitat along the new river reach to support 7 to 8 million juvenile fish. In addition, resident freshwater fish such as cutthroat trout, rainbow trout, largemouth bass, and carp would be displaced. Without maintenance sediment removal operations, Percival Cove would also be filled in and lost as a net pen rearing area.

The evolution of an emergent wetland would increase habitat for waterfowl, herons, and mink, as well as other birds and wildlife that are common to such habitat (e.g. red-winged blackbirds, raccoons, muskrats, etc.).

As lake filling progresses, there likely would be increasing areas of wetlands where water circulation is reduced—leading to increased temperatures, algae growth, and periodic low levels of dissolved oxygen. Acceptable water quality would be expected in and near the main river channels (**figure 15**), but is likely to degrade in the shoreward direction.

5.4.2.2 Impacts Common to All Action Alternatives

The total lake bottom area in sectors 1 and 2, which is proposed for dredging, is estimated at 27 acres, or approximately 10 percent of the entire lake basin. Any aquatic plant life or bottom-dwelling organisms living in the dredge area would be removed with the dredging operation. Post-dredging water depths would be approximately 12 feet in sector 1 and 6–9 feet in sector 2. Existing aquatic plant growth and bottom-dwelling organisms are expected to be largely absent in sector 1 and have a low density in sector 2. Relatively high river currents and high rates of sedimentation preclude significant plant growth and bottom-dwelling organisms in sector 1. Based on previous field observations at the time of lake drawdown, plant growth is also expected to be low in sector 2 for the same reasons.

These impacts would be temporary, because the dredged areas would be recolonized by aquatic plants and bottom-dwelling organisms from the river, south basin, and adjacent habitat. Previous studies by Orsborn et al. (**1975**) also suggest that the practice of saltwater flushing may contribute to recolonization of bottom-dwelling organisms on an annual basis.

Impacts on fish feeding are expected to be small, especially for salmon species, because (1) salmon tend to be surface feeders and (2) the impacted area would contribute only one percent of the total salmon food supply, if both artificial (90 percent) and natural (10 percent) food supplies are considered.

Based on the timing of sediment removal operations (between December 1 and March 1), no significant adverse impacts would be expected to occur to fish or other wildlife within the lake itself. December 1–March 1 is a time when fish migration is at a minimum through

Capitol Lake, and juvenile fish rearing is also limited. No salmon would be expected to be passing through the lake or using the lake during this time frame (**K. Keown, personal communication**). Steelhead and sea-run cutthroat trout would be expected in the lake during this time frame, but would be expected to avoid the area disturbed by the dredging activity (**K. Keown, personal communication**). Potential adverse effects due to turbidity, downstream of the dredging operation, are also considered to be small, because high river flow rates during this time of the year are expected to aid in quickly diluting turbid water to background levels. Therefore, there is little chance that salmon or trout would be adversely affected by the dredging.

Resident fish such as minnows, suckers, carp, and small bass could be sucked into the dredge. However, the likelihood of impact seems small because the majority of these fish are expected to reside in other areas of the lake where currents are lower and where aquatic plants are more abundant, and because the area proposed for dredging (27 acres) is small.

Open-water and shoreline habitat would remain similar to present day conditions over the next five years. This would be accomplished by performing sediment removal operations in dredging sectors 1 and 2 and by preserving shoreline habitat with the proposed shoreline buffer zone (**figure 2**).

No adverse impacts would be expected to occur to the bald eagles which are observed occasionally in the south basin. This is because these birds seem to be used to the high level of activity in and around the I-5 freeway and Tumwater Historical Park (**J. Michaels, personal communication**). Also, the dredging operation would be located on the north side of the I-5 bridge, and would be separated from the area where the eagles are normally observed by the freeway.

5.4.2.3 Gravity Dewatering

5.4.2.3.1 Capitol Lake. Periodic dewatering and sediment handling operations behind the dike in the middle basin's southwest corner, would eliminate up to 3.7 acres of wetlands south of the timber footbridge in the dewatering construction area (**figure 2**) and would disturb the site once or twice during the five-year project period. There would be no direct impacts to wetlands north of the timber footbridge after clearing the channel between the two areas. Based on the two previous sediment removal operations, it is highly likely that wetland vegetation would naturally recolonize this area following each sediment removal episode. Secondary impacts could occur in the settling pond/wetland north of the footbridge due to the discharge of treated return flows to this area. Depending on the size of the dredge and rate of dredging, water levels could be raised during the December 1 to March 1 period and could affect survival of plant species living on the margin of the wetland. In addition, fine sediments that would settle out in this wetland could cover over bottom-dwelling organisms and/or amphibian eggs, if any have been laid at this time of year.

Also, during construction there would be heavy equipment and truck traffic in the southern portion of the wetland behind the dike, that could disturb birds and other wildlife in the adjacent wetland area, north of the footbridge.

Breeding pairs of pileated woodpeckers and green-backed herons would have migrated out of the area by this time and would not return until about April. Also, since mink activity would be primarily restricted to shoreline areas where dredging would be avoided, no significant impacts to mink are anticipated.

In the absence of mitigation, purple loosestrife could infest the area in the vicinity of the dewatering site in the southwest corner of Capitol Lake's middle basin.

5.4.2.3.2 Thurston County Landfill Site. No impacts on vegetation or wildlife would be expected, since the proposed disposal site has already been cleared and graded. It is anticipated that purple loosestrife would not be a major concern at the Thurston County Landfill site, since sediment would be used as landfill liner and would be covered indefinitely. Thus, transported sediment may only be exposed to conditions suitable for seed germination for a short period of time after they are delivered to the site and prior to construction of the landfill liner.

5.4.2.3.3 Chehalis Western Trailhead Site. Approximately five acres of pioneering trees and shrub habitat, and associated bird and animal life, would be lost in preparing the site for disposal of lake sediments. Once filled with lake sediments, the site would be graded and landscaped for park use. Some wildlife habitat use of the site may be likely.

It is anticipated that purple loosestrife control would not be a major concern at the Chehalis Western Trailhead site because most lake sediments would remain covered indefinitely. Those sediments at the surface of the fill likely would be hydroseeded and/or landscaped as upland park areas. Therefore, the preferred wetland habitat for purple loosestrife would not be present. In addition, the site would be managed by the Thurston County Department of Parks and Recreation, and the Department's existing Integrated Pest Management (IPM) Plan would be implemented at the site (**Thurston County Department of Parks and Recreation 1995**). Under the provisions of the IPM, sites are monitored weekly for noxious weeds. Any weeds discovered are "hand pulled and properly disposed of to prevent the spread of seeds."

5.4.2.4 Mechanical Dewatering

The main difference between this alternative and the Gravity Dewatering Alternative, is that there would be no direct impacts to the wetlands behind the dike in the southwest corner of Capitol Lake's middle basin with the Mechanical Dewatering Alternative. Since there would be no excavation work there would be no removal of the 3.7 acres of wetlands within the construction dewatering facility. Secondary impacts on wetlands, bottom-dwelling organisms, and amphibians would be similar to those described under the Gravity Dewatering Alternative.

The impacts of this alternative on upland disposal sites, both positive and negative, would also be the same as those addressed for the Gravity Dewatering Alternative above.

5.4.2.5 Marine Disposal

No significant adverse impacts are expected in Budd Inlet in the vicinity of barge loading, nor in the vicinity of the Anderson/Ketron Island disposal zone where sediment disposal is planned. Bottom-dwelling organisms would be covered with a new layer of non-toxic sediment, but this has been recognized as an acceptable impact under *PSDDA Reports - Final Environmental Impact Statement for Unconfined Open-Water Dredge Disposal for Dredged Material, Phase II* (**U.S. Army Corps of Engineers et al. 1989**). Recolonization is expected, since the disposed sediments seem to be very similar to sediments found at the deep, open-water disposal site, and no contaminants were found during PSDDA testing of the sediments. The Corps and/or DNR would monitor the bottom sediments at the Anderson/Ketron Island site to confirm sediment quality after deposition.

The Washington Department of Agriculture (DOA) has raised a concern regarding the disposal of Capitol Lake sediments in Puget Sound, based on the possibility that purple loosestrife seeds contained in the sediment might float to area estuaries and establish new colonies of this noxious wetland plant (**K. D. Dolstad, personal communication**). This concern is based in part on observations made by WDFW personnel (**M. Genrich, personal communication**) that purple loosestrife has been observed growing in an estuarine environment near the mouth of the Skagit River. This observation may indicate that purple loosestrife can grow in estuarine wetlands, and not just freshwater wetlands.

The DGA recognizes the importance of the role that DOA has in managing purple loosestrife to limit additional colonization, and is committed to working cooperatively with DOA to implement the dredging project in such a manner as to comply with DOA requirements. However, DGA believes that the risk of colonization of area estuaries, due to the disposal of Capitol Lake sediments at Anderson/Ketron Island is very low. The DGA believes that there is little likelihood that purple loosestrife seeds would be present in the sediments in sectors 1 and 2, because this is an area of relatively high current just downstream of the I-5 channel constriction.

It seems much more likely that floating seeds would be deposited along the shorelines of Capitol Lake or Budd Inlet rather than in the deep water sediments in Sectors 1 (water depths 7-12 feet) and 2 (water depths 4 to 6 feet). Although purple loosestrife has been observed at various locations along the shorelines of Capitol Lake, DGA has been informed by the Thurston County Noxious Weed Control Agency that there are no known colonies of purple loosestrife along the shorelines of Budd Inlet (**R. Johnson, personal communication**). Colonization along other marine shorelines seems unlikely.

Dredging in sectors 1 and 2 would not involve any areas where purple loosestrife plants would be growing. All dredging would occur at distances of 100 to 300 feet away from shoreline areas where purple loosestrife might possibly grow.

If any purple loosestrife seeds did settle out in sectors 1 and 2, it seems that they would have attained sufficient specific gravity to settle out in marine waters along with the sediments in which they may be deposited. For the reasons listed above, it seems there would be little risk of purple loosestrife colonization of area estuaries in conjunction with deep, open-water marine disposal at the Anderson/Ketron Island site.

There would be only two barge hauls per day with this alternative, and this would be consistent with normal marine traffic in Budd Inlet and along the route to the Anderson/Ketron Island site. No over-filling of the barge would be permitted and barge seals would be inspected and repaired if necessary prior to the excavation process, so there would be no impacts to marine aquatic life in the water column aside from temporary turbidity impacts within the approved disposal zone.

Although the great egret has been observed in the Budd Inlet area in past years, the project should have no impact on this bird species, since the sediment removal operations would take place during winter months after the egret has flown south for the winter.

5.4.3 Mitigation

5.4.3.1 No Action Alternative

If the lake is allowed to fill, and insufficient habitat remains for rearing of juvenile salmon, it may be feasible to release juvenile salmon from the hatchery program elsewhere in the river upstream of Tumwater Falls. In addition, a practice of raising and lowering (bumping) the lake with saltwater or freshwater could be employed to mitigate backwater stagnation and poor water quality impacts on fish, and to minimize stranding of fish in backwater areas.

Purple loosestrife monitoring and control would be necessary over the entire 270-acre wetland area, once the entire lake was filled and emerged as a wetland.

5.4.3.2 Gravity Dewatering Alternative

Under this alternative, mitigation of wetland impacts behind the dike could be accomplished by creating additional emergent marsh wetland habitat (this would be an enhancement activity) on the lake side of the dike. Based on initial discussions with Ecology, a minimum of one acre of enhancement wetlands would be required for each acre of wetland removed with the dewatering operation. This kind of enhancement habitat could also mitigate for temporary loss of amphibians and/or bottom-dwelling organisms within existing wetlands. Additional riparian wetland mitigation may also be considered, as described below.

Soil material for in-lake enhancement of wetlands could come from sediment removal operations. With the proper elevation of deposited soils on the lake side of the dike, there may be no need for wetland vegetation planting. Wetland plants would likely colonize the

area voluntarily, as they have done in the wetland area behind the dike following two previous sediment removal operations. However, it may be desirable to plant the proposed wetland enhancement area to avoid problems with colonization by undesirable species like reed canary grass, purple loosestrife, or other similar invasive plants tending to produce monocultural plant communities.

Another mitigation element would involve DGA participation in riparian improvements specified in the Deschutes Riparian Habitat Rehabilitation Plan (**City of Tumwater 1993**). The amount of riparian mitigation work would have to be determined cooperatively by DGA, the City of Tumwater, and Ecology. Mitigation work would involve enhancement of riparian habitat, functions, and values, and would likely contribute to some reduction in streambank erosion and sediment loading to Capitol Lake.

Another mitigation measure would be to construct a new dike that would preserve approximately 1.5 to 2.0 of the 3.7 acres of wetlands on the south side of the timber footbridge. Materials for dike construction would probably come from existing sediment deposits behind the dike (they could be used for dike construction as opposed to hauling in materials from off-site locations). This would minimize the number of acres of wetlands impacted and also would reduce the amount of enhancement and/or riparian mitigation required.

Mitigation of water level impacts on existing wetlands could be mitigated by redesign and reconstruction of the existing outlet structure to limit vertical water level fluctuations.

Another mitigation approach might involve some combination of the above. For all but the riparian habitat enhancement work, the dredged sediments could be used as wetland soils or for dike construction. This may make the mitigation costs for the project more acceptable.

A wetland enhancement and riparian restoration planting and monitoring plan would be prepared by DGA for approval by the City of Tumwater and Ecology prior to sediment removal. Measures necessary to monitor and control purple loosestrife at the dewatering site and at the upland disposal sites would be included (see **Appendix D**, Purple Loosestrife Management Plan). At the Chehalis Western Trailhead site, mitigation could involve retaining a native vegetated buffer around the gravel pit area perimeter, as a means of buffering adjacent birds and wildlife from earthwork activities at the site. In addition, park designers could give consideration to using landscape species most suitable for bird and wildlife habitat, to the degree compatible with proposed park uses.

5.4.3.3 Mechanical Dewatering Alternative

Under this alternative, the wetlands behind the dike in Capitol Lake's southwest corner would not be disturbed, and therefore no mitigation would be required for wetlands. Mitigation for water level impacts within the wetlands would be provided by proper design, construction, and operation of the outlet to limit vertical water level fluctuations. Mitigation at upland disposal sites would be the same as those described for the Gravity Dewatering Alternative.

5.4.3.4 Marine Disposal Alternative

Post-disposal monitoring of the Anderson/Ketron disposal site is the only mitigation that would be required under this alternative. See section 5.1.3.5 for further explanation of decisions that could be made depending on the outcome of post-disposal monitoring.

5.5 ENVIRONMENTAL HEALTH

Refer to the Water Resources Section.

5.6 LAND AND RECREATIONAL USES

5.6.1 Affected Environment

5.6.1.1 Capitol Lake

The immediate Capitol Lake shoreline is primarily open space, trails, and park lands. Capitol Lake Park is on the northeastern shores of the north basin; Marathon Park is on the southwest shore of the north basin; the Capitol Lake Interpretive Center is in the middle basin's southwest corner; and Tumwater Historical Park is on the western shore of the south basin. Recreational fishing occurs throughout the lake. Other recreational uses include jogging, walking, or bicycling along the lake shore; sight-seeing (afforded by open-water vistas); bird-watching; boating; canoeing; fish-watching (at the fish ladders and traps); and Lake Fair (an annual, week-long, community event).

In addition, Capitol Lake also provides an aesthetic component of land use value in Olympia and Tumwater, not only as the reflecting pool for the Capitol Buildings, but also as an important view component of residential and commercial land uses surrounding the lake.

Marathon Park and the Capitol Lake Interpretive Center are owned by the State and are operated and maintained by DGA. The Capitol Lake Interpretive Center has two fishing/observation piers, and fishing also is possible off the footbridge that crosses the constriction between the north and middle basins near Marathon Park.

Tumwater Historical Park is partly on state land leased to the City of Tumwater and partly on property donated to the City by the Olympia Brewery. There is a boat launch for fishing boats at the north end of Tumwater Historical Park near the I-5 freeway. The north basin of Capitol Lake, most of the middle basin (the portion north of the Capitol Lake Interpretive Center), and the eastern half of the lake's south basin are within the city of Olympia, while the remainder of the middle and south basins are within the city of Tumwater.

The City of Olympia and DGA have both been working to develop a proposed new Heritage Park, which would provide a park environment for the entire area between the existing Capitol grounds (east side of the north end of the middle basin) and the existing

Capitol Lake Park on the northeast shore of the north basin (**Jones and Jones 1986, The Portico Group and the SWA Group 1994**). Construction of the park may begin in 1997.

Existing trails follow the entire length of the lake's west side, running from Tumwater Historical Park to the Capitol Lake Interpretive Center, then north along the western side of the Deschutes Parkway, on to Marathon Park, and around the lake's north end. The City of Olympia proposes a Class II bicycle path along this route. This new path would connect to other east-west bicycle routes along 4th and 5th avenues. A system of sidewalks and trails also bounds the entire north basin of Capitol Lake and loops back across the lake adjacent to the railroad right-of-way (the railroad track forms the constriction separating the lake's north and middle basins) to Marathon Park. The existing rail corridors in the lake's vicinity are identified by the City of Olympia as future urban trails (**City of Olympia 1994**).

Steep, wooded slopes bound the entire west side of the lake basin between the Deschutes Parkway and the developed lands at the top of the bluff. Steep, wooded slopes also adjoin the southeast portion of the north basin, and the eastern margins of the middle and south basins. Developed lands around the north basin are primarily commercial on the east side and a mixture of commercial and residential on the west side. Existing land uses up slope of the middle basin include the Capitol grounds and residential uses on the east, and the Thurston County courthouse complex, motel, office, and residential uses on the west. In the south basin, existing land uses include residential and commercial on the east and residential and park use on the west.

Just north of Capitol Lake, along the shores of Budd Inlet, there are various land uses. Land uses on the east side of the inlet include Percival Landing (a waterfront park), commercial and office buildings, a marina (Olympia Yacht Club), and industrial uses associated with the Port of Olympia (northern half of the eastern shore). Land uses to the west are primarily residential, but also include office, commercial, and industrial.

The City of Olympia future land use designations are generally consistent with existing land use and land use trends in the vicinity of Capitol Lake (**City of Olympia 1994**). However, the future, high density, multifamily land use designation for the southeast side of the north basin potentially seems to be in conflict with the proposed Heritage Park.

Among future land uses designated in the Tumwater Land Use Plan (**City of Tumwater 1994**) is the Shoreline Environment - Deschutes River Special Area River Management Plan which includes the New Market Historic District (surrounding the south basin on the south-east and southwest sides), and a park/open space designation for the Capitol Lake Interpretive Center. These designated future uses are consistent with existing land uses and trends.

5.6.1.2 Thurston County Landfill Site

The Thurston County Landfill (**figure 7**) is bounded by a gravel pit and the I-5 freeway to the south, by undeveloped forest lands to the east and north, and by Marvin Road and undeveloped forest lands to the west. There are also industrial and office park

developments to the north of the landfill, but they are presently separated from the landfill by a substantial forested buffer (**figure 7**).

The Thurston County Landfill site has a future industrial land use designation, and is consistently zoned for light industrial land use. There are no recreational uses at or near the landfill site.

5.6.1.3 Chehalis Western Trailhead Site

The trailhead site covers approximately 20 acres and is bounded by 89th Avenue SE on its southern border. The Chehalis Western Trail (presently undeveloped) runs north-south through the middle of the site. Undeveloped forest lands bound the site on the east side. The remainder of the site is bounded by undeveloped and rural lands, including farms to the north, south, and west (**figure 8**).

Improvements to the Chehalis Western Trail are expected to begin in 1996. In the vicinity of the Trailhead the Rural Trail width will be 22.5 feet. The trail will be comprised of one 2-foot shoulder; two 5-foot bicycle/pedestrian lanes; one 4-foot runner's lane, one 3-foot (or wider) vegetated buffer, and one 3.5-foot equestrian trail (**Thurston County Parks and Recreation Department 1994**). The buffer and equestrian trail will be located on the east side of the trail, on the same side as the proposed disposal site in the abandoned gravel pit.

Both future land use and zoning are the same for this area—the site is designated rural residential, with one unit per two acres (**Thurston County Advance Planning and Historic Preservation 1995 and Thurston County Advance Planning and Historic Preservation and Thurston Geodata Center 1995**). Given the rural residential zoning, the Thurston County Department of Parks and Recreation may have to obtain a Special Use permit for the proposed Chehalis Western Trailhead park.

5.6.2 Impacts

5.6.2.1 No Action Alternative

5.6.2.1.1 Short-term Impacts. There would be no significant adverse impacts to land uses or recreation in the absence of dredging during the five-year maintenance period.

5.6.2.1.2 Long-term Impacts. A significant impact of the No Action Alternative would occur with the predictable loss of 270 acres of open water and its subsequent replacement by riparian wetlands. Eventually (over a period of 30 to 85 years for the middle basin and 100 years for the north basin), if the entire lake was allowed to fill with sediment, the open-water lake vistas—visible from many vantage points in the area—would be lost. The lake would then no longer serve as a reflecting pool for the Capitol Buildings, and existing residential and commercial view properties would lose their lake views. Loss of open-water vistas would also detract significantly from the proposed Heritage Park. Lake views would be

replaced by views of emergent, scrub-shrub, and forested wetlands. Replacement of open-water views with wetland views may have an adverse impact on the value of those properties with existing lake views. **Figure 22** compares an existing view of Capitol Lake's south basin with an existing view of the middle basin. The south basin has been allowed to fill in and has become an emergent, scrub-shrub, and forested wetland. Note that filling is not complete in the south basin and that some open-water habitat remains under existing conditions. As filling progresses in coming years, it is expected that the entire south basin, with the exception of the main river channel, will be occupied by wetland vegetation similar to that shown in the South Basin photograph (**figure 22**). Similar wetland vegetation would be expected to occur in the middle basin without maintenance dredging.

The No Action Alternative also would reduce open-water recreational opportunities like boating, pier and boat fishing, and sight-seeing. Scenic open-water vistas—presently available at the Capitol Lake Interpretive Center, Marathon Park, Capitol Lake Park, and along existing lakeside trails—would be lost. With wetlands replacing open-water areas, it is likely that formerly unrestricted views would be blocked by wetland vegetation such as willow, black cottonwood, alder, or shrubs like blackberry and hardhack. Such view blockages could detract from the outdoor experience that many lakeside park and trail users presently enjoy and could lead to conditions favoring increased criminal activity and reduced pedestrian security and safety. However, walking, jogging, and bicycling would still be possible on existing trails.

A potential benefit of the No Action Alternative, is that bird and wildlife watching opportunities would increase with the increase in area wetlands.

5.6.2.2 Gravity Dewatering Alternative

5.6.2.2.1 Capitol Lake. There would be temporary displacement of up to 3.7 acres of wetlands at the Capitol Lake Interpretive Center with this alternative. This would not be considered a significant change in land use in the sense that the same area has been designated for such use and has been used as a gravity dewatering facility on one occasion in the past (1986). The Capitol Lake Interpretive Center is designated as Greenbelt under the City of Tumwater zoning code, and the City has indicated that future use for dewatering would be considered consistent with the Greenbelt zone, "as long as the proposed use is consistent with community needs, provided there is appropriate opportunity for public review and comment." (**C. Carlson, personal communication**).

Summer and fall (July–October) recreational uses in the middle basin would be temporarily affected during excavation and hauling of sediment at the gravity dewatering facility. These potential impacts have been partially mitigated by past construction of berms between the dewatering area and the recreational trail that traverses the top of the dike. These berms obscure visibility into the dewatering construction area and reduce equipment noise associated with excavation and truck hauling. However, excavation activities would be visible and audible to people crossing the small wooden footbridge and to traffic on SR 101 and I-5 in the vicinity of the dewatering area.

Open Water Vista - Middle Basin

Wetland Vista - South Basin

92007-61-895 SEIS (1/16/96) AGT

Capitol Lake SEIS

Figure 22
Comparison of Views in the
Middle Basin and the South Basin

During winter (December 1 to March 1), trail users would see and hear the dredging equipment on the lake and disposal and dewatering operations behind the dike. As with the earth-work activities in the summer/fall period, the discharge and dewatering of the dredge slurry would be largely out of sight for people using the main trail, but visible to people crossing the wooden footbridge.

5.6.2.2.2 ***Thurston County Landfill Site.*** There would be no significant adverse land use or recreational impacts associated with stockpiling and using sediments at the Thurston County Landfill, since this use would be consistent with the activities already approved at the landfill. This use also would be consistent with the site's light industrial zoning.

5.6.2.2.3 ***Chehalis Western Trailhead Site.*** This site is designated Residential (one unit per 2 acres) under the Thurston County Comprehensive Plan, and has the same zoning. The site's proposed park use may require a Special Use Permit under the County Zoning Ordinance (**Thurston County 1994**).

Using sediment to fill the site's abandoned gravel pit would be compatible with construction of site improvements for future park use. It would also be consistent with Thurston County's policy of reclaiming abandoned gravel pits, with the goal of reducing the risk of future groundwater contamination.

The use of trucks and earth-moving equipment at the gravel pit site could interfere with optimal enjoyment of the Chehalis Western Trailhead, since disposal operations could extend beyond the time of initial construction. This assumes that 60,000 cubic yards would be delivered to the site in 1996, and that another 60,000 cubic yards could be delivered sometime within the subsequent five-year period. Trail users would be able to see and hear trucks and earth-moving equipment at the site during the second cycle. Local rural residents would also be temporarily affected. Dredge material handling and disposal at the site would last approximately 60 to 90 days during each dredge cycle.

5.6.2.3 Mechanical Dewatering

5.6.2.3.1 ***Capitol Lake.*** Mechanical dewatering activity would occur at the Capitol Lake Interpretive Center during each dredging cycle, with sediment removal and trucking activities occurring December 1 through March 1. The impact would be less noticeable than with the Gravity Dewatering Alternative, because all activity would occur during winter when there is less frequent use of trails around the lake. Summer trail users would notice no significant change from existing conditions because the wetland area south of the wooden footbridge would not be disturbed by excavation activities, and all mechanical dewatering equipment would be removed at the end of each dewatering operation.

Winter trail users would notice the dredge operating in the middle of the lake, and boaters would have to navigate around the barge and barge-to-shore pipeline, but this would not be considered a significant impact to recreational use due to the time of year and relatively short duration of operation.

5.6.2.3.2 Upland Disposal Sites. Impacts would be the same as those for the Gravity Dewatering Alternative discussed in sections 5.6.2.2.2 and 5.6.2.2.3.

5.6.2.4 Marine Disposal Alternative

There would be no changes in land use with this alternative. Recreational trail users around Capitol Lake would observe the dredge and pipeline from December 1 to March 1, and boaters in Capitol Lake would have to navigate around the dredge pipeline, but these would not be considered significant impacts due to the time of year and relatively short duration of the operation.

A booster pump (similar to the dredge) and one or two marine barges would be temporarily located at the Port of Olympia dock as shown in **figure 13,** from December 1 to March 1 of each dredging cycle. At this location, the equipment would be visible to people using the Percival Landing boardwalk, but would be relatively far away and would probably not represent a significant change in noise over existing traffic noise. The dredge slurry pipeline would be routed under water on the bottom of Budd Inlet between the 5th Avenue dam and the Port dock so as to avoid any interference with recreational boat traffic except during the time of installation and recovery.

5.6.3 Mitigation

5.6.3.1 No Action Alternative

5.6.3.1.1 Short-term Mitigation. There would be no need for mitigation during the five-year planning period if dredging was not performed.

5.6.3.1.2 Long-term Mitigation. The only potential mitigation for loss of open-water views and recreational viewing, boating, and fishing would be to limit lake filling to the middle basin and resume maintenance sediment removal operations prior to the filling of the north basin. This would (1) mitigate potential impacts to Heritage Park, (2) preserve the north basin as a reflecting pool for the Capitol Buildings, and (3) retain the north basin open-water area for fishing, boating, and other open-water recreational activities. This also would mitigate adverse impacts to other park, recreational, and view properties as compared to the complete filling of the lake as under the No Action Alternative. Additional boardwalk trails could be constructed through the middle basin's new wetlands to enhance their recreational and educational value. Mitigation for reduced pedestrian/trail safety caused by additional wetland vegetation could involve more frequent patrols along the trails by police.

5.6.3.2 Gravity Dewatering Alternative

Additional earth berm construction and landscaping could be provided at the Capitol Lake Interpretive Center to further isolate recreational trail users from excavation/filling

operations. New and expanded educational displays also could be provided to inform trail users as to dewatering facility's purpose and how the wetland responds to cycles of disturbance and recovery.

At the Chehalis Western Trailhead site, retaining a vegetated buffer, building earth berms, and/or providing landscape improvements could obscure disposal operations from recreational trail users and neighboring property owners.

No mitigation would be proposed for the Thurston County Landfill.

5.6.3.3 Mechanical Dewatering Alternative

No mitigation would be proposed for this alternative in the vicinity of Capitol Lake. Mitigation at the Chehalis Western Trailhead site would be the same as for the Gravity Dewatering Alternative above. No mitigation would be proposed for the Thurston County Landfill.

5.6.3.4 Marine Disposal

The plan to keep the dredge slurry line on the bottom of Budd Inlet, and to locate booster pump and barge loading activities in the industrial area at the Port of Olympia is considered mitigation. This approach would eliminate the impacts to recreational boating traffic that would otherwise occur if the dredge slurry line was floated across Budd Inlet, and also would reduce the noise impact to users of Percival Landing and the Olympia Yacht Club Marina if the booster pump and barges were located closer to Capitol Lake. No other mitigation is deemed necessary with this alternative.

5.7 SHORELINE USE AND CRITICAL AREAS

5.7.1 Affected Environment

5.7.1.1 Capitol Lake

5.7.1.1.1 Shoreline Use. The entire shoreline of Capitol Lake and Percival Cove is designated as a Conservancy environment under the Shoreline Master Program (SM.) for the Thurston Region (**Thurston Regional Planning Council 1990**), except for the portion of the north basin of Capitol Lake from the tide gate east to a point opposite 8th Avenue SE (approximately midway down the east shore), which is designated urban. Budd Inlet, north of Capitol Lake, also is designated as an urban environment.

Dredging is a permitted activity under the SMP, if the specific provisions of the SMP are followed. One purpose of this SEIS is to demonstrate compliance with the SMP for both removal and disposal of lake sediments. Important provisions have been selected from the

SMP and are presented below. The reader is referred to the SMP for the complete text relative to goals, policies, and regulations.

Section Two -- General Goals and Policies

I. GOAL - "The goal of this Master Program is to preserve to the fullest extent the scenic, aesthetic, and ecological qualities of the Shorelines of the Thurston Region in harmony with those uses which are deemed essential to the life and well-being of its citizens."

II. PURPOSE - "The local governments of Thurston County recognize that the Shorelines of the State and the Region are among the most valuable and fragile of our natural resources. There is great concern regarding their utilization, protection, restoration, and preservation . . . There is, therefore, a clear and urgent demand for a planned, rational, and concerted effort, jointly performed by federal, state, and local governments, to prevent the inherent harm in an uncoordinated and piecemeal development of the Shorelines of the State and Region."

V. REGIONAL CRITERIA

G. "Shorelines of this Region which are notable for their aesthetic, scenic, historic, or ecological qualities shall be preserved. Any private or public development which would degrade such shoreline qualities shall be discouraged. Inappropriate shoreline uses and poor quality shoreline conditions shall be eliminated when a new shoreline development or activity is authorized."

VII. SHORELINE ENVIRONMENTS

B. CONSERVANCY ENVIRONMENT

Purpose. The intent of a Conservancy Environment designation is to protect, conserve and manage existing resources and valuable historic and cultural areas in order to ensure a continuous flow of recreational benefits to the public and to achieve sustained resource utilization. The preferred uses are nonconsumptive of the physical and biological resources of the area and uses of a nonpermanent nature which do not substantially degrade the existing character of the areas. Nonconsumptive uses are those use which utilize resources on a sustained yield basis while minimally reducing opportunities for other future uses of the resources of the area.

Definition. The Conservancy Environment designates shoreline areas for the protection, conservation, and management of existing valuable natural resources and historic and cultural areas. This environment is characterized by low-intensity land use and moderate-intensity water use with moderate to little visual evidence of permanent structures and occupancy.

Goal Statements

4. Recreation. Recreational opportunities are to be preserved and expanded through programs of development (public and private), and various means of public acquisition, such as purchase, leased easements, and donations. The intensity of the recreational use will be limited by the capacity of the environment to sustain it.

5. Shoreline Use. A goal is to locate structures and uses in such a position that they are not highly visible from the water.

6. Conservation. The goal of this element is to protect, conserve, and manage existing natural resources and valuable historical and cultural areas in order to ensure a continuous flow of recreational benefits to the public, and to achieve sustained resource utilization.

7. Historical and Cultural Values. This goal shall be to promote, protect, and preserve historical, cultural, scientific, or educational values on shorelines where these values are acknowledged.

8. Restoration. The goal of this element is to restore to a useful or original condition those areas (including waters which are blighted by present uses) and dilapidated or abandoned structures.

VI.B.1. "Dredging should be conducted in such a manner as to minimize damage to natural systems in both the area to be dredged and the area for deposit of dredged materials."

VI.B.3. "Deposition of dredged material in water areas should be allowed for habitat improvement, to correct problems of material distribution adversely affecting aquatic populations, or when a site has been approved by the Interagency Open Water Disposal Site Evaluation Committee (WAC 332-30-166)."

VI.C.1 through VI.C.7. of General Regulations:

1. *All applications for dredging require:*

   a. *Location and quantity of material to be removed.*

   b. *Method of removal.*

   c. *Location of spoil disposal sites and environmental mitigation measures.*

2. *Plans for protection and restoration of wetland environments affected.*

3. *Toxic leachates, if any, cannot reach shorelines or associated wetlands.*

4. There may be a requirement to provide dikes that would allow sediments to settle prior to discharge from the diked area. Also dikes are to be protected from erosion.

5. No permit shall be issued for dredging unless it has been shown that the material to be dredged will not exceed the Environmental Protection Agency (EPA) and/or Department of Ecology criteria for toxic sediments.

6. Dredging for the sole purpose of obtaining fill material is prohibited.

7. Permits will be granted only if the project is consistent with zoning and/or land use designation.

8. Dredged materials can only be deposited in water if they improve habitat, are approved under WAC 330-30-166, or will increase public recreational benefits.

VI.D. Environmental Designations and Regulations:

1. Urban, Suburban, Rural, and Conservancy Environments. The following dredging activities are allowed:

a. Deepening navigational channels

b. Improving water quality

c. Burying public utilities

d. Increasing recreation benefits

e. Maintaining water flow

f. Allowing an activity permitted by this Master Program.

5.7.1.1.2 Critical Areas. The gravity dewatering site is regulated by the Wetlands Protection Ordinance (1278) and associated provisions of the City of Tumwater Conservation Plan (CTCP) (**City of Tumwater 1991**).

The CTCP specifies a short-term goal of no net loss of wetlands, and a long-term goal of increasing the quantity and quality of wetlands. It includes a wetland protection policy of attempting to avoid or reduce the area of wetland impacts if practicable, and to compensate for losses where avoidance or reduction of impacts are not practicable. Wetland buffer zones are also specified and vary from 25 feet to 300 feet from the edge of the wetland depending on wetland classification (Class I most valuable, to Class IV least valuable) and intensity of land use (low or high) with larger buffers for wetlands adjacent to high-intensity land uses. The CTCP also provides criteria regarding replacement ratios for impacted wetlands. These ratios vary from 1.25 acres to 6 acres of replacement wetland for every acre of impacted wetland, depending on the wetland classification.

The City ordinance classifies wetlands in descending order of importance and value from Class I to Class IV. Proper classification of any impacted wetlands is important, because the degree or amount (in acres) of wetland mitigation is related to the value of the wetland impacted.

It is noteworthy that the **City of Olympia Comprehensive Plan (1994)** has designated the steep wooded slopes surrounding Percival Creek, Percival Cove, and the western shore of Capitol Lake's north basin as a Medium Significant Wildlife Habitat Unit. This includes Percival Creek, Percival Cove, and a small area extending into Capitol Lake's middle basin (see **Appendix G**). The City also shows the Capitol Lake Interpretive Center and portions of the north basin's northeastern shore, in the vicinity of Water Street, as part of the floodplain. This is consistent with the FEMA floodplain mapping (**Appendix F**). In addition, all of the steep slope areas previously discussed are described as having slope instability and severe soil limitations for roads and buildings. Wetlands are designated along much of the middle basin's western shore, a portion of the land north of the railroad and west of the Deschutes Parkway (north basin's southwest side), along portions of the middle basin's east side, and throughout the south basin (**City of Olympia 1994**).

5.7.1.2 Thurston County Landfill and Chehalis Western Trailhead Sites

5.7.1.2.1 Shoreline Use. There are no shorelines at these sites.

5.7.1.2.2 Critical Areas. The Thurston County Critical Areas Ordinance (Chapter 17.15 - **Thurston County Advance Planning and Historic Preservation 1994**) includes provisions pertaining to "Aquifer Recharge Areas" (Part 500), "Geologic Hazard Areas" (Part 600), "Important Habitats and Species" (Part 700), "Special Management Areas" (Part 800), and "Floodplains, Streams and Wetlands" (Part 900).

Only the Aquifer Recharge Areas and Special Management Areas portions of the ordinance apply. The Thurston County Landfill site and Chehalis Western Trailhead site have no geologic hazards, important habitats and species, floodplains, streams, or wetlands.

The purpose of the Aquifer Recharge Areas is to maintain groundwater recharge and prevent groundwater quality impacts. Since the vicinity of both the Thurston County landfill and trailhead sites are considered "Extremely Susceptible" to groundwater impacts, special care is needed to protect groundwater resources. The ordinance specifies that, "stormwater impacts shall be mitigated through the application of the standards contained within the *Drainage Design and Erosion Control Manual for the Thurston Region* (**Thurston County 1991**) and the *Northern Thurston County Groundwater Management Plan* (**Thurston County Health Department 1992**). In addition, the health officer is to consider the impact of the project on groundwater quantity. The ordinance has a special section on sites used for mining gravel, and indicates that, "The protection of groundwater shall be given the highest priority in the approval of land uses after cessation of use as a gravel mine." The ordinance requires preparation of a Drainage and Erosion Control Plan and Hydrogeological Report. A performance monitoring program may be required at the discretion of the health officer.

The only Special Management Areas issue that may affect the landfill and trailhead sites, is the Noxious Weed Containment Areas. Under the ordinance, a noxious weed containment area boundary is established for purple loosestrife and adjusted annually, if needed, with the yearly adoption of the *Pest and Vegetation Management Policy* (**Thurston County 1993**). Although there is no known purple loosestrife at either upland site now, this plan may be amended to include the upland disposal sites, if there is sufficient concern about post-disposal purple loosestrife control. Other noxious weeds of special concern under the ordinance include gorse and Italian and slender thistle; however, these are not known to occur in the vicinity of either the landfill or trailhead sites.

Other specific requirements of the Special Management Areas are:

- review of the County grading permit by the TCNWCA
- addition of a noxious weed eradication goal as a condition of permit approval
- prohibition of removal of noxious weeds from a Noxious Weed Containment Area
- thorough cleaning of equipment upon entering and leaving a containment area
- specification of disposal of noxious weeds (an approved method is double bagging and disposal at the Thurston County Landfill)

5.7.1.4 Anderson/Ketron Islands

5.7.1.4.1 Shoreline Use. The shorelines of Anderson and Ketron Islands are designated conservancy under the Pierce County SMP (**Pierce County 1974**). These are also shorelines of statewide significance requiring the following to be considered in order of importance:

1. Recognize and protect the statewide interest over local interest.
2. Preserve the natural character of the shoreline.
3. Plan for long-term over short-term benefit.
4. Protect the resources and ecology of shorelines.
5. Increase public access to publicly owned areas of the shorelines.
6. Increase recreational opportunities for the public on the shorelines.

The DNR has an active shoreline permit authority for disposal of dredged material at the Anderson/Ketron Island deep, open-water marine disposal site (**T. Benson, personal communication**). Assuming that all other permits and approvals could be obtained, disposal would be allowed under the existing permit.

5.7.1.4.2 Critical Areas. Aside from those critical areas already described for Capitol Lake, there are no critical areas associated with the Marine Disposal Alternative.

5.7.2 Impacts/Compliance

5.7.2.1 No Action Alternative

5.7.2.1.1 Shoreline Use. Capitol Lake is a water of the State. Under the Shoreline Management Act it is defined and protected as a lake. It is also historically significant because it was "created" as a reflecting pool in response to the vision of the architects Wilder and White who developed the original Capitol Campus plan in 1911. It seems appropriate to suggest that Capitol Lake is a unique lake resource and one that is highly prized for its scenic, aesthetic, historic, and biological importance. The goals and policies of the SMP for the Thurston Region make it clear that such resources are to be preserved, protected, restored, conserved, managed, and utilized for their scenic, aesthetic, historic, cultural, recreational, and ecological qualities.

If maintenance dredging is not performed, Capitol Lake and its associated scenic, aesthetic, historic, cultural, recreational, and ecological values would be lost. Scenic open-water vistas would largely be replaced by thick wetland vegetation. This would have an adverse impact on the existing aesthetic quality of lake shoreline park and trail environments, including those of the Capitol Lake Interpretive Center, Marathon Park, Capitol Lake Park, Deschutes Parkway, and proposed Heritage Park. Boating, water skiing, and lake boat fishing would be eliminated. Freshwater fishing for warmwater species like largemouth bass and rainbow trout would also be lost. The historic value of the lake as a reflecting pool for the Capitol Buildings would be lost, and its use as an important salmon rearing facility also would be lost.

5.7.2.1.2 Critical Areas. Filling of Capitol Lake would result in limited additional flooding impacts to the city of Olympia and would not be consistent with the City's Critical Areas regulations unless mitigation was provided. Also, if purple loosestrife persisted in the area, it is assumed that the newly formed wetlands would be placed under quarantine by the TCNWCA, and DGA would ultimately be responsible for monitoring and maintenance of purple loosestrife over the entire 270-acre wetland area.

5.7.2.2 Gravity Dewatering Alternative

5.7.2.2.1 Shoreline Use. The proposed maintenance sediment removal project is consistent with the general goals and policies of the SMP for the Thurston Region **(Thurston Regional Planning Council 1990)** as summarized in section 5.7.1.1.1 above. The intent of the project is to preserve, protect, restore, conserve, manage, and utilize the lake and its shorelines for its scenic, aesthetic, historic, cultural, recreational, and ecological qualities.

The proposed maintenance sediment removal work also is considered consistent with the Conservancy shoreline designation for this portion of Capitol Lake. The intent of the project is to protect, conserve, and manage existing lake and lake shoreline resources to maintain lake and lake shoreline recreational uses with minimal adverse impacts on the environment. The proposed action is temporary and nonpermanent in nature, is

nonconsumptive, and would not substantially degrade the area's existing character. The Conservancy environment designates this shoreline area for the protection, conservation, and management of existing valuable natural resources (water quality and fish habitat), historic value (Capitol Lake as the reflecting water body for the Capitol Buildings), and cultural areas (Lake Fair and tribal fisheries). The proposed maintenance dredging project, under the Gravity Dewatering Alternative, proposes to temporarily use up to 3.7 acres of nearshore wetlands to preserve, and not limit, existing beneficial uses or alternative beneficial uses, of 270-acre Capitol Lake.

The Conservancy environment is also characterized by low-intensity land use and moderate-intensity water use with moderate to little visual evidence of permanent structures and occupancy. Under the Gravity Dewatering Alternative, 70 percent (12 acres) of the surface area of the Capitol Lake Interpretive Center would remain continuously available for recreational purposes (a low-intensity use at the site). The remaining 5 acres (30 percent) would be used for dewatering purposes for up to 360 days (one or two dredging cycles with 90 days excavation and 90 days for re-filling with sediment) over a five-year period, or about 20 percent of the time. The dredging activity itself would require the hydraulic dredge to excavate a 27-acre area in the middle basin's southern portion (10 percent of the total lake surface area) for up to 180 days over a five-year period (10 percent of the time).

There would be little visual evidence of occupancy during the proposed temporary work. The dredge would be visible from the shoreline, as would the floating dredge slurry pipeline. However, the pipeline would pass under the dike trail through an existing culvert pipe installed for this purpose, and would not be a physical or visual obstruction over the trail. In addition, most of the earthwork activity would be obscured from users of the main dike trail because the existing vegetated berm separates the dewatering area from the lake shoreline and dike trail—this berm was designed specifically to limit views into this planned dewatering facility. Also, there are limited views into the dewatering area from other areas. It cannot be easily seen from Deschutes Parkway or the I-5 freeway. It is directly visible to users of the side trail that connects the main dike trail and the sidewalk along Deschutes Parkway, but this trail is not heavily used.

Under section VI.B.1. of the SMP for the Thurston Region (**Thurston Regional Planning Council 1990**), dredging would be conducted so as to minimize damage to natural systems in Capitol Lake, the gravity dewatering area, and the two upland disposal sites. Mitigation measures for these three areas—lake, dewatering area and upland sites—for the various elements of the environment are specified throughout this SEIS. Dredging would occur in sediment removal sectors 1 and 2 once or twice over a five-year period. Thus no more than 10 percent of the lake's total surface area would be disturbed at any one time. Also, shoreline areas that are important for aquatic plant growth and for fish rearing would be avoided as indicated by the shoreline buffer zones shown in **figure 2**. The timing of sediment removal operations would be set between December 1 and March 1, so as to minimize adverse impacts on anadromous fisheries.

Under SMP Section VI.B.3., no material would be disposed of in existing open-water areas of Capitol Lake, except for possible enhancement of shoreline wetland habitat, as a means of mitigating wetland habitat impacts within the dewatering construction area.

Under SMP Section VI.C.1 through 7, the proposed project would be in compliance as follows:

1. The location and quantity of material to be removed is specified in this SEIS. In addition, the method of removal is specified; the location of potential disposal sites is indicated; environmental mitigation measures are specified; and means of protecting and restoring affected wetland environments are indicated.

2. Preliminary sediment characterization studies indicate that no toxic leachate would result from removal or disposal of Capitol Lake sediments (**Entranco 1994**). The PSDDA sediment test results showed that there are no exceedances for any toxic materials in sectors 1 and 2 where dredging would take place (see **Appendix I**).

3. Existing or possible new dikes would provide the necessary settling prior to discharge from the dewatering area.

4. Sediment characterization studies (**Entranco 1994**) have indicated that the concentrations of metals and PCBs **do not exceed** EPA and Ecology freshwater sediment criteria. (Please note that there are no state standards for freshwater sediments at this time.) The PSDDA sediment test results confirmed these studies for sectors 1 and 2 where dredging is proposed (see **Appendix I**).

5. Dredging **is not** being performed for the sole purpose of obtaining fill material.

6. The project is consistent with zoning and land use designations as indicated in section 5.6 of this SEIS.

7. Dredged materials would only be deposited in freshwater if they would improve shoreline wetland habitat, or in marine water at a site authorized by the Interagency Open Water Disposal Site Evaluation Committee (WAC 332-30-166), such as the Anderson/Ketron Island disposal site.

Under SMP section VI.D.1., the proposed maintenance dredging work is consistent with the following "allowed" dredging activities: (1) deepening navigational channels (lack of long-term maintenance dredging would make boating impossible in Capitol Lake), (2) improving water quality (in the absence of maintenance dredging there is good reason to believe that water quality could further degrade in areas of poor circulation, see 5.3 Water Resources), (3) increasing recreation benefits (in the absence of maintenance dredging boating and lake fishing would be lost along with unique lake shoreline park and trail environments), (4) maintaining water flow (there would be limited additional flooding

impacts in the absence of dredging, and (5) other activities permitted by the SMP for the Thurston Region (see discussion of consistency with general goals and policies above).

5.7.2.2.2 Critical Areas. It is assumed that the use of the dewatering area behind the dike in the middle basin's southwest corner would be regulated by the City of Tumwater Wetlands Protection Ordinance (1278) (**City of Tumwater 1991**). Under the ordinance, attempts will be made to avoid, minimize, and/or otherwise mitigate wetland impacts as discussed in section 5.4.3 of this SEIS. Based on agency coordination meetings between DGA, Tumwater, and Ecology, DGA anticipates that a wetland mitigation plan can be worked out cooperatively between these three organizations that will meet the mitigation requirements of the Tumwater wetland ordinance.

None of the other critical areas in the vicinity of Capitol Lake would be impacted by the project. Shoreline wetlands would be avoided and protected by precluding sediment removal operations within the proposed shoreline buffer zone (**figure 2**). In addition, no work would occur in the south basin; no work would occur in the Medium Significant Wildlife Habitat Unit, which encompasses Percival Cove (City of Olympia); and no work would occur in upland areas of steep slopes in the vicinity of Capitol Lake.

The proposed use of Capitol Lake sediments as a liner material at the Thurston County Landfill would be considered a positive impact, since Capitol Lake sediments are without contamination (**Entranco 1994**). Assuming that Capitol Lake sediments would meet the specific requirements of Thurston County for the intended liner material, either with or without amendment, use of sediments as a liner would preclude leaching of potentially harmful landfill chemicals into the underlying aquifers.

Temporary erosion/sedimentation and related water quality impacts could occur in the absence of mitigation (refer to sections 5.1 and 5.3). Such impacts would be in violation of the Aquifer Recharge Areas section of the Critical Areas Ordinance. Although the ordinance also requires preparation of a Hydrogeological Report, one would **not be prepared**, with the understanding that the relevant groundwater quantity and quality issues have been adequately addressed in the Water Resources section of this SEIS (section 5.3).

Deposition of Capitol Lake sediments would be considered as a positive impact at the Chehalis Western Trailhead site, reducing the susceptibility of the aquifer to future contamination at the site. Depositing sediments in the abandoned gravel pit (at the Trailhead site) would be consistent with: (1) the provisions of the ordinance requiring that the highest priority be given to protection of groundwater in the approval of land uses following cessation of use as a gravel mine, and (2) the policies for mineral resource lands promoting restoration of mineral extraction sites for appropriate future land uses in a manner that "blends with adjacent landscape and contours" (**Thurston County Advance Planning and Historic Preservation 1995**).

Without mitigation, it is also possible that purple loosestrife could be inadvertently distributed elsewhere in the county (refer to section 5.4). Such impacts would not be

consistent with the Purple Loosestrife Special Management Areas section of the Critical Areas Ordinance. However, adequate mitigation is proposed (see Appendix D).

5.7.2.3 Mechanical Dewatering Alternative

5.7.2.3.1 Shoreline Use. Shoreline use would be similar to the Gravity Dewatering Alternative (section 5.7.2.2), except that there would be no impacts to wetlands behind the dike in the middle basin's southwest corner, and no mitigation of these impacts within Capitol Lake or elsewhere. In addition, dredging and dewatering activities would be completed in 90 days per dredge cycle rather than the 180 days required for the Gravity Dewatering Alternative. This is because it would not be necessary to perform excavation prior to dredging, and the dredging and dewatering activity can be accomplished concurrently with this alternative. Visually, this alternative may be considered less intrusive than the Gravity Dewatering Alternative, because there would be no clearing and/or grading in the wetland area, and no bare soils remaining at the site following completion of the work, as there would be with the Gravity Dewatering Alternative.

As with the Gravity Dewatering Alternative (5.7.2.2.1), the Mechanical Dewatering Alternative is considered to be consistent with the various provisions of the SMP for the Thurston Region (**Thurston Regional Planning Council 1990**).

5.7.2.3.2 Critical Areas. The Mechanical Dewatering Alternative would have the same impacts and requirements as the Gravity Dewatering Alternative regarding compliance with the critical areas ordinances of the City of Tumwater and Thurston County as discussed under section 5.7.2.2.2.

5.7.2.4 Marine Disposal Alternative

5.7.2.4.1 Shoreline Use. Provisions of Pierce County's SMP (**Pierce County 1974**) would be met under the shoreline permit already in possession of DNR (**T. Benson, personal communication**). In all other respects, the provisions of the Shoreline Master Program for the Thurston Region (**Thurston Regional Planning Council 1990**) would be similar to those discussed for the Gravity Dewatering Alternative under section 5.7.2.2.2, except that there would be no impacts to wetlands behind the dike in the middle basin's southwest corner, and no associated wetland mitigation in shoreline areas of Capitol Lake, or elsewhere.

5.7.2.4.2 Critical Areas. Under the Marine Disposal Alternative, there would be no impact to any of the critical areas in or adjacent to Capitol Lake. In addition, there would be no use of upland disposal sites and thus none of the critical area issues associated with upland sites would apply to this alternative.

5.7.3 Mitigation

5.7.3.1 No Action Alternative

Partial mitigation for loss of the entire lake environment may involve preserving Capitol Lake's north basin, and constructing additional public trails and education displays in the wetland that would ultimately occupy the middle basin of what is presently Capitol Lake. Retaining the north basin would allow its continued use as a salmon rearing facility, continued boating and freshwater fishing, and would retain the unique lake shoreline environment for Capitol Lake Park, Marathon Park, proposed Heritage Park, and associated lakeshore sidewalks and trails.

5.7.3.2 Gravity Dewatering Alternative

Provision of wetland mitigation as discussed in section 5.4 of this SEIS (for impacts to wetlands behind the dike in the middle basin's southwest corner) would be consistent with the provisions of the SMP for the Thurston Region (**Thurston Regional Planning Council 1990**), the City of Tumwater Wetlands Protection Ordinance (**City of Tumwater 1991**), and the provisions of the State Environmental Policy Act.

All other necessary mitigation would be accomplished by implementing the Purple Loosestrife Management Plan (**Appendix D**) and the Water Quality Management Plan (**Appendix E**).

5.7.3.3 Mechanical Dewatering Alternative

Mitigation for this alternative would involve implementing the Purple Loosestrife Management Plan (**Appendix D**) and the Water Quality Management Plan (**Appendix E**).

5.7.3.4 Marine Disposal Alternative

Mitigation for this alternative would involve implementing the Water Quality Management Plan (**Appendix E**). No mitigation would be required for purple loosestrife under this alternative.

5.8 HISTORIC AND CULTURAL RESOURCES

5.8.1 Affected Environment

Native Americans from the tribes now known as Nisqually, Squaxin, and Chehalis tribes gathered shellfish and frequented the inlets and prairies of Puget Sound. The rivers of Thurston County were long-established sites for salmon harvesting, and the prairies of the County were popular hunting, planting, and harvesting sites. However, coordination with

the State Office of Archaeology and Historic Preservation indicates there are no cultural resources in the immediate vicinity of proposed project work areas (**G. Griffith, personal communication**).

Capitol Lake is, itself, considered an historically significant resource given the fact the lake was conceived as part of the 1911 Capitol Campus Plan prepared by architects Wilder and White. The lake was originally constructed to serve as a reflecting water body for the Capitol Buildings.

With respect to other historic resources, there are numerous historical buildings in the vicinity of Capitol Lake's south basin. However, no project work will occur in the south basin, so none of these resources would be affected. In addition, a review of the Historic Sites Map from the Thurston County Comprehensive Plan indicates that no historic resources occur in areas that would be impacted by the project at upland disposal sites.

5.8.1.1 Cultural Background and Resources - Capitol Lake

Capitol Lake, particularly the area around the south (upper) basin, was the site of significant prehistoric and historic activities. Two sites along the lake have been registered with the Washington Archeological Research Center in Pullman as prehistoric resources. One two-acre site in Tumwater Historical Park contains evidence of an Indian fishing village and shellfish collecting site. Artifacts indicate this site may have been a permanent village of the Nisqually Indian tribe for 500 years or more. Another area on the east shore of the south basin was probably occupied for hunting and fishing activities. A third site discovered along the west shore of the south basin was most likely a fishing location and contains scattered cultural materials. The exact location of these sites have not been given in this document to avoid the possibility of unauthorized removal of archaeologically important material. None of these sites is in a proposed construction area for the project under any of the alternatives.

The traditions and lifestyle of the Native Americans of Southern Puget Sound, specifically in the Budd Inlet area, depended on the produce of the beaches and saltwater. Coho and chum salmon, dried and smoked, were the staple of winter and early spring food for the inhabitants of the area. Shellfish of many kinds, including native oysters, abounded on the gravelly shores and exposed tide flats. Budd Inlet was a favorite area for digging, drying, and smoking clams. Shell mound remains in the area indicate that besides several species of clams and the goeduck, the Native American diet included whelks, mussels, moon snails, large barnacles, and limpets.

The lifestyle of the Native American also depended on the plants in the adjacent woods and prairies. Roots, bulbs (especially the blue flowering camas), nuts such as acorns, and berries of many kinds were industriously gathered.

Large cedar logs were used to build canoes by a process of controlled burning and adzing. Cedar roots were woven into baskets. Woven cattails were used as ponchos for protection

from the rain. Tule reeds and cattails were woven into mats of various sizes which served a variety of purposes including kneeling pads for canoe paddlers, table cloths, padding for sleeping platforms, wall hangings to keep the draft out from between the wall planks, and coverings to keep beached canoes from warping or splitting. These mats also served a very important use as portable coverings for lightweight house frames during the more migratory life of root gathering and berry picking during spring and summer.

Until shortly after the mid-18th century, the Native Americans of Southern Puget Sound lived in a cultural pattern strong in traditions. This was interrupted by the westward expansion of European settlement. In 1841, American exploration of Puget Sound was undertaken by Lt. Commander Charles Wilkes, who mapped and named landmarks throughout the region. Four years later in 1845, Michael T. Simmons led the first group of permanent American settlers to Tumwater falls. He settled in the area that would become Tumwater while others settled in the rich prairies to the south.

Today, members of the Squaxin Island Tribe maintain an active cultural interest in the culture and harvest of salmon, as well as other fish and shellfish resources of southern Puget Sound, including those of Capitol Lake and the Deschutes River.

5.8.1.2 Thurston County Landfill Site

The Thurston County Landfill is approximately nine miles from Capitol Lake. The site has been cleared and graded for landfill purposes already. There are no known historic or cultural resources on the site.

5.8.1.3 Chehalis Western Trailhead Site

This site is approximately eight miles southeast of Capitol Lake. The site is partially forested, partially covered by shrubs, and partially barren. There are no known historic or cultural resources on the site.

5.8.2 Impacts

5.8.2.1 No Action Alternative

Under the No Action Alternative, Capitol Lake and its associated beneficial uses and values would be lost. This would occur over a 30 to 85 year period in the middle basin, and up to 100 years in the north basin.

Under the No Action Alternative there would be no impacts to prehistoric or historic resources. There would be no sediment removal in the lake and no work would occur in the southern basin of Capitol Lake where prehistoric and historic resources are located.

The lake would, however, fill with sediment over time and become a freshwater marsh and river channel. This would affect the fish and plant resources that have played an important role in the culture of the Native Americans of Southern Puget Sound. The net effect would be the replacement of open-water habitat with wetland habitat, a shift that would provide enhanced habitat value that could be used to plant and cultivate wetland plants suitable for traditional Native American cultural uses, but reduce open-water habitat for fish. Without maintenance sediment removal, wetlands would also develop in Percival Cove and in the north basin of the lake. The loss of open-water habitat throughout the lake could displace the WDFW artificial fish feeding operations and could reduce the capacity of the resource for rearing juvenile salmon (see Plants and Wildlife, section 5.4).

In time, sand bar formation in the middle basin also would result in the possibility of fish stranding in the backwater areas isolated from the main river channel by the sandbars, especially during low-flow summer months. In addition, areas of stagnant water would be created where exchange with river water would be eliminated.

5.8.2.2 Impacts Common to All Action Alternatives

There would be no impacts to prehistoric or historic resources. However, the fish and plant resources that have played an important role in the culture of the Native Americans of Southern Puget Sound could be affected. Refer to the Water Resources and Plants and Wildlife sections of this SEIS for a detailed discussion of potential impacts and mitigation.

5.8.3 Mitigation

Refer to the Water Resources and Plants and Wildlife sections of this SEIS for a discussion of mitigation measures associated with potential impacts to fisheries.

5.9 TRANSPORTATION

5.9.1 Affected Environment

5.9.1.1 Capitol Lake Vicinity

Truck and heavy equipment access to the southwestern corner of Capitol Lake's middle basin would be from Deschutes Parkway, a two-lane paved urban arterial. Trucks leaving the Capitol Lake area would turn south on Deschutes Parkway to gain access to I-5 and/or city/county arterial roadways. Trucks would not be allowed to travel north on Deschutes Parkway due to load limits on the northern part of the Parkway.

5.9.1.2 Route to Thurston County Landfill Site

Trucks leaving the Capitol Lake area would gain access to I-5 at the northbound on-ramps in the vicinity of the Tumwater Historical Park entrance. They would continue north/eastbound on I-5 to Marvin Road where they would exit the freeway, turn north on Marvin Road, cross over the freeway, and turn right into the Thurston County Landfill. With the exception of Deschutes Parkway, this route is used heavily by truck traffic under existing conditions.

5.9.1.3 Route to Chehalis Western Trailhead Site

Trucks would travel south to Deschutes Way, turn east onto Custer Way, then south onto Cleveland Avenue, then east onto Yelm Highway, then south onto Rich Road SE, and finally east onto 89th Avenue SE to the proposed disposal site just north of Latigo Street SE. This route involves highway or arterial class roadways, except for 89th Avenue SE, which is a county collector. Traffic levels, including truck traffic, are expected to be relatively high, on the highway and arterial roadways, but relatively low and infrequent on rural 89th Avenue SE.

If an alternative route is needed to avoid the proposed roadway improvements along Cleveland Avenue and Yelm Highway, local streets would be used to access I-5 southbound to 93rd Avenue SW. Trucks would then turn east on 93rd Avenue SW to Old 99 Highway SE, and then to Rich Road, and 89th Avenue SE.

5.9.1.4 Marine Traffic

Marine barge traffic would travel north through Budd Inlet, then northeast through Dana Passage, and would then connect with Nisqually Reach and follow it around to the disposal site midway between Anderson and Ketron Islands. This is a common route for various kinds of commercial marine traffic entering and leaving the Port of Olympia.

5.9.2 Impacts

5.9.2.1 No Action Alternative

There would be no traffic impacts with the No Action Alternative.

5.9.2.2 Gravity Dewatering Alternative

As indicated in the Noise Impact section of this SEIS (section 5.2), truck traffic would occur for 65 days with each dredging cycle (one and possibly two cycles in five years), between the hours of 7:00 a.m. and 6:00 p.m., weekdays only, from July through November, in order to transport 60,000 to 70,000 cubic yards of sediment. Based on truck capacity,

three truck trips per hour or 33 truck trips per day would be needed to haul the dredged sediment.

Truck traffic could create additional traffic congestion in the vicinity of the construction access road off of Deschutes Parkway. Truck traffic entering and leaving the construction site would be moving slowly to turn and decelerate/accelerate, respectively. Depending on the volume of other traffic on the parkway, this could result in some minor backing-up of traffic behind the trucks.

Since truck traffic is relatively common along the route to the Thurston County Landfill no significant impacts are anticipated. In contrast, truck traffic to the Chehalis Western Trailhead site is likely to be equal to, or greater than, total daily traffic volumes along rural 89th Avenue SE. This increase in construction-related truck traffic would represent a significant short-term construction impact for rural residents in the vicinity. Temporary increases in truck traffic could pose additional traffic safety and traffic noise concerns for area residents.

In addition, the City of Tumwater has indicated that the primary route described above, would involve portions of Cleveland Avenue and Yelm Highway. Since portions of these roads are expected to be under construction during the next several years, the City recommends the use of the alternative route on I-5 to 93rd Avenue SW and then to the site.

5.9.2.3 Mechanical Dewatering Alternative

Transportation impacts would be similar in volume to that described above for the Gravity Dewatering Alternative. However, with the Mechanical Dewatering Alternative, truck traffic would occur at the same time as the dredging operations, from December 1, 1996 through March 1, 1997, and perhaps for one additional dredging cycle within the five-year planning period.

As with the Gravity Dewatering Alternative, no significant impacts are anticipated with truck hauling to the Thurston County Landfill, but temporary increases in traffic safety and noise could occur in the vicinity of the Chehalis Western Trailhead site.

5.9.2.4 Marine Disposal Alternative

Under this alternative there would be no significant truck traffic impacts at any location. Sediments would be transported by marine barge to the deep, open-water marine disposal site at Anderson and Ketron Islands once a day during December 1 through March 1. Since this kind of marine traffic is common in the area, no adverse impacts are anticipated.

5.9.3 Mitigation

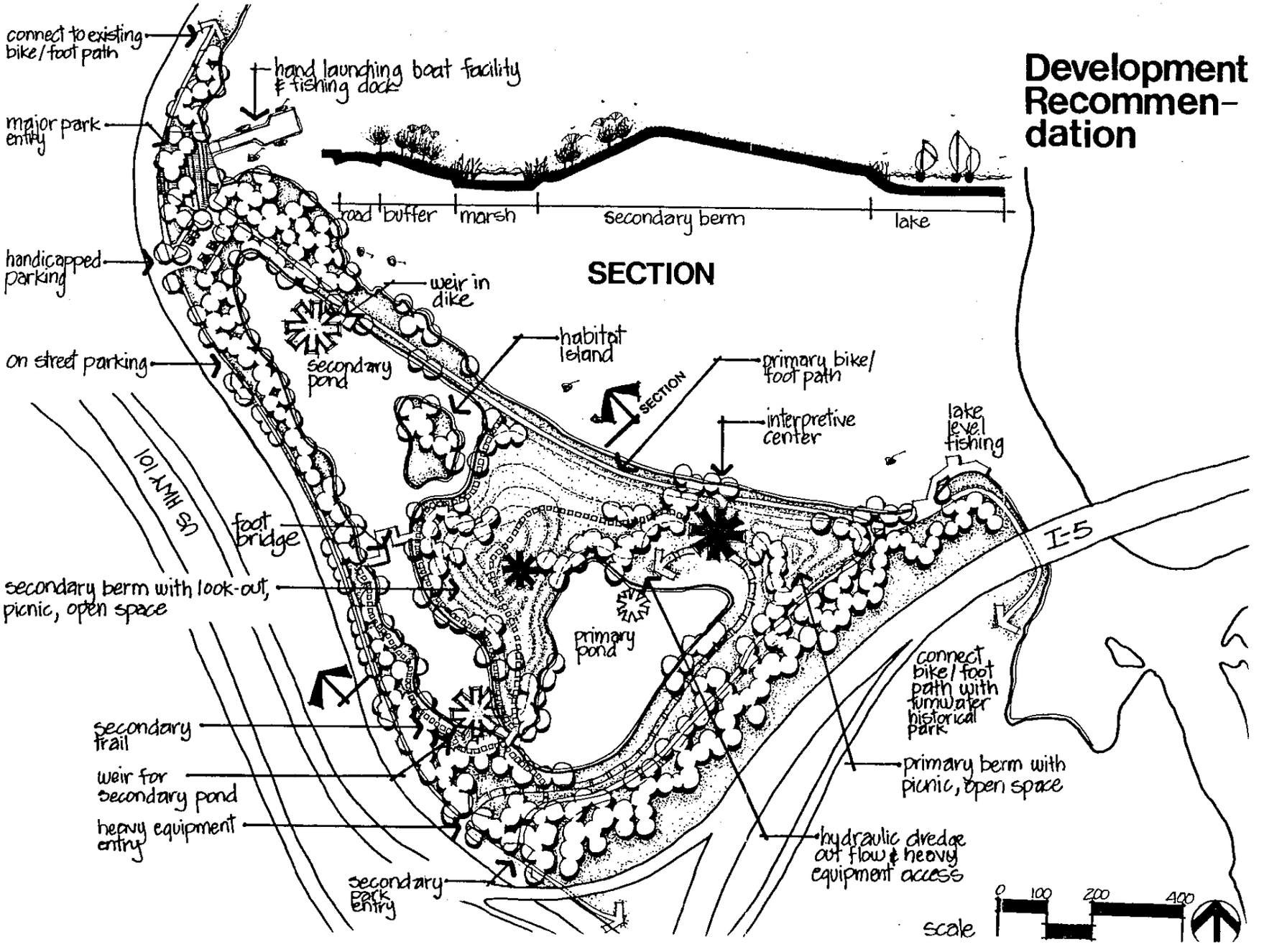
No mitigation would be required for the No Action or Marine Disposal alternatives. And no mitigation is proposed for truck traffic to the Thurston County Landfill, since truck traffic is considered relatively common along the proposed truck traffic route.

Mitigation for truck traffic impacts in the vicinity of the construction access at Deschutes Parkway and in the vicinity of the Chehalis Western Trailhead site would involve using flashing traffic barricades and traffic flaggers to assist with orderly traffic control during construction. Mitigation for temporary truck noise is addressed in section 5.2.3 of this SEIS. In addition, the contractor would be required to repair any roadway damage within 100 feet of the truck access turnouts for these two sites.

APPENDIX A

Selected Pages From Capitol Lake Middle Basin Recreation Site

(Richard Carothers Associates 1981)


Development Recommendation
connect to existing bike/foot path
hand launching boat facility & fishing dock
major park entry
road
buffer
marsh
secondary berm
lake
SECTION
handicapped parking
weir in dike
habitat island
secondary pond
on street parking
SECTION
primary bike/foot path
interpretive center
lake level fishing
US HWY 101
foot bridge
I-5
secondary berm with look-out, picnic, open space
primary pond
connect bike/foot path with tumwater historical park
secondary trail
weir for secondary pond
heavy equipment entry
primary berm with picnic, open space
hydraulic dredge out flow & heavy equipment access
secondary park entry
scale
0
100
200
400

Appendix A

NOTES

[1] Private Communication, Bill Quigg, Quigg Brothers MacDonald Inc.

[2] Quigg.

[3] Quigg.

[4] Private Communication, Dick Fankhouser, Washington State Parks Department, Olympia, Washington.

[5] Department of General Administration, State of Washington, Capitol Lake Restoration and Recreation Plan: Final Environmental Impact Statement, Olympia, Washington, 1977, Introduction p. 22.

[6] Department of General Administration, State of Washington, Capitol Lake Restoration and Recreation Plan: Final Environmental Impact Statement, Olympia, Washington, 1977, Introduction p. 31.

[7] Private Communication, Len Younke, U.S. Army Corps of Engineers, Seattle, Washington.

[8] Younke.

[9] Younke.

[10] Private Communication, Mr. Malign, Port of Olympia, Olympia, Washington

[11] Private Communication, Jerry C. Lenzi, P.E. and Ronald C. Cook, P.E., State of Washington Department of Transportation, Lacey, Washington.

[12] Private Communication, Richard Pierce, State of Washington Department of Ecology, Olympia, Washington.

[13] Private Communication, L.E. Carlsson, Department of General Administration, Olympia, Washington.

[14] Private Communication, Bill Keller, Marine Construction & Dredging.

[15] Department of General Administration, State of Washington, Capitol Lake Restoration and Recreation Plan: Final Environmental Impact Statement Supporting Documents, Olympia, Washington, 1977, Appendix C.

[16] FEIS Supporting Documents.

[17] FEIS Supporting Documents.

[18] FEIS Supporting Documents.

[19] Carlsson.

[20] Department of Civil and Environmental Engineering, Washington State University, Hydraulic and Water Quality Research Studies and Analysis of Capitol Lake Sediment and Restoration Problems, Pullman, Washington, 1975, p. 72.

[21] Quigg.

[22] Hittman Associates. Containment Area Facility Concepts for Dredged Material Separation, Drying and Rehandling (A Report for Environmental Effects Laboratory, U.S. Engineer Waterways Experiment Station, Vicksburg, Mississippi), Columbia, Maryland, 1974, p. 112-188.

[23] FEIS Supporting Documents.

[24] Hittman Associates.

Appendix D

REFERENCES

Private Communication, Jim Brown, Tumwater Public Works, Tumwater, Washington

Private Communication, L.E. Carlsson, Department of General Administration, Olympia, Washington

Private Communication, Jim Dikestra, Malco Chemical

Private Communication, Dennis Door, Puget Power, Olympia, Washington

Private Communication, Dick Fankhouser, Washington State Parks Department, Olympia, Washington

Private Communication, Roger Harkens, Washington Department of Game, Olympia, Washington

Private Communication, Ron Hill, Argo Industrial, Seattle, Washington

Private Communication, Steve Hillsman, United Flotation Systems, Columbus, Ohio

Private Communication, Ray Johnson and Earl Finn, Washington State Department of Fisheries, Olympia, Washington

Private Communication, Bill Keller, Marine Construction & Dredging

Private Communication, K. Frank Kirkbride, Landscape Architecture Consultant, for Tumwater Historic Park, Olympia, Washington

Private Communication, Jerry C. Lenzi, P.E. and Ronald C. Cook, P.E., State of Washington Department of Transportation, Lacey, Washington

Private Communication, Mr. Malign, Port of Olympia, Olympia, Washington

Private Communication, Bill Milton, Washington State Department of Transportation

Private Communication, Pacific Northwest Bell, Olympia, Washington

Private Communication, Jerry Petheram, City of Tumwater Parks and Recreation, Tumwater, Washington

Private Communication, Richard Pierce, State of Washington Department of Ecology, Olympia, Washington

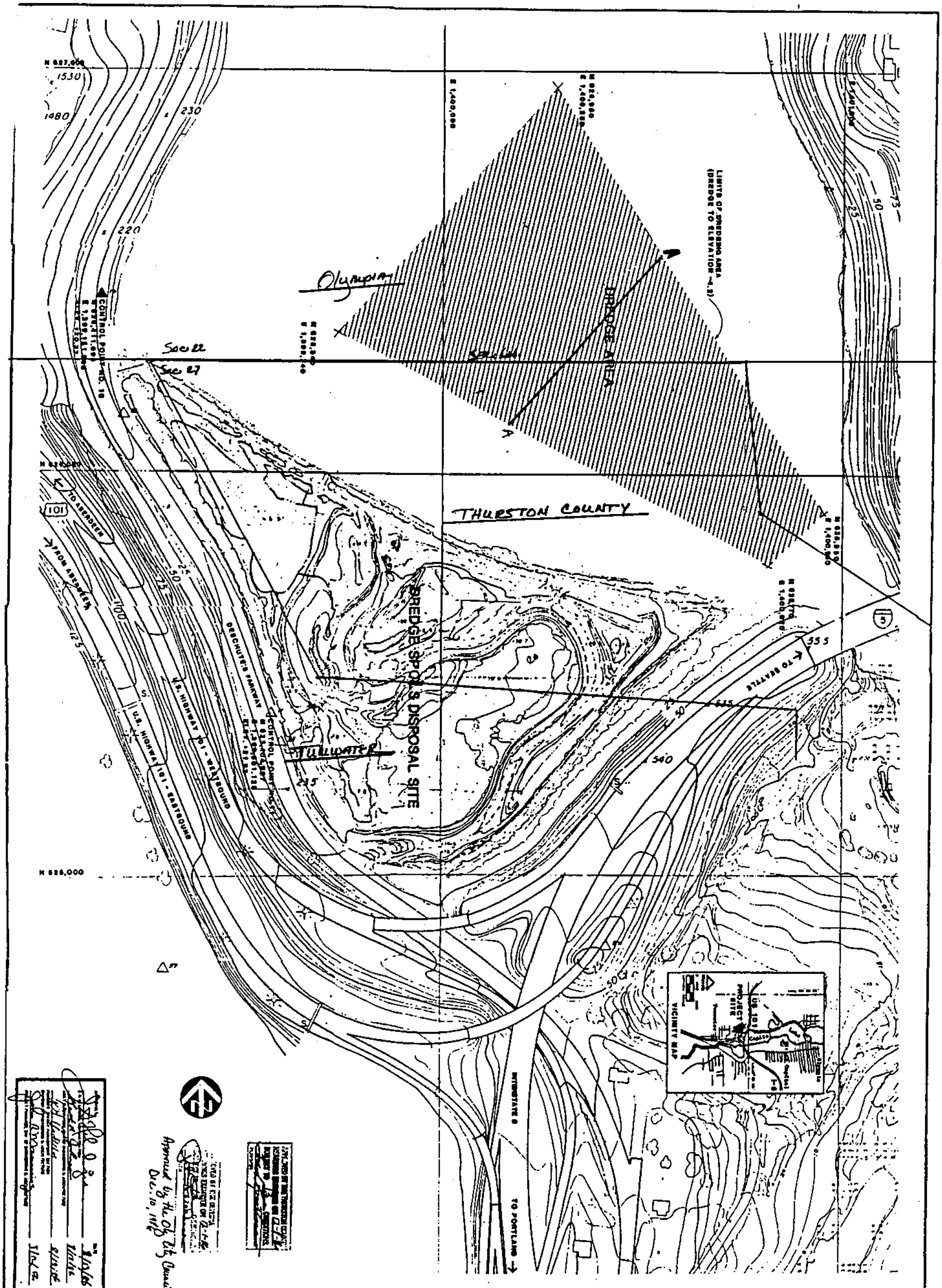
Private Communication, Bill Quigg, Quigg Brothers MacDonald Inc.

Private Communication, Mr. Vea, Mr. Hogan, Mr. Denny, U.S. Army Corps of Engineers, Seattle, Washington

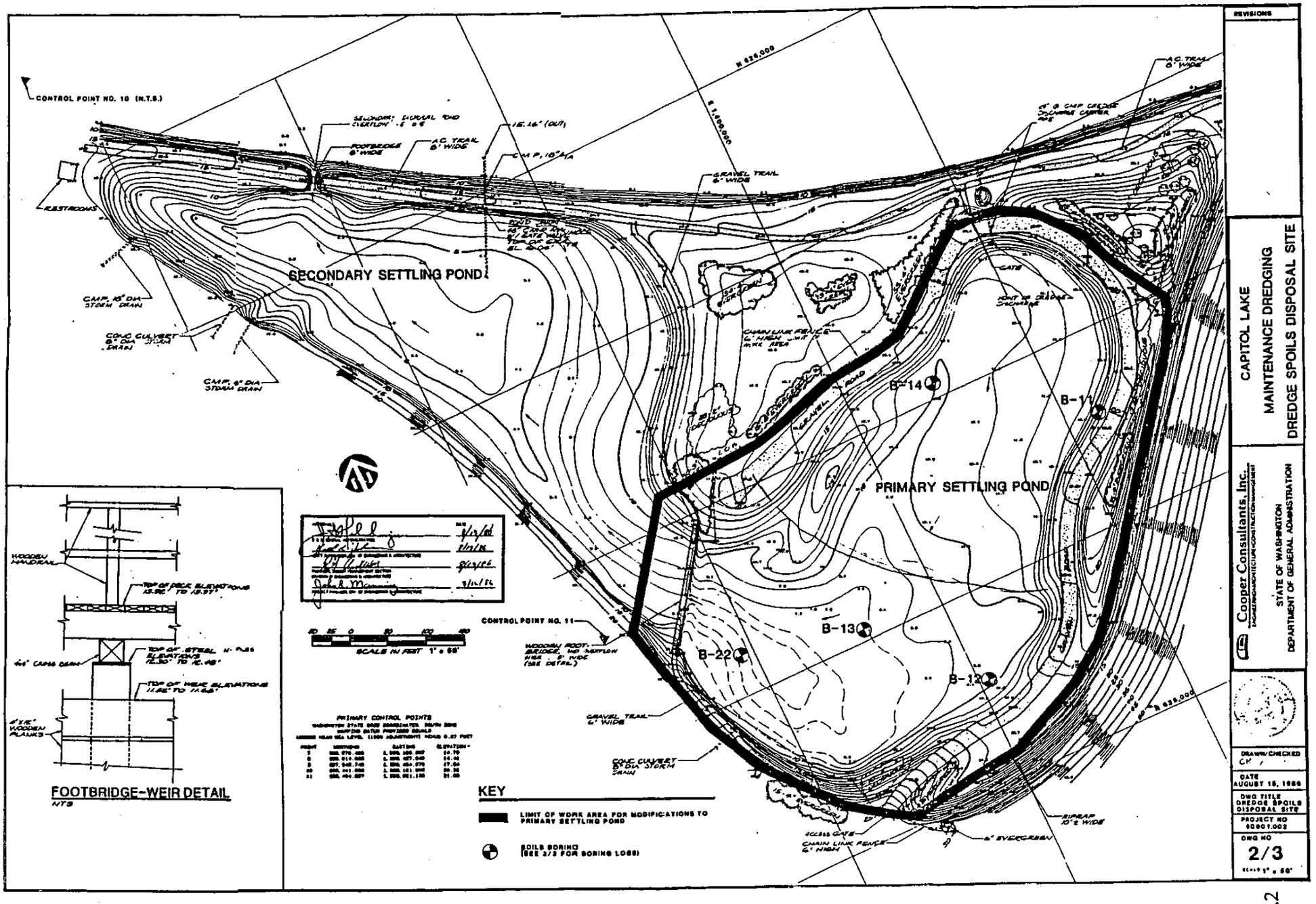
Private Communication, Len Younke, U.S. Army Corps of Engineers, Seattle, Washington

APPENDIX B

Figures from 1986 SEPA Environmental Checklist Showing Dredge and Fill Sites



DATE AUGUST 18, 1986 · DWG TITLE SITE MAP · DWG NO 1/3	Cooper Consultants, Inc. — STATE OF WASHINGTON DEPARTMENT OF GENERAL ADMINISTRATION	CAPITOL LAKE MAINTENANCE DREDGING SITE MAP	B.1


CONTROL POINT NO. 10 (N.T.S.)
SECONDARY SETTLING POND
PRIMARY SETTLING POND
FOOTBRIDGE 6' WIDE
A.C. TRAIL 6' WIDE
GRAVEL TRAIL 6' WIDE
RESTROOMS
CMP, 18" DIA STORM DRAIN
CONC CULVERT STORM DRAIN
CMP, 8" DIA STORM DRAIN
CHAIN LINK FENCE 6' HIGH
GATE
ROAD
B-14
B-11
B-13
B-22
B-12
CONTROL POINT NO. 11
WOODEN FOOT BRIDGE, NO HANDRAIL HIGH 2' WIDE (SEE DETAIL)
CONC CULVERT 8'DIA STORM DRAIN
RIPRAP 10'± WIDE
8' EVERGREEN
ACCESS GATE
CHAIN LINK FENCE 6' HIGH
SCALE IN FEET 1" = 60'
PRIMARY CONTROL POINTS
WOODEN HANDRAIL
TOP OF DECK ELEVATIONS 13.92' TO 13.97'
TOP OF STEEL H-PILES ELEVATIONS 11.52' TO 11.48'
TOP OF WEIR ELEVATIONS 11.82' TO 11.68'
4"x6" CROSS BEAM
4"X6" WOODEN PLANKS
FOOTBRIDGE-WEIR DETAIL
NTS
KEY
LIMIT OF WORK AREA FOR MODIFICATIONS TO PRIMARY SETTLING POND
SOILS BORING (SEE 2/3 FOR BORING LOGS)
REVISIONS
CAPITOL LAKE
MAINTENANCE DREDGING
DREDGE SPOILS DISPOSAL SITE
Cooper Consultants, Inc.
STATE OF WASHINGTON
DEPARTMENT OF GENERAL ADMINISTRATION
DRAWN/CHECKED
DATE AUGUST 15, 1986
DWG TITLE DREDGE SPOILS DISPOSAL SITE
PROJECT NO 8080.002
DWG NO 2/3
SCALE 1" = 60'

APPENDIX C

Regulatory Status— Wetlands in Dewatering Construction Area

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO ATTENTION OF

Regulatory Branch

SEP - 1 1995

Nick Cockrell
Washington State Department of General Administration
Division of Capitol Facilities
Olympia, Washington 98504

Reference: 95-4-00834
Wa St Dept of Gen
Administration

Dear Mr. Cockrell:

As requested in your letters of February 6, 1995, and April 4, 1995, we have made a determination regarding the continued use of the de-watering area located in the middle basin of Capitol Lake. This area is not considered to be abandoned as a de-watering site. Therefore, a Section 404 permit is not required to discharge dredged material into wetlands on the site during future dredging projects.

If you have any questions, please contact Mr. Jack Kennedy by telephone at (206) 764-3495.

Sincerely,

for D. Kennedy
Ann R. Uhrich
Chief, Environmental and
Processing Section

APPENDIX D

Purple Loosestrife Management Plan

APPENDIX D
UPLAND DISPOSAL PURPLE LOOSESTRIFE MANAGEMENT PLAN

Purple loosestrife (Lythrum salicaria) is a noxious emergent wetland plant that is under active quarantine by the Washington State Department of Agriculture because it tends to out-compete and displace more desirable wetland plant species. A single full-grown plant is capable of producing up to 2 to 3 million viable seeds per year, with a 90 percent germination rate in the first year and an 80 percent germination rate during the second and third years. Seeds may remain viable (able to germinate) for as long as eight years. The plant generally blooms in June, July, August, and early September.

Purple loosestrife is a facultative wetland plant, which means it is most likely to be found in habitats with water-saturated soils. However, this plant has been observed on drier, upland habitats (**L. Lantz, personal communication**). It is not found in open-water habitats. This means that both the temporary dewatering area behind the dike and upland disposal sites could have the potential to grow purple loosestrife under wetland soil conditions, and, to a lesser degree, on upland soils.

Since this plant is known to inhabit riparian areas of the lower Deschutes River and the south basin of Capitol Lake, the possibility exists that (1) seeds could occur in lake bottom sediments and/or, (2) plant fragments or seeds could find their way to the sediments deposited behind the dike prior to off-site transport and upland disposal. Therefore, these undesirable plants could infest the area in the vicinity of the dewatering site in the southwest corner of the middle basin of Capitol Lake and/or could infest upland disposal sites. In view of this potential, a purple loosestrife management plan is recommended as a part of the proposed action.

With respect to upland disposal sites, it is anticipated that purple loosestrife management would not be a major concern at either of the two sites. At the Thurston County Landfill Site, sediment materials would be used for landfill liner and would ultimately be covered with garbage and then a landfill cap. At the Chehalis Western Trailhead, sediment would be used to fill the gravel pit until the top of the fill was approximately even with the surrounding terrain. The site would then be graded and landscaped for park uses.

To minimize the opportunity for loosestrife germination and spread at either the temporary dewatering site and/or any of the upland disposal sites, this management plan would be implemented. The plan promotes a non-chemical approach as the preferred method of control consistent with Thurston County Integrated Pest Management polices and practices. The plan assumes that only small areas (less than 0.25 acre) would become infested and that hand pulling methods would provide adequate control. If larger areas become infested, a contingency plan would be developed with the Thurston County Noxious Weed Control Agency.

The purple loosestrife management plan may include the following components:

a. A wetland biologist would survey all shoreline, wetland, and upland disposal sites at least once during the growing season each year (April, May, and June) to look for the presence of purple loosestrife. Monitoring would occur every year during the five-year sediment removal operation, and for a period of eight years beyond the time of the last sediment removal cycle.

b. Areas with purple loosestrife growth (either near-lake or remote upland areas) would be flagged or staked in the field. Purple loosestrife plants would be hand pulled, placed in plastic bags (double bagged to reduce the risk of rupture) and disposed of in the Thurston County Landfill. The strategy would be to remove new plant growth prior to seed formation.

c. To minimize the area of suitable habitat for purple loosestrife, upland disposal sites would require a site grading plan that would maintain 3:1 side slopes for mounded sediment, and drainage facilities would be designed to minimize saturated soils and /or shallow groundwater conditions that would promote preferred habitat conditions for the plant. The site grading plan would be reviewed and approved by the Thurston County Noxious Weed Control Agency prior to implementation.

d. Upon completion of annual or biennial sediment deposition, sediment stockpiles at upland disposal sites would be hydroseeded to prevent erosion and minimize growth opportunities for purple loosestrife. Any unavoidable, permanent wetland habitats within the stockpile zones would be densely planted with competing wetland plants like cattail, sedges, rushes, and wetland tolerant grasses and monitored/managed as cited above.

e. Trucks and other earth-moving or mechanical dewatering equipment would be thoroughly washed every time they left the lakeside dewatering site, or a remote upland disposal site, to eliminate the possibility of transporting purple loosestrife seeds.

APPENDIX E

Water Quality Management Plan

APPENDIX E
WATER QUALITY MANAGEMENT PLAN

A water quality management plan would be implemented to mitigate highly turbid return flows from the hydraulic dredging operation, and potential erosion/sedimentation problems from exposed soils at the dewatering site and/or the upland disposal sites.

Control of sediments carried by trucks to and from the upland disposal sites would be managed by:

1. Constructing gravel access pads at the points of ingress/egress from paved roads (at Capitol Lake and upland disposal sites).

2. Washing truck and other equipment prior to leaving the site.

3. Shoveling, sweeping, and washing off any sediments spilled onto paved surfaces.

Initial settling of suspended and settleable solids would occur in the wetland area behind the dike and south of the footbridge/weir (**figure 4**). Water would then spill over the weir boards located under the wooden foot bridge and pass to the wetland north of the weir (**figure 4**). As water passes over the weir board, chemical flocculents would be added to the water to aid in the precipitation and settling of suspended solids. The non-toxic flocculents, chitosan (a complex sugar material derived from shrimp and crab shells) and bentonite (clay) (**Entranco 1995**), or similar chemicals, would be added to aid in settling and removal of remaining suspended solids in wetlands north of the footbridge/weir. Treated water would be discharged back to Capitol Lake through the return flow discharge pipe (**figure 4**). If necessary, a second silt curtain could be located in a semi-circle around the discharge pipe.

Within several days of completing sediment removal operations each spring (March), the dewatered sediments would be hydroseeded to minimize erosion/sedimentation impacts on adjacent wetlands. Deposited sediments would be allowed to continue to dewater through the end of July and would then be excavated using heavy duty earth moving equipment (dragline or large trackhoe) during August, September, and October. Following excavation, steep slopes adjacent to the construction access road would be covered with jute matting and hydroseeded. All other bare soils would be hydroseeded as soon as practical following completion of excavation.

Since the Thurston County Landfill Site has retention ponds downslope from the detention site, water quality control at this disposal site is not expected to be difficult. Control efforts at the Chehalis Western Trailhead site would be coordinated with plans to construct biofiltration swales for control of parking lot runoff, for pre- and post-construction fill activities.

A site grading and drainage plan would be prepared for each upland disposal site. A maximum side slope of 3:1 would be specified for all upland disposal operations as a means of limiting erosion/sedimentation impacts. Plans for the Thurston County Landfill

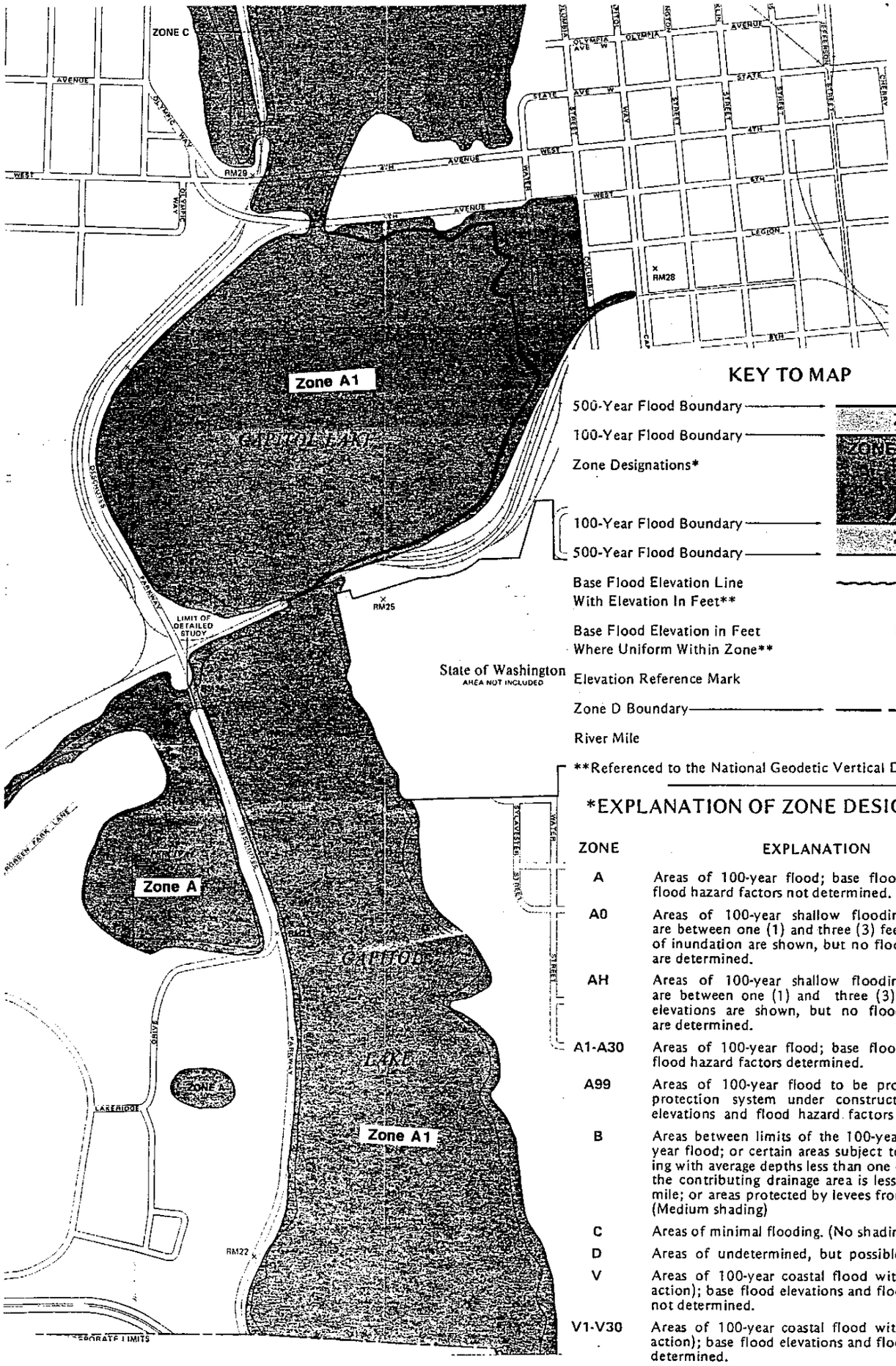
would be prepared by Thurston County Solid Waste. The plan for the Chehalis Western Trailhead would be prepared by the Thurston County Parks and Recreation Department or their consultant.

In the case of the Thurston County Landfill Site, it is anticipated that site drainage plans would include a temporary erosion and sedimentation control plan, with hydroseeding, slope control, and runoff routing to existing sedimentation basins. The sediment stockpile area is located adjacent to the north retention pond, and it is assumed that any site runoff would be routed to this pond.

All facilities would be designed in accordance with the Drainage Design and Erosion Control Manual for the Thurston Region (**Thurston County 1991**) and/or the Stormwater Management Manual for the Puget Sound Basin (**Ecology 1992**) and would be documented in a Stormwater Site Plan for review and approval by Thurston County.

APPENDIX F

FEMA 100-Year Floodplain Map and Floodplain Analysis



KEY TO MAP

500-Year Flood Boundary	
100-Year Flood Boundary	
Zone Designations*	ZONE B / ZONE A1 / ZONE A / ZONE B
100-Year Flood Boundary	
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

Source: Federal Emergency Management Agency 1982

This flood plain analysis has been excerpted from the Wetland Development Feasibility Analysis for Capitol Lake, prepared by Entranco Engineers, Inc. November 1990 for the Washington State Department of General Administration.

Flood Control

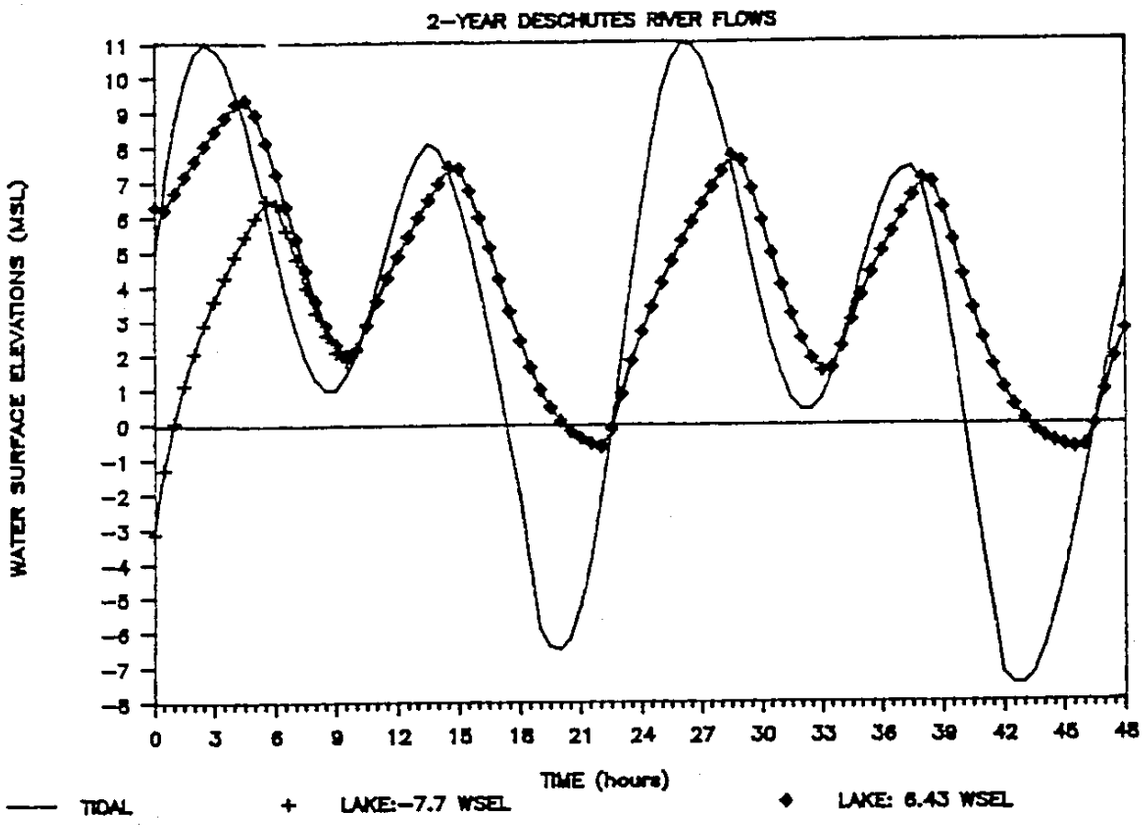
On the basis of preliminary flood impact analyses (refer to Table 2 and figures 10 and 11), it appears that flood storage capacity in Capitol Lake, even assuming total drawdown prior to flooding, provides relatively little flood control benefit during the 100-year flood. This is because lake volume is relatively small compared to the combined volumes of flood flows produced by the Deschutes River and Percival Creek. A preliminary computer model analysis indicates that the lake volume is consumed in only 2.8 hours and that peak lake elevations are controlled by corresponding tidal elevations. Once the normal lake volume is consumed, it continues to fill until it reaches an elevation about 1.5 feet higher than the tidal elevation. At this lake elevation there is sufficient head differential for the lake to begin to discharge at rates high enough to keep up with the rate of inflow. As indicated in table 2, the maximum lake elevation is only 0.46 feet lower (10.90 feet MSL) when the lake is drawn down all the way (-7.7 MSL), than the maximum elevation (11.36) that occurs if the lake is maintained at 6.43 MSL prior to flooding.

The model was also run assuming that the middle basin was filled to elevation 6.43 MSL, in order to evaluate the potential impact of wetland development. The results for the 100-year storm event indicated that the maximum flood elevation would increase by approximately 0.35 to 0.80 feet to elevations 11.70 and 11.71 (see table 2).

Table 2
Summary of Lake Level Data: Capitol Lake

Flow Condition	Maximum Tide Elevation (MSL)	Starting Elevation (MSL)	Maximum Lake Level (MSL) Existing	Middle Basin Filled	Change in Elevation (feet)
2-year Flow	11	-7.70	7.74	9.21	1.47
	11	6.43	9.37	10.23	0.86
100-year Flow	11	-7.70	10.90	11.70	0.80
	11	6.43	11.36	11.71	0.35

Figure 10
Tidal and Lake Levels,
2-Year and 100-Year Deschutes River Flows



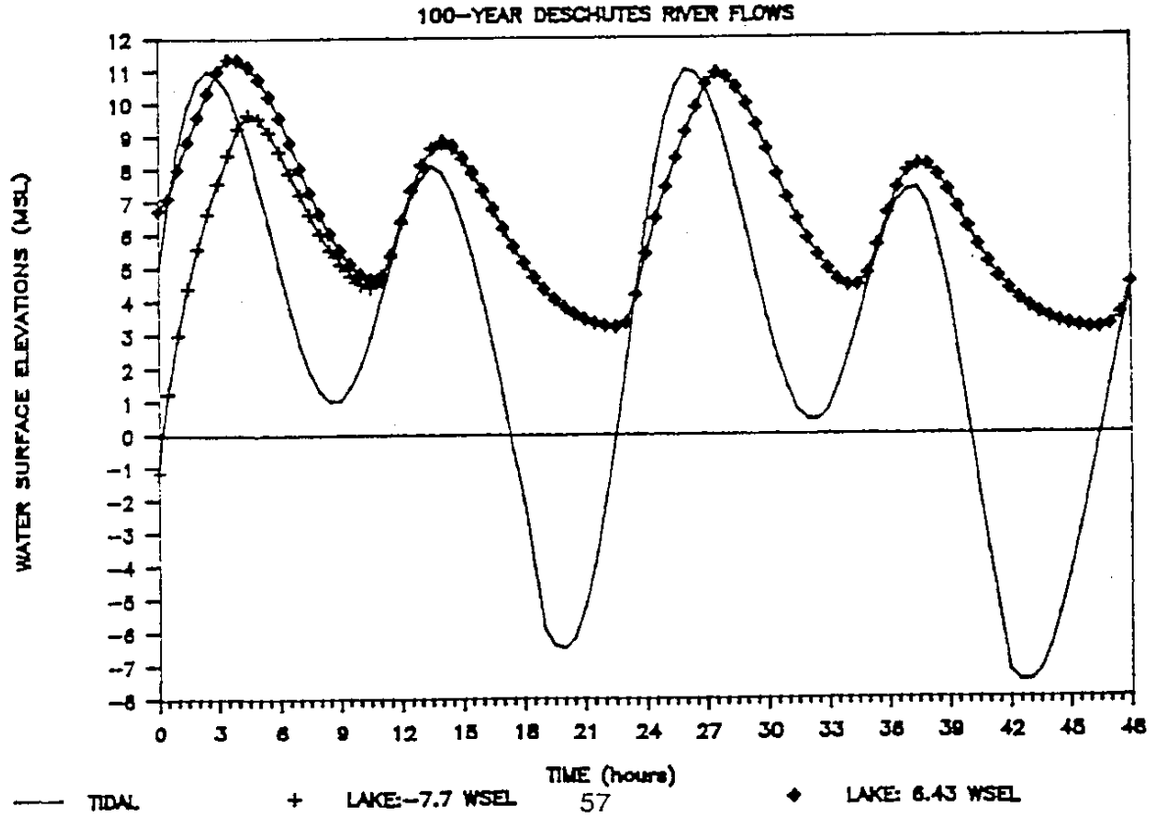
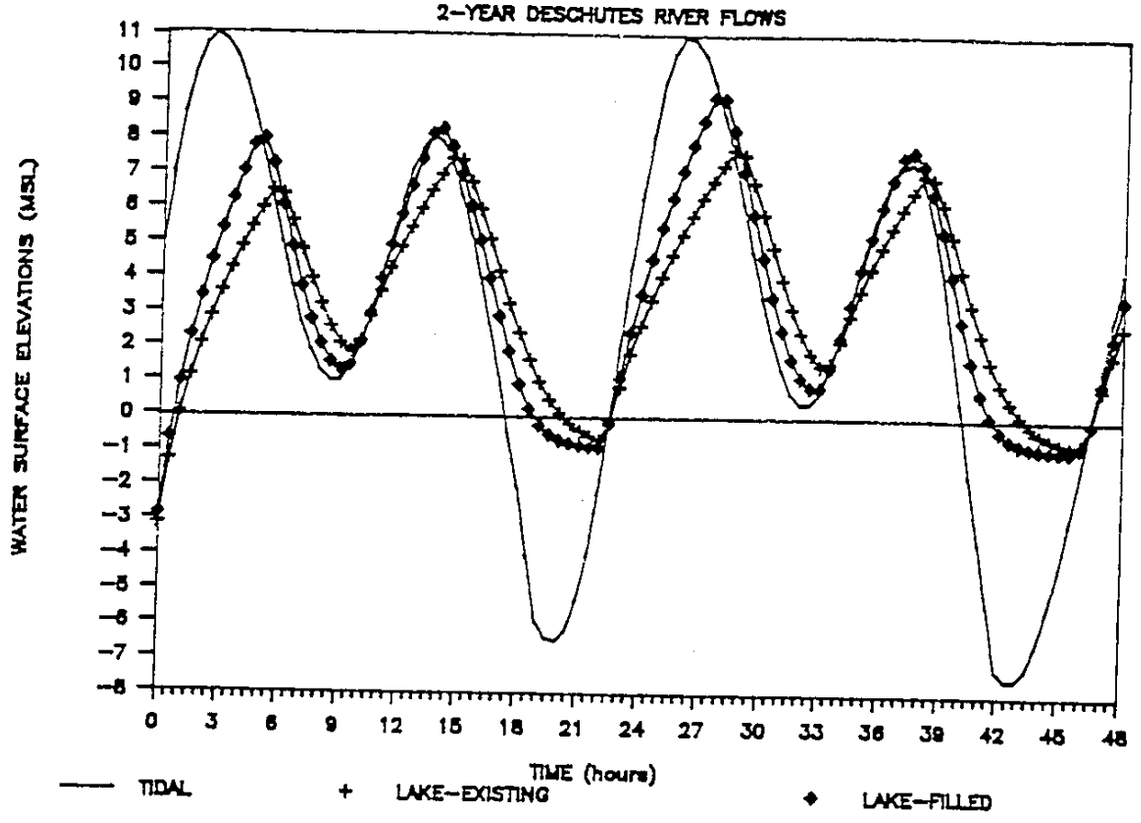
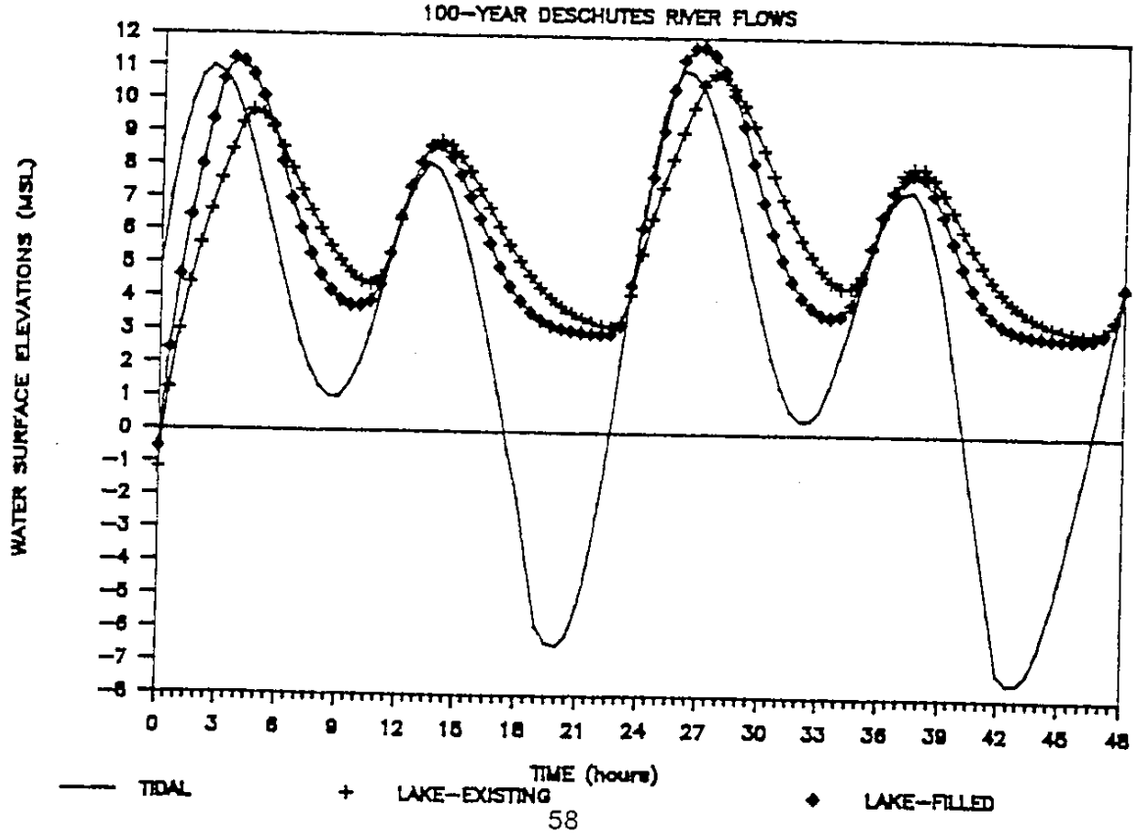


Figure 11
Comparison of Different Starting Water Surface Elevations,
2-Year and 100-Year Deschutes River Flows





The City of Olympia has estimated the 100-year flood elevation at approximate elevation 11.0 MSL, based upon federal flood hazard studies. During the recent January 9, 1990 flood, flood elevations in the City apparently reached elevations about 11.0 MSL. Flood damage occurred along Columbia and Water Streets as it typically does; however, flood damage was apparently not extensive.

Since Concepts I, II and III would ultimately result in filling of the majority of the volume of the middle basin, the potential flood impacts of the three concepts are expected to be similar. The increase in flood elevation of 0.35 to 0.80 feet is considered a significant impact when compared with existing flood elevations. Mitigation of potential flood impacts in the City of Olympia could be provided by constructing flood control dikes along the eastern shore of the north basin. This would require concurrent construction of underground detention storage in downtown Olympia and or one to several stormwater lift stations. These flood impact mitigation measures could interfere with the proposed Heritage Park Plan and Capitol Lake Park Renovation.

Potential flood impacts of Tumwater Historical Park, in the south basin, could also be mitigated by dike construction. It should be noted that potential flood impacts in the south basin could be reduced with Concept III given the potential for high river flows to transport existing sediment deposits downstream into the middle basin during low tidal elevations.

Finally, it should be noted that structures located in the existing flood plain are already exposed to the risks of flood impact and damage.

Water Elevations

The water surface elevation of Capitol Lake is controlled by the operation of tide gates located at the 5th Avenue dam. Currently the lake level is maintained at 6.43 feet MSL (-3.5 feet City of Olympia datum) during the summer months and at 5.43 feet MSL (-4.5 feet City of Olympia datum) during the winter months (C. Ikerd, pers. comm.).

The tide gates are closed when the tide elevation exceeds the lake level. Typically the gates are closed a couple of times each day, with the duration of the closure ranging from 20 minutes to 3 hours (C. Ikerd, pers. comm.). Actual closure times are dependent upon tide elevations and river flows. The higher the tide, the longer the gates are closed. Similarly, the lower the flows, the longer the gates are closed. Data collected by Entranco during the 1983 Capitol Lake study indicated that the gates usually remained closed for a period of about 3 hours (Entranco Engineers 1984).

When the gates are closed, the lake level rises in accordance with the amount of freshwater entering the lake. The Deschutes River dominates all inflows to Capitol Lake, contributing an estimated 85 percent of the annual freshwater budget. Average daily flows in the Deschutes River range from approximately 100 cfs during the summer to 850 cfs during the winter. At the extreme, recorded flows ranged from a low of 70 cfs up to a maximum of 6,650 cfs during the period from 1945 to 1964. Table A-2 summarizes recorded Deschutes River flows. Figure A-5 illustrates the range of daily flows that can be encountered over the course of a year.

Table A-2
Summary of Average Daily Flows
Recorded at the Deschutes River from 1945 to 1964
(USGS Station 12080000, Deschutes River near Olympia)

	Recorded Flows (cfs)		
Month	Average	Maximum	Minimum
October	175	932	70
November	501	3,700	77
December	669	3,770	83
January	787	4,930	221
February	852	4,200	160
March	586	3,360	239
April	466	1,760	218
May	311	1,030	143
June	191	391	110
July	132	312	84
August	107	181	74
September	106	268	77

Table A-3
Estimated Capitol Lake Level Fluctuations
Corresponding to a 3-Hour Gate Closure Time
(feet)

Month	Based Upon Maximum Daily Flows [1]	Based Upon Average Daily Flow	1983 Study [2]
October	0.92	0.17	NA
November	3.67	0.50	NA
December	3.74	0.66	NA
January	4.89	0.78	NA
February	4.17	0.85	NA
March	3.33	0.58	0.50
April	1.75	0.46	0.20
May	1.02	0.31	0.25
June	0.39	0.19	0.25
July	0.31	0.13	0.20
August	0.18	0.11	0.20
September	0.27	0.10	0.20

[1] Flows are based upon Deschutes River recorded data with a 14.7 percent adjustment (increase) to account for Percival Creek.

[2] 1983 data was collected at the north basin tide gate (Entranco 1984). Water surface elevation changes do not necessarily reflect changes in the middle and south basins.

Flood Control

Capitol Lake provides flood protection for low lying areas adjacent to the lake. Peak flows in excess in 2,000 to 3,000 cfs can be expected on an annual basis. During periods when high flows coincide with high tides, the lake serves to hold the incoming river flows until the tide elevation drops and the gates are opened. If adequate storage is not available, adjacent areas (including part of the city of Olympia) can flood.

Under existing conditions lake elevations may reach as high as 11.36 feet MSL during 100-year flow conditions. Flooding has occurred at the sites indicated in table A-4.

Table A-4
Historically Flood-Prone Areas in the
Vicinity of the North Basin of Capitol Lake

Location	Approximate Elevation
North Shore Parking Lot	8.0 feet MSL
East Shore Railroad Tracks	9.0 + feet MSL
Water Street	9.5 - 10.5 feet MSL
Columbia Street	10.0 + feet MSL
5th Avenue	11.0 + feet

Under current practice, the lake level is lowered when high flows are expected in the Deschutes River. The lake level can be dropped all the way if a major flood is expected (C. Ikerd, pers. comm.).

Coordination with the WDF is required to lower the lake level since the lake is currently being used for fish rearing. During the recent flood event of January 9, 1990. fisheries allowed 10,000 fingerlings to die when the lake level was lowered before the flood.

Table A-5 presents peak flows predicted for the Deschutes River. The recurrence interval represents the average frequency of occurrence for that particular flow. For example, a 2-year flow is expected to occur on the average once every two years. The predictions were statistically derived from flows recorded from 1945 to 1964. During that period, the maximum recorded flow was 6,650 cfs (on January 26, 1964).

Table A-5
Predicted Flood Flows for the Deschutes River
(USGS 1985)

Recurrence Interval (years)	Flow (cfs)
1	1,878
2	3,803
5	4,926
10	5,644
25	6,529
100	7,813

WSU (1975) estimated the 2- and 100-year Percival Creek flows to be 150 and 360 cfs, respectively.

The range of lake level fluctuations during flood flows depends upon the magnitude of the flow and the timing with respect to high tides. During high flows, the lake level can rise approximately one inch every five minutes (C. Ikerd, pers. comm.).

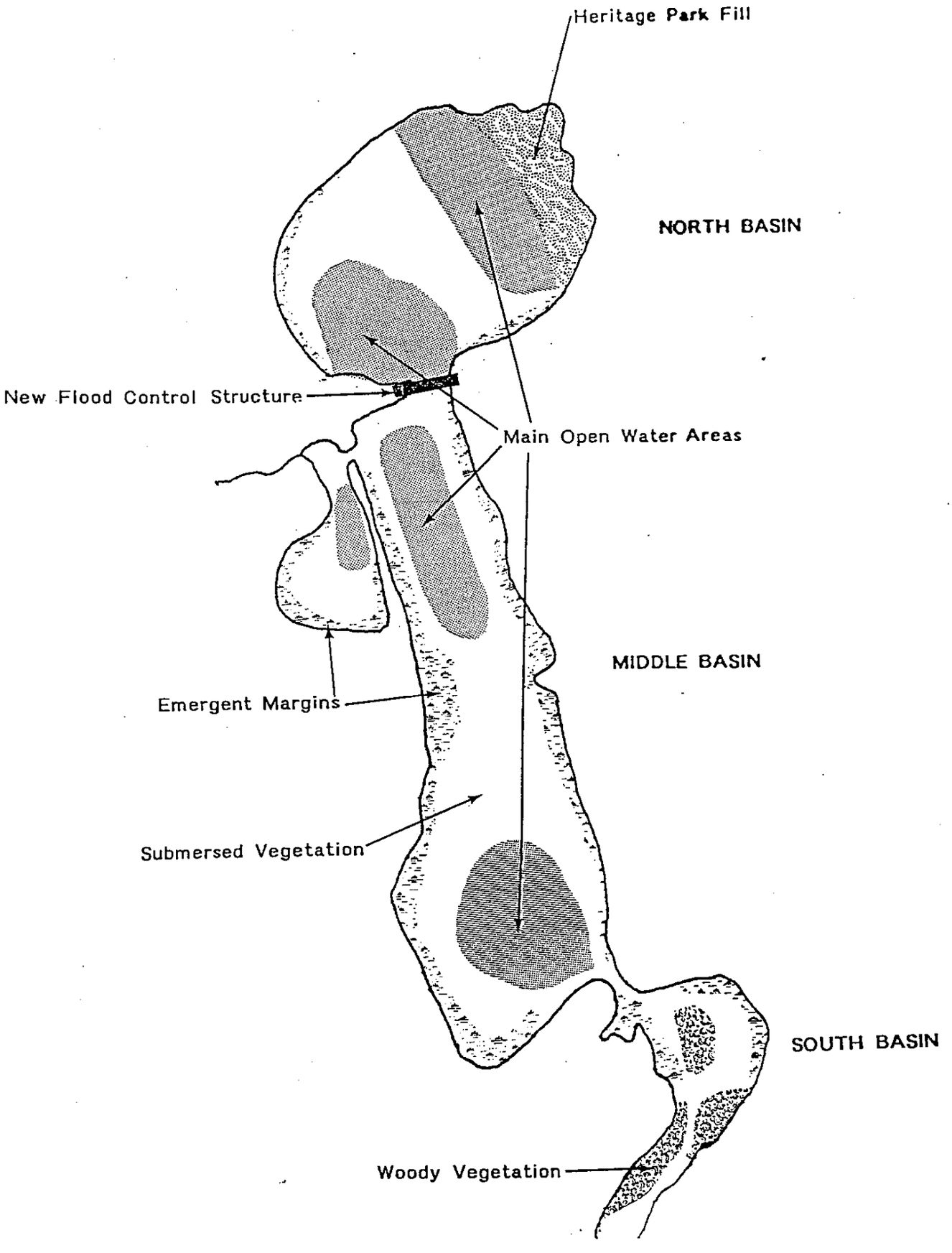
Table A-6 presents a range of lake level fluctuations that could occur under different flows and durations of tide gate closure. The larger lake level changes under the longer gate closure times (e.g. 3 and 6 hours) may not be realistic, because at some point in time, the lake level would exceed the tide, and the gates could be opened.

Table A-6
Estimated Capitol Lake Level Changes
Associated with Peak Flows in the Deschutes River

Recurrence Interval (years)	Flow (cfs)	Lake Level Rise (ft.) for Duration of Gate Closure			
		1-hour	2-hour	3-hour	6-hour
1.01	1,878	0.5	1.0	1.5	2.9
2	3,803	1.0	2.0	2.9	5.2
5	4,926	1.3	2.5	3.6	6.5
10	5,644	1.5	2.9	4.1	7.2
25	6,529	1.7	3.3	4.6	8.1
100	7,813	2.1	3.8	5.4	9.2

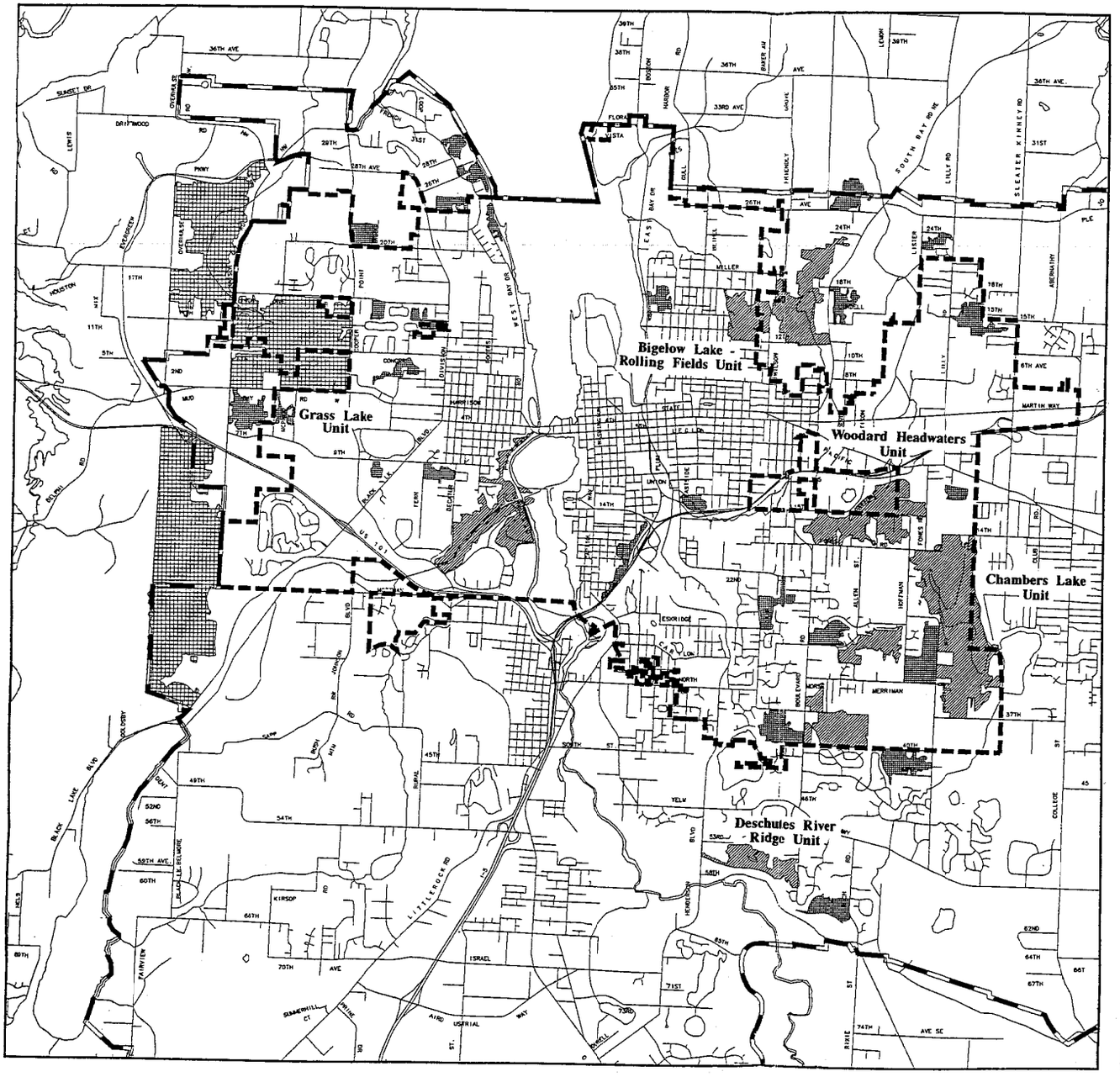
The values shown in table A-6 are based upon a starting elevation of 6.43, the typically maintained lake level. If the lake level was dropped prior to the flood flow, the elevation changes would tend to increase due to the fact that there is relatively less volume at lower levels. For example, it is estimated that if the lake is lowered more than 6 feet prior to the flood flow, the 10-year flow over a one hour duration would cause a 2.8 foot rise as opposed to a 1.5 foot rise beginning at the typically maintained lake level. The ending elevation, however, would be less.

Future flood elevations and/or the duration of gate closure could be changed if the predicted increase in sea level occurs. It is estimated that the mean sea level could rise by 1.5 to 6.5 feet by the year 2100 as a result of global warming. Higher tides would result in longer gate closures, thereby potentially causing higher water levels in Capitol Lake. Changes in the operation of the tide gates or the maintained lake level could offset some of the potential for flooding from the lake site.


Heritage Park Fill
NORTH BASIN
New Flood Control Structure
Main Open Water Areas
MIDDLE BASIN
Emergent Margins
Submersed Vegetation
SOUTH BASIN
Woody Vegetation

APPENDIX G

City of Olympia Comprehensive Plan Significant Wildlife Habitat Units



City of Olympia Comprehensive Plan

Significant Wildlife Habitat Units

- Large
- Medium
- Small
- Olympia City Limits
- Urban Growth Boundary

Disclaimer:

The information on this map is for planning purposes only. Urban and suburban zones (generally 4 houses/5 acres), lawns, playfields, row crop agriculture, or undeveloped land under one acre were not included in this study.

City of Olympia

Date: 7/12/94

Map 2-4

G.1

Produced by: Olympia Community Planning & Development
Advance Planning & Historic Preservation

APPENDIX H

A Paraphrase of Comments Received on October 1995 Draft SEIS and Responses from the Washington State Department of General Administration

APPENDIX H

A PARAPHRASE OF COMMENTS RECEIVED ON OCTOBER 1995 DRAFT SEIS AND RESPONSES FROM THE WASHINGTON STATE DEPARTMENT OF GENERAL ADMINISTRATION

Because this is a new Draft Supplemental Environmental Impact Statement (DSEIS), the Washington State Department of General Administration (DGA) has decided not to publish the written letters from the October 1995 DSEIS. This decision was made with the understanding that there would be a new DSEIS and a new set of written comments, and that it could be confusing to readers to have two sets of comments and responses in the Final SEIS. However, DGA also determined that it would be appropriate and helpful to summarize the key issues raised in the October 1995 DSEIS and to indicate how they have been addressed in this new DSEIS. The following table has been prepared to provide this information.

Comments are listed in the following order: (1) state agencies, (2) local agencies, (3) tribes, (4) corporations, and (5) individual citizen comments.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Ecology	1. The Shoreline Permit for maintenance dredging is only good for five years and would not cover the entire ten-year plan as indicated in the October DSEIS.	The new project proposal in this revised DSEIS is limited to a five-year period.
Ecology	2. A wetland mitigation plan will be required prior to issuance of the Shoreline Permit for any alternative impacting wetlands.	The DGA has initiated several meetings with Ecology and the City of Tumwater regarding further definition of wetland mitigation. The discussion of wetland mitigation for the Gravity Dewatering Alternative has been expanded in this new DSEIS.
Ecology	3. Construction of wetlands in the shoreline buffer area would be considered "wetland enhancement" by Ecology. A minimum of 1:1 replacement ratio is necessary in Capitol Lake, plus additional mitigation in the lower reaches of Capitol Lake.	These concerns are reflected in the revised discussion of wetland impacts and mitigation in this new DSEIS. The DGA is committed to working out wetland mitigation details with Ecology, the Department of Fish and Wildlife, the City of Olympia, the City of Tumwater, and the U.S. Army Corps of Engineers (Corps).
Ecology	4. A vegetation planting and monitoring plan will be needed as part of the mitigation plan.	The DGA will include a planting plan and monitoring plan as elements of wetland mitigation. Refer to the Plants and Wildlife section of Chapter 5 of this SEIS.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Ecology City of Tumwater	5. The issue of saltwater flushing needs to be addressed as it relates to the feasibility of wetland mitigation and impact/benefit to the fish rearing program.	Saltwater flushing will retard the growth of true freshwater aquatic plants in the littoral zone of any enhancement wetlands. Impacts are less likely on marsh and scrub-shrub vegetation, especially if these plant types are established in the spring prior to saltwater flushing in June or July. The impact of saltwater flushing on fish will be addressed in the Capitol Lake Management Plan and will also be regulated under a new HPA permit to be issued by the Washington State Department of Fish and Wildlife. Therefore, it is not addressed further in this SEIS.
Ecology	6. Regarding purple loosestrife, does the County Weed Control Board quarantine prohibit dredged sediments from being used elsewhere in the lake or watershed?	It is DGA's understanding that the Thurston County Noxious Weed Control Agency will allow transfer to a limited number of remote disposal sites under the condition that these sites will be monitored and controlled. This understanding is reflected in the Plants and Wildlife section of this DSEIS.
Ecology	7. Monitoring and control will be necessary elements of the wetland mitigation plan.	The DGA intends to include purple loosestrife monitoring and control as part of the wetland mitigation plan.
Ecology	8. Clearly define the No Action Alternative and don't confuse it with partial filling of the lake.	In keeping with the original 1977 FEIS, the No Action Alternative has been defined as complete filling and loss of the lake. To avoid confusion, reference to impacts of possible mitigation mea sures that would limit filling have been eliminated.
Ecology	9. The description of the Gravity and Mechanical Dewatering alternatives need to clearly indicate that return flows will be routed through the wetlands, and the impacts (water level, sedimentation, etc.) need to be addressed. Also, any work in the channel connecting the two wetland bodies needs to be addressed.	These changes have been incorporated in this new DSEIS.
Ecology	10. Contact Loree Randall regarding use of flocculents.	Loree Randall has been contacted, and copies of information on "Chitosan", the proposed flocculent, have been faxed to her.
Ecology	11. Wetlands can reduce fecal coliform counts in the lake.	The degree of treatment is dependent upon the size of the wetland, rate of inflow, residence time of bacteria in the wetland, and other variables.
Ecology	12. Wetland mitigation needs to consider avoidance and minimization in the disposal area.	Avoidance and minimization opportunities are addressed in the mitigation section of Plants and Wildlife.
Ecology	13. Provide information on the width of the shoreline buffer zone and the existing and proposed lake bottom contours.	New text and figures have been included in this DSEIS to provide the requested information.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Ecology	14. Discuss consistency of the proposed project with Section Three VI.D.1 on page 65 of the Shoreline Master Program (SMP). Specifically address whether long-term maintenance dredging every other year is an "activity or use of a nonpermanent nature" and one that would "not significantly degrade the existing character of the area", and one that would be "characterized by low-intensity land use and moderate-intensity water use with moderate to little visual evidence of permanent structures and occupancy." Also address definition, purpose and goal statements of the SMP, pages 28 and 29.	The requested assessment has been provided in this new DSEIS, but in the context of the new dredging proposal, in which dredging would occur once or possibly twice over a five-year period, rather than once every other year for a ten-year period.
Ecology, City of Tumwater	15. On page 1 of the DSEIS make it clear that there is only one lakeside disposal site, and that the Centralia Coal Mine site has been eliminated.	These changes have been made.
Ecology	16. Provide documentation that the cities of Tumwater and Olympia support measures to maintain the middle basin as open water.	This new DSEIS makes reference to the 1989 Capitol Lake Action Plan, in which both the City of Tumwater and the City of Olympia participated. In addition, DGA has committed to developing a Capitol Lake Management Plan beginning in 1996.
Ecology	17. Ecology recommends that the DSEIS not be finalized until additional PSDDA sediment testing is completed under the "Dredger's Option".	The revised sediment removal plan will involve dredging in sediment removal sectors 1 and 2, only (**figure 2** of Chapter 1). These sectors have no sediment contamination.
City of Tumwater	18. Should purple loosestrife monitoring be stopped after 2 years?	**Table 2** has been modified to indicate monitoring for eight years, consistent with **Appendix D**.
City of Tumwater	19. The existing City of Tumwater Noise Ordinance restricts trucking operations to the hours of 7:00 a.m. and 6:00 p.m., weekdays only.	This change has been made in this new DSEIS. It is understood that a new noise ordinance in under consideration by the City Council and may be approved prior to commencement of dredging. The DGA will comply with the appropriate ordinance restrictions at the time of construction.
City of Tumwater	20. The section of the DSEIS regarding Shoreline Use and Critical Areas needs to include discussion of the City of Tumwater Critical Areas Ordinance pertaining to wetlands	The new information has been included in this new DSEIS.
City of Tumwater	21. The City of Tumwater Public Works Director indicated a desire to require interagency agreement to monitor and repair any roadway damage caused by truck haul.	The DGA is concerned that this will not be feasible, because it will be impossible to distinguish impacts caused by trucks associated with the project and other trucks using overlapping routes. The DGA thinks this may be possible for the section of roadway within 100 feet of the construction access at Capitol Lake and the Chehalis Western Trailhead. The DGA will require the contractor to repair any damage which is the obvious result of project truck traffic within this 100-foot zone.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
City of Tumwater	22. Include Tumwater in section 2.1.4.	This correction has been made.
City of Tumwater	23. Correct **figure 9** to indicate that no return flow water will be discharged to the sanitary sewer.	This correction has been made.
City of Tumwater	24. In section 3.5.1, indicate that only those Lakefair activities associated with the lake—boat races, etc.—would be lost if the 5th Avenue dam is removed.	It seems that if there is any action taken to remove the dam, and the lake is eliminated, that the annual community fair will, at a minimum have to be renamed, since there would no longer be any lake. It is understood that some new kind of fair could be held with similar socio-economic benefits.
City of Tumwater	25. Does noise travel better over water than land, and should this be noted in the DSEIS?	Noise does travel better over water than land, and noise impacts could be somewhat greater than the levels indicated in the October DSEIS. This has been noted in this new DSEIS.
City of Tumwater	26. Replacement ratios of 2.5:1 up to 12:1 are specified in the City of Tumwater Wetlands Protection Ordinance, where "enhancement" is the proposed method of mitigation instead of "creation". Replacement ratios are 1.25:1 up to 6:1 for wetland creation, depending on the classification of the impacted wetlands.	At the suggestion of Ecology, DGA is prepared to provide enhancement mitigation in Capitol Lake at a minimum ratio of 1:1. Other mitigation could involve participation in riparian improvements under the Deschutes Riparian Habitat Rehabilitation Plan. The amount of riparian mitigation will be determined cooperatively between DGA, Ecology, and the City of Tumwater.
City of Tumwater	27. Include the language - "as long as the proposed use is consistent with community needs, provided there is appropriate opportunity for public review and comment", in the section on Land and Recreational Uses on pages 95 and 96 to qualify statements regarding consistency with existing and future land uses.	The DGA understands that the City of Tumwater is concerned about whether it would be consistent with existing and future land use to conduct maintenance dredging every other year for a period of ten years. The DGA believes that the revised short-term (five-year) maintenance dredging proposed in this new DSEIS is consistent with community needs, as indicated in the 1989 Capitol Lake Restoration Committee Report and Proposed Action Plan. This is the most recent document containing policy and broad community goals regarding the preservation of Capitol Lake. Whether a longer-term, higher frequency of dredging is consistent with Tumwater land use or shoreline use designations is an issue that DGA intends to discuss thoroughly with the City of Tumwater in the context of the upcoming Capitol Lake Management Plan.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
City of Tumwater	28. In section 5.6.2.2.1, how can it be said there will be no significant change in land use with destruction of 3.75 acres of wetland?	The DGA holds the view that there is no significant change in land use because the two-chamber gravity dewatering pond was constructed in the early 1980s following the design concept prepared by Richard Carothers and Associates (**1981**). The dewatering facility was used in this manner once in 1986. The new plan is to continue use of the dewatering facility as it has been conceived since the early 1980s, including disruption of wetlands within the dewatering area.
City of Tumwater	29. The maintenance exemption under the City of Tumwater Wetland Ordinance does not apply.	Appropriate corrections have been made on pages 102, 103, 107, and 109.
City of Tumwater	30. Consider an alternative haul route not involving use of Cleveland Avenue and Yelm Highway to avoid construction in the spring of 1996 and the summer of 1997.	If an alternative route is needed, and it is not entirely clear that one will be needed, DGA would recommend the use of local streets to access I-5 southbound to 93rd Avenue SW, east on 93rd Avenue SW to Old 99 Highway SE, and then to Rich Road, and 89th Avenue SE. This alternative route is included in the Transportation section of this DSEIS.
City of Olympia	31. Please include a distribution list in the DSEIS and include Joanne Richter, Todd Stamm, and Steve Friddle from the City of Olympia.	The distribution list is included in this new DSEIS and includes Joanne Richter, Todd Stamm, and Brad Davis.
City of Olympia	32. There is insufficient information to support the need for long-term maintenance dredging.	In view of this concern by the City of Olympia and other commentors, DGA has agreed to engage in the cooperative development of a Capitol Lake Management Plan. The issue of whether or not to perform long-term dredging will be addressed in this planning process. Proposed maintenance dredging under this DSEIS has been reduced to no more than two dredging cycles over a five-year period. This will allow DGA to continue maintenance activities under the policy direction of the existing 1989 Capitol Lake Restoration Committee Report and Proposed Action Plan, until the new Capitol Lake Management Plan is completed.
City of Olympia Squaxin Island Tribe Steve Shanewise (The Coot Company)	33. Are the flood impacts of the No Action Alternative as great as indicated in the DSEIS? Are flood control dikes and berms really needed for mitigation?	Since the City of Olympia has questioned the need for this mitigation, DGA has indicated that this mitigation "may" be necessary.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
City of Olympia	34. More information is needed to verify the claim that the No Action Alternative would have adverse impacts on views and property values.	The DGA has taken photos of the south basin and middle basin to compare the views, since the middle basin may look like the south basin once filling has progressed to the same degree. Based on this comparison, DGA believes that the view impacts are real. Regarding the property value impacts, DGA has revised the text to indicate that property value impacts "may" occur.
City of Olympia Squaxin Island Tribe	35. More information is needed to verify that the No Action Alternative would result in loss of fish rearing habitat.	If the entire lake fills with sediment, the remaining fish habitat would be primarily limited to the main river channel. The DGA questions whether this would be adequate to support the 7–8 million salmon released from hatchery operations. It may be possible, however, to release fish to upstream segments of the Deschutes River to provide the necessary amount of habitat. This view is reflected in the new DSEIS. The appropriate lake management approach for fisheries also will be addressed in the Capitol Lake Management Plan.
City of Olympia Squaxin Island Tribe Steve Shanewise	36. An analysis of other alternatives to systematic dredging of the entire middle basin is needed. Another possibility would be to allow the middle basin to fill, with subsequent limited maintenance dredging in the north basin.	The DGA has revised the proposed action to limit dredging to sectors 1 and 2 only (rather than 1–10). The option to resume dredging in the north basin after the filling of the middle basin is addressed as a mitigation measure for the No Action Alternative.
Squaxin Island Tribe	37. Systematically dredging the entire middle basin is considered outside the scope of a supplemental EIS given the scope of selective dredging identified in the 1977 Final EIS.	In response to this comment, DGA has withdrawn the proposal to dredge in sectors 3 through 10, and has limited the present proposal to sectors 1 and 2, which encompass the original recommended sediment trap, and an adjacent area to the east.
Squaxin Island Tribe	38. The beneficial uses of Capitol Lake should be (1) better defined, (2) prioritized, and (3) trade-offs identified for alternative management approaches.	These concerns will be addressed in the Capitol Lake Management Plan. The planning process is scheduled to begin in 1996.
Squaxin Island Tribe	39. What is the fish habitat value of the south basin? What documentation can be provided regarding fish habitat use for sockeye salmon and rainbow trout as opposed to steelhead?	The DGA has no information on this subject, but would be willing to include a discussion in the Final SEIS if the Squaxin Island Tribe has information that they would like to share.
Steve Shanewise (The Coot Company)	40. What is the water quality benefit of dredging the lake? Can dredging be performed to enhance water quality?	There is little short-term (five-year period) water quality benefit associated with maintenance dredging. However, if maintenance dredging is not performed, the lake will become increasingly shallow, there will be increasing areas of poor water circulation as sand bars isolate the main river channel from backwater areas, and this will lead eventually to higher water temperatures, increased algae growth and seasonally low (summer and fall) dissolved oxygen levels.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Steve Shanewise	41. Aquatic vascular plants help to remove nutrients from the water. Ninety-five percent of the lake basin is devoid of plant life because of saltwater flushing. Therefore, all saltwater flushing should be eliminated.	The role of aquatic vascular plants in removing nutrients is complex. While DGA agrees with Mr. Shanewise that aquatic plants are important to nutrient removal in wetland treatment systems, DGA believes that plants do not play an important role in Capitol Lake. This is because the short water residence time in the lake does not allow for plant uptake of nutrients and because there is a relatively low plant density. In any case, this is not a significant issue with the revised scope of dredging because there is presently little or no aquatic vegetation to impact in sectors 1 and 2. The DGA also agrees that there would be more aquatic plants in the absence of saltwater flushing. Whether this is desirable or not is a question that will be addressed in the upcoming Capitol Lake Management Planning process. Some people think that saltwater flushing should be increased so as to convert the system back to a tidal estuary.
Steve Shanewise	42. There may be adverse impacts to Budd Inlet associated with lake drawdown prior to saltwater flushing. These need to be evaluated.	In the future, this issue will be addressed by DGA and the Washington State Department of Fish and Wildlife annually, with the issuance of an Hydraulic Permit Application for drawdown, and an environmental checklist. These issues will also be addressed in the Capitol Lake Management Planning process.
Steve Shanewise	43. Dredging ought to be referred to as "Perpetuity Dredging" if it is going to be required as a long-term, ongoing maintenance function. Consider (1) installing a permanent pipeline to a permanent marine barge mooring site, (2) focusing on maintaining high water quality/habitat for fish as the primary beneficial use, (3) incorporating new flood control measures in the north and middle basins, (4) designing/maintaining the system to accommodate human recreational uses. See a proposed conceptual lake plan with open water, submergent vegetation, and emergent shoreline edges.	These are all interesting concepts that will be explored in greater depth during the Capitol Lake Management Planning process. The figure you provided has been incorporated in the DSEIS at the end of **Appendix F**.
Steve Shanewise	44. The public meeting of October 25, 1995 should not be considered a valid public hearing since no testimony was recorded.	Notes were taken regarding public testimony at the meeting. However, public comments will be recorded at the next public hearing on the new DSEIS.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Steve Shanewise	45. More attention should have been given to the No Action and other alternatives in the October DSEIS (page 7).	Since the revised DSEIS only addresses dredging in areas proposed in the original 1977 Final EIS, which did include several in-lake dredging alternatives, the modified proposal is considered an appropriate "supplemental" impact statement. As indicated above, other alternatives will be explored more fully in the Capitol Lake Management Planning process.
Steve Shanewise	46. The total dredging costs in **table 1** are incorrect.	Thank you for pointing out this error. **Table 1** has been revised and corrected in this new DSEIS. The table has also been modified to reflect the lower amount of dredging proposed.
Steve Shanewise	47. Can the work be scheduled to avoid the Christmas season?	An attempt will be made to minimize the visual impact of the pipeline by routing it along the shoreline of the lake. In Budd Inlet, most of the pipe would be submerged and lying on the bottom. However, work will still be done during the December 1 to March 1 time frame to minimize impacts on salmon.
Steve Shanewise	48. The Corps indicated that wetlands within the dewatering construction area are not under their jurisdiction, but made no comment about DGA's right to use them (page 11).	The text has been revised to use language quoted from the Corps letter.
Steve Shanewise	49. Juvenile salmonids do not use the open water habitat that would be lost (page 13, third paragraph).	See comment 35 and its response.
Steve Shanewise	50. Capitol Lake is already subject to wetland regulations (comment regarding the No Action Alternative).	The text has been revised to take out the comment regarding wetland regulations.
Steve Shanewise	51. Fish passage from Percival Cove to Capitol Lake would not be impaired with the No Action Alternative as indicated in paragraph 3, page 33.	Dredging in Percival Cove has been eliminated from the new proposed action.
Steve Shanewise	52. What will be the impact of return flow water to Budd Inlet with the Marine Disposal Alternative (page 45)?	The entire dredge slurry (including sediment and water) will be discharged to barges in Budd Inlet with no overflow or return flow to Budd Inlet. The entire slurry will be barged to the designated marine disposal site at Anderson/Ketron Island and it will be dumped there. Therefore, no adverse impacts to Budd Inlet are anticipated, assuming no significant barge leakage or accidental spillage.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Steve Shanewise	53. The DSEIS indicates that dredging will no longer take place in the south basin because of "highly valued wetlands and fish and wildlife habitat." If this is true, then what is the concern about similar habitat developing in the middle basin (page 48)?	This is a good question and clarification is needed. Under existing conditions, the south basin does provide highly valued habitat for both fish and wildlife during most of the year. However, prior to the first fall rains in late summer and early fall, poor water quality is common in the backwater areas of the south basin. These areas have poor water circulation because the majority of flow through the south basin is confined to the main river channel. Poor water quality is best illustrated by thick algae mats that grow only in the backwater areas of the south basin (see **figure 21** in Chapter 5). It is our view that as the south basin continues to fill with sediment in coming years, that the extent and severity of algal growth could become worse. If it does, this could lead to fish kill problems when the algae mats die and decompose, because the decomposition process could lead to reduced dissolved oxygen levels in localized areas. This could be particularly problematic during the late summer/early fall when many adult salmon congregate in the south and middle basins, for up to a month or more prior to the first fall rains. We think that this problem could extend into the middle basin as sand bars develop, and large portions of the lake become cut off from active water circulation patterns that help maintain good oxygen supply. We do note, however, that algal growth problems may be mitigated to some degree in the future by implementing better nutrient control measures in the watershed.
Steve Shanewise	54. Lake Fair would not cease if the basin became a tidal basin (page 48).	See comment 24 and its response.
Steve Shanewise	55. Elimination of dredging for 60 years should save $36 million or more according to **table 1**.	**Table 1** has been revised, due to the error noted in comment 46. However, based on the cost per yard, $10 to $27, the cost to dredge 60 years of sediment accumulation (assuming 35,000 cubic yards per year) would be $21 to $57 million, depending on the method of disposal. A footnote has been added to show this range.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Steve Shanewise	56. The cost of the saltwater flushing barrier could be reduced by constructing it at the shortest distance across the channel instead of north of the channel as shown in **figure 16a**.	The DGA understands this concept and the interest in saving dollar resources. However, the proposed sheet pile construction needs to be located some distance away from the railroad trestle to avoid adverse structural impact to the trestle. In developing this conceptual engineering plan, the engineers assumed that it would be unlikely that Burlington Northern would permit construction of added structural elements onto their existing trestle. The pedestrian bridge was added in compliance with the SMP which promotes public access enhancements for projects under shoreline permit jurisdiction.
Steve Shanewise	57. Water quality would not degrade with the formation of a natural marsh (page 81).	See comment 53 and its response.
Steve Shanewise	58. Why would silt curtains not extend all the way to the bottom (page 84)?	Good question. If silt curtains extend all the way to the bottom, accumulating silt can deposit on the portion of the curtain lying on the bottom and add sufficient weight that the curtains tear in the process of trying to re-locate them. This problem is avoided when the curtains are limited to a depth of 1-2 feet off the bottom. The settling out of sediment is still enhanced within the curtain.
Steve Shanewise	59. Are cutthroat trout found in Capitol Lake or not (page 87)?	Yes. The report has been revised to eliminate ambiguity.
Steve Shanewise	60. Fish will not get stranded on sandbars in a natural Delta Marsh system.	The DGA has clarified the text on page 113 to indicate that the concern with stranding is not that fish will become stranded on sandbars, but may become stranded in backwater areas isolated from the main river channel by sandbars.
Centralia Mining Company	61. The Centralia Coal Mining Company requested that the mine permit area be eliminated from further consideration as an upland disposal site.	The mine permit area has been eliminated from the new DSEIS.
Resource Management, Inc.	62. The goal of maintaining the lake is supported, and especially the beneficial fish use. Sediment control will continue to be needed as development continues in the watershed.	Comments noted.
Resource Management, Inc.	63. Dredging work will help maintain good water quality for the fisheries, since shallow water tends to heat up more rapidly. Warmer temperatures could result in fish kills.	The DGA agrees that higher temperatures under shallow water conditions could be of possible concern to fish life. Also see response to comment 53.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Resource Management, Inc.	64. Recent studies by the University of Washington and the Corps show that water quality can be severely degraded on a daily basis below dense beds of aquatic plants, with high temperatures near the surface, and low dissolved oxygen levels near the sediment.	The DGA agrees that these are potential problems associated with excessive aquatic plant growth. Excessive plant growth has been avoided during the past 25 years, in large measure by the practice of saltwater flushing. However, DGA also recognizes the beneficial influences that aquatic plants can have when limited to appropriate coverage and density (supply oxygen to the water column during the day, provide shading, provide habitat and cover for fish and fish food organisms, etc.). The DGA is committed to a further evaluation of the advantages and disadvantages of aquatic plant beds during the Capitol Lake Management Planning process.
Resource Management, Inc.	65. There is an active and increasing use of the middle basin by fisherman, right in town. This recreational fishing activity would be lost if maintenance dredging is not performed.	The DGA agrees with this assessment. However, DGA is open to comments from the Department of Fish and Wildlife and the Squaxin Island Tribe regarding priority management considerations. These will be addressed in the upcoming Capitol Lake Management Planning process.
Resource Management, Inc.	66. Purple loosestrife will be a continuing and costly management problem if Capitol Lake is allowed to become a wetland. Herbicide treatment—the most effective control method at present—is expensive and is opposed by some members of the public.	The DGA agrees with this assessment, and with the concern about the possible degradation of new wetlands, and the cost of appropriate management.
Resource Management, Inc.	67. Consideration could be given to piping the dredge slurry to an upstream location that does not have existing wetlands.	This is an alternative that can be explored during the Capitol Lake Management Planning process.
Resource Management, Inc.	68. Potential long-term impacts of dredging do not seem significant. There would be project benefits to wildlife, water resources, and recreational uses and adverse impacts to fish and wildlife if the project is not implemented.	The DGA agrees with this assessment.
Jerry L. Harper Evergreen Park Association	69. Capitol Lake provides a highly appreciated resource in terms of beauty and its many uses for area residents. Even if the lake had not been created, dredging would be required to maintain navigable depths for shipping in the harbor and Budd Inlet. We believe that dredging should be done to preserve Capitol Lake and that the dredged materials should be disposed of in a Corps approved deep water spoils disposal site in Puget Sound. There are safe ways to remove and dispose of the sediment without harming the fish or wildlife that depend on Capitol Lake.	Your comments are appreciated.

Table H-1
Summary of the October SEIS Comments and Responses

Source	Comment	Response
Northland Planning Service	70. I appreciated being included in the review of this document. I have been involved with this project at several points over the past twenty-five years.	Your comments are appreciated, especially the insights on the history of this project.
Percival Point Property Owner's Association	71. Our association which represents seven condominium owners, strongly recommend that the dredging be done. Our condominiums have as one of their main features the beautiful vista overlooking Capitol Lake. We feel that not dredging would significantly affect our properties value both aesthetically and financially. We support the dredging and transport of the material for disposal at the Anderson Island site.	Your comments are appreciated.
Dan Beedle	72. I agree that dredging should be performed to maintain and preserve Capitol Lake. However, I feel that marine disposal poses too many potential environmental problems due to the amount of material proposed for dredging and disposal. Disposal at the Thurston County Landfill seems to be reasonable but disposal at the other two sites—Centralia Coal Mine and Chehalis Western Trailhead—do not appear to be an appropriate solution. I prefer the Mechanical Dewatering Alternative as the most efficient, least time involvement, and being the most environmentally sound. I would propose that the dewatered materials be sold to landscaping companies to defray the dredging costs rather than have them trucked to disposal sites.	Your comments are appreciated.
Mabel H. Hansen	73. If the residents of Olympia supported allowing the lake to fill in that would be all right, although I am concerned about the salmon's ability to spawn. The Gravity Dewatering Alternative appears to be the best in terms of limiting disturbance to plants, fish, animals, and people. I would support this alternative. If the Gravity Dewatering Alternative cannot be selected, I would support the Marine Disposal Alternative as my second choice. The Mechanical Dewatering Alternative would not get my support. I believe it is valuable to preserve the areas we currently have for plant and wildlife habitat, water resources, and the current land and recreational uses.	Your comments are appreciated.

APPENDIX I

Puget Sound Dredged Disposal Analysis Sediment Testing Results For Capitol Lake

CAPITOL LAKE REVISED SHORT-TERM MAINTENANCE SEDIMENT REMOVAL PLAN - JANUARY 1996

Sediment chemistry testing is required under the Puget Sound Dredged Disposal Analysis (PSDDA) program to determine if sediments can be safely disposed of in Puget Sound. The PSDDA program is jointly administered by the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and Washington State departments of Ecology and Natural Resources.

Sediment samples from dredge material management units 1, 2, 3, 8, 9, and 10 (**figure 18** of the Draft SEIS) were collected on September 20, 1995. The PSDDA program requires that sediments be tested for a total of 76 chemicals. Laboratory test results indicated that for sectors 1 and 2, none of the 76 chemicals occurred at levels that would cause concern for the environment.

One chemical from this list, benzoic acid, exceeded the maximum level established by PSDDA criteria in sectors 3, 8 and 9, where no dredging is proposed at the present time. Benzoic acid is an anti-microbial compound that is used as a food additive to preserve foods and beverages at concentrations up to 1,000 parts per million. It also occurs naturally in some foods such as cranberries, prunes, plums, and ripe olives and in some plant resins. Because it is used as a food additive, there is no human health concern with this compound. However, there may be concerns about potential impacts to aquatic organisms. Benzoic acid was below the limit of detection at sectors 1 and 2.

APPENDIX J

Nontoxic Flocculents Technical Information

NEW

NOW APPROVED

PROCESSING AID

CHITOSAN AS FLOCCULENT IN FOOD AND FEED INDUSTRY

Chitosan is a natural, nontoxic polycationic coagulant/flocculent. This biopolymer is extracted from shrimp and crab shells, and is available through a stable supply from Pronova Biopolymer a.s. It is approved for animal feed and as food processing aid.

It is effective for recovering valuable proteinaceous materials. The materials recovered by chitosan can be used for food and feed applications, unlike materials recovered by synthetic polyelectrolytes.

Technically the recovering of materials is mainly made by;

- gravity settling
- air flotation
- centrifugal dewatering

APPLICATION AREAS

- Juice/beverages	(2,11,22)
- Vegetable processing	(3,8,11)
- Poultry	(4,5,8)
- Meat	(8)
- Meat by-products	(8,12)
- Dairy - cheese whey	(7,8,25)
- Seafood	(1,6,8,17,19,20,24)

- Miscellaneous	
- *fruitcake waste*	*(6,8)*
- *molasses*	*(10,18)*
- *alfalfa protein*	*(13)*
- *starch*	*(14,21)*
- *sludge dewatering*	*(15,23)*
- *tomato seed protein*	*(16)*

PRONOVA
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APPROVALS - SAFETY IN USE OF PRONOVA BIOPOLYMER CHITOSANS

Chitosan has been included in the Codex Alimentarius Inventory of Processing Aids (ALINORM 91/12, para 104), effective by The 22th Session of the Codex Committee on Food Additives and Contaminants, Hague, March 20, 1990. Chitosan has been given approval in feed (Official Publication 1986, pp. 177-178 from the Association of American Feed ControlOfficials Incorporated). When used as flocculent to recover feed constituents, maximum chitosan concentration should not exceed 0.1% of the feed.

Chitosan is used in food and pharmaceuticals, and has general food approval in Japan.

Chitin, the acetylated parent compound of chitosan, is a normal part of our diet, e.g. baked goods (yeast) some cheeses (fungi), mushrooms and shellfish.

All Pronova Biopolymer chitosans for use in food processing aid applications fulfils the requirements of;

FAO FOOD AND NUTRITION PAPER - 4 - Rome 1978: Specifications for Identity and purity of Thickening Agents, Anticaking agents, Antimicrobials, Antioxydants and Emulsifiers.

FOOD CHEMICAL CODEX, 3. Edition, Washington, D.C., 1981

EEC: Council Directive of 25 July 1978 laying down specific criteria of purity for emulsifiers, stabilizers, thickeners and gelling agents for use in foodstuffs (78/663/EEC).

BDR: Reinheitsanforderungen laut Anlage 1 zur Zusatzstoffverkehrs-Verordnung (Bundesgesetzblatt Nr. 88 vom 23. Dezember 1977).

CHITOSAN CHEMISTRY

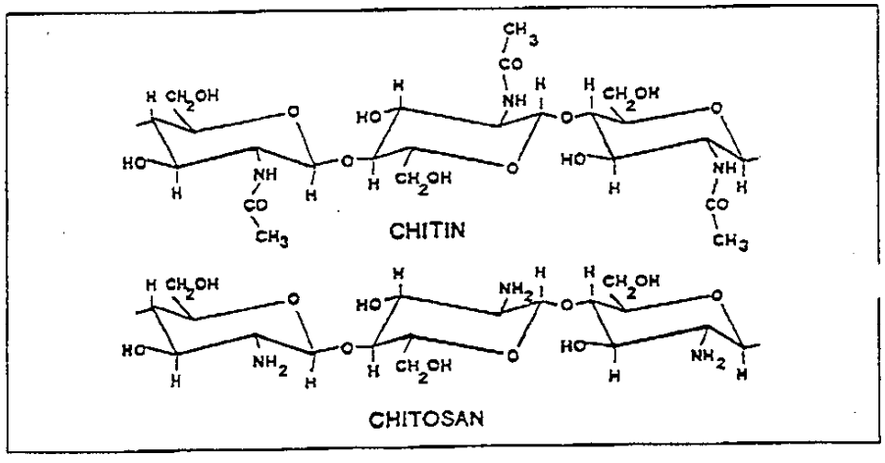
Chitosan is partially deacetylated chitin. Chitin is extracted commercially from shrimp and crab shells, and transformed to chitosan to obtain a soluble polymer.

Potential raw materials are numerous.

Chitosan is a biopolymer, specifically a polysaccharide, which consists of only two monosaccharides; N-acetyl-D-glucosamine and D-glucosamine. The soluble chitosans usually contain above 70 % D-glucosamine. These monosaccharides are linked together by one type of linkage, ß (1 - 4), which is identical with cellulose molecules.

It is the protonized (polycationic) form of chitosan which is soluble in aquatic systems, pH < 6.0. Chitosan dissolves in solutions of various acids, in most organic acids and in mineral acids like hydrochloric acid and nitric acid (table below).

CHEMICAL STRUCTURE OF CHITIN & CHITOSAN



SOLUBILITY (1 gm chitosan / 100 ml acidic solution)

Acid concentration	1%	5%	10%	50%	>50%
Acetic	+	+	+	+	
Adipic	+				
Citric	-		+		
Formic	+	+	+	+	+
Lactic	+	+	+		
Malic	+	+	+		
Tartaric	-		+		
HCl	+	-	-		
HNO_3	+	-	-		
H_3PO_4 1)	-	-	-		
H_2SO_4 1)	-	-	-		

1) Chitosan is not soluble in sulfuric acid and has only marginal solubility in phosphoric acid at concentrations below 0.5 %.

HOW IS CHITOSAN USED AS A FLOCCULENT

Preparation of chitosan solutions

Generally, a 1% stock solution is prepared and then diluted as needed. The pH must be maintained below 6.0 to avoid precipitation of chitosan.

The following procedures are recommended to prepare solutions on a large scale of ProFloc SD 340 and ProFloc 340.

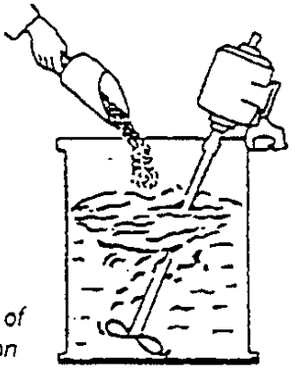
ProFloc SD 340, water soluble chitosan/adipic acid blend

Pronova Biopolymer offers dry blends of chitosan and adipic acid. This one-bag system offers the simplicity of merely adding the blend to water, which first dissolves the acid and then in turn dissolves the chitosan. Complete dissolution can be accomplished usually in 1-2 hours, depending on the mixing agitation.

ProFloc 340, pure chitosan

ProFloc 340 can be added to a previously prepared acidic solution or it can be slurried in water and then the desired amount of acid can be added. In both ways, the time of dissolution depends on mixing agitation.

Heating the chitosan solutions can accelerate the dissolution process, but prolonged heating in acid can result in loss of viscosity. In general, the concentration of the stock chitosan solution is 0.25 - 1.0% in 0.25-1.0% acid. Since high molecular weight chitosan is quite viscous, vigorous agitation will be required to prepare a 1% solution.



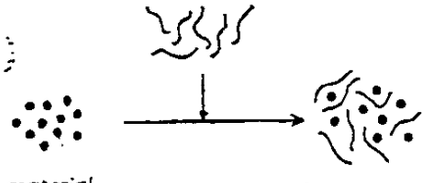
Preparation of stock solution

Optimizing the dosage levels of chitosan

In most applications the optimal chitosan concentration as flocculent should be in the range 20 - 200 ppm. Scaling up, through laboratory, pilot and full scale trials is compulsory to secure optimal results.

Flocculation tests (8,26)

Since each test solution will have varying amounts of material to be flocculated, the optimum ratio of chitosan to recovered solids will need to be determined. The optimum application rate of chitosan is generally accomplished by adding decreasing amounts of chitosan. This procedure will also avoid overdosing. Improved flocculation with chitosan can be achieved by altering the pH of the waste stream and by adding coagulation aids such as multivalent salts (e.g. Al, Fe, Ca).



material to be flocculated

addition of chitosan

flocculation

sedimentation

Jar Tests (9)

The following tests were used to show the effectiveness of chitosan to recover proteinaceous material from cheese whey (8). Chitosan solutions, 1 gm/100 ml in 2% (W/W) acetic acid were mixed in six amounts ranging from 2.5 to 15.0 ml per liter of cheese whey at pH 6.0. After dilution of chitosan, the solutions were mixed at 100 rpm for 2 minutes then 3 minutes at 30 rpm. After settling for one hour at room temperature, supernatants were analyzed for turbidity. Results can be expressed as percent reduction in comparison to that of an untreated control. In this particular study, the optimum dosages of around 50 mg chitosan per liter of cheese whey resulted in over 90% reduction of turbidity by coagulation of suspended solids.

Buchner funnel test for coagulated sludge (26)

The following test can be used to evaluate chitosan's effectiveness for coagulation of activated sludge provided multiple tests are run. Activated sludge suspensions (500 ml) are mixed (20 rpm) during addition of chitosan. After mixing for 2 minutes at 100 rpm, then 3 minutes at 30 rpm, the conditioned sludge is then filtered through Whatman No. 4 paper in a 9 cm diameter Buchner funnel. The amount of liquid collected in 30 seconds with a 24 inch Hg vacuum is measured.

PRONOVA BIOPOLYMER CHITOSAN FOR FLOCCULATION

ProFloc™: A powdered material suitable for water treatment, recovery of feed quality material from food waste streams, collection and removal of toxic metals, seed coating and industrial applications needing a cationic polymer.

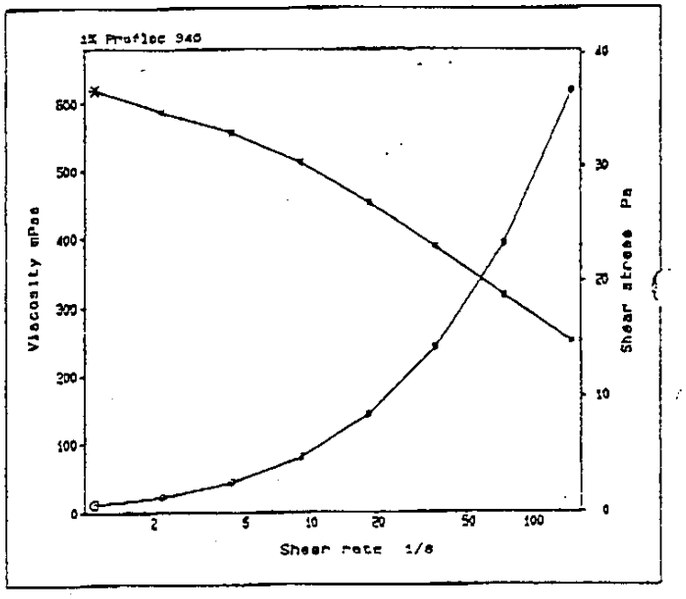
Product specifications;

- moisture	< 10.0%
- ash	< 1.5%
- insolubles	< 2.0%
- deacetylation	> 70.0%
- viscosity *)	> 200 mPa.s(cps)

*) Brookfield LVT Viscometer, 30 rpm, 25°C; ProFloc 340, 1% in 1 % Acetic Acid - ProFloc SD 340, 2 % in water.

BOHLIN RHEOMETER SYSTEM

Viscometry test
1990-11-08 10:34:41



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DISCLAIMER

Recovery and Utilization of Chitin and Chitosan in Food Processing Waste Management

Waste products of the shellfish industry have applications as diet supplements, and in food processing waste management, beverage clarification, and the production of packaging films

Dietrich Knorr

□ THE TREMENDOUS POTENTIAL of chitinous polymers for numerous applications has received limited recognition in the past. However, a significant amount of fundamental research on chitin and chitosan have been carried out since chitin was first described 180 years ago (Braconnot, 1811). Substantial research on chitin and chitosan has been performed especially during the last 20 years with four international conferences taking place and two significant publications appearing in 1989 (Skjåk-Braek et al., 1989; Pariser and Lombardi, 1989).

Chitin is a waste product of the seafood processing industry with an estimated 1.2×10^5 metric tons annually accessible on a worldwide basis (Table 1).

It is also estimated that fungi could provide 3.2×10^4 metric tons of chitin annually (Brine, 1984). Some values for chitin concentrations of mycelia of fungi are given in Table 2.

The two biopolymers chitin and chitosan (partially deacetylated chitin) offer a wide range of unique uses including clarification and purification of water and beverages; applications in pharmaceuticals and cosmetics; and agricultural, food, and biotechnology uses.

Total sales of chitin/chitosan are expected to reach almost 2 billion US dollars during the next ten years (Table 3). In the area of waste recovery and management two intriguing concepts for application and uses of chitinous polymers exist. One is the bioconversion of chitin/chitosan for the production of value added products and the other one is the utilization of the waste chitin/chitosan for the removal and recovery of other waste materials or valuable by-products. It is the aim of this paper to briefly review those two areas of chitin/chitosan utilization.

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Recovery of Chitin and Chitosan

Main U.S. sources of shellfish that are processed into chitin and chitosan are Dungeness crabs (*Cancer*

Table 1—Chitin from U.S. Crab *and shrimp processing waste and global estimates of potential chitin sources (after Brine, 1984)*

	Dry waste (10^3 metric tons)		Chitin (10^3 metric tons)	
Product	Worldwide	U.S	Worldwide	U.S.
Shellfish	154		39	
Crab		17		6
Shrimp		78		39
Krill	801		56	
Clam/oyster	482		22	
Squid	21		1	
Total	1,458	95	118	45

Table 2—Relative Amounts of Chitin *in the mycelium of various fungi (after Ruiz-Herrera, 1978)*

Fungus	Chitin content (%)
Mucor rouxii	9.4
Aspergillus phoenicis	23.7
Aspergillus niger	42
Neurospora crassa	8.0–11.9
Penicillium chrysogenum	19.5–42
Trichoderma viridis	12–22
Saccharomycopsis gutulata	2.3
Blastomyces dermatitidis	13
Histoplasma capsulatum	25.8
Histoplasma farciminosum	40
Tremella mesenterica	3.7
Paracoccidioides brasiliensis	11

magister), King crabs *(Paralithodes camschatica)* and the Pacific shrimp *(Pandalus borealis)*. The chitin and chitosan manufacturing process consists of removing proteins from ground shells by treatment with sodium hydroxide. Minerals such as calcium carbonate and calcium phosphate are removed by hydrochloric acid treatment. Deacetylation of chitin to chitosan is performed by treatment with sodium hydroxide to hydrolyze the N-acetyl-linkage, followed by rinsing, pH adjustment and drying.

Self-dissolving chitosan is prepared by blending chitosan powder with an organic acid (e.g. adipic acid) and purified chitosan can be processed by dissolving chitosan in an organic acid (e.g. acetic acid) followed by a filtration process (Sandford and Hutchings, 1987). A simplified flow chart of the chitin/chitosan manufacturing process is outlined in Figure 1.

Table 3—Estimated Worldwide Sales *of chitin and chitosan within 10 years (after Anonymous, 1989)*

Areas of application	Estimated sales (10^6 US$/year)
Agriculture	230
Cosmetics and toiletries	90
Food and beverages	110
Health care industry	1,250
Immobilization and cell culture	45
Product recovery and separation	50
Waste and water treatment	140
Total	1,915

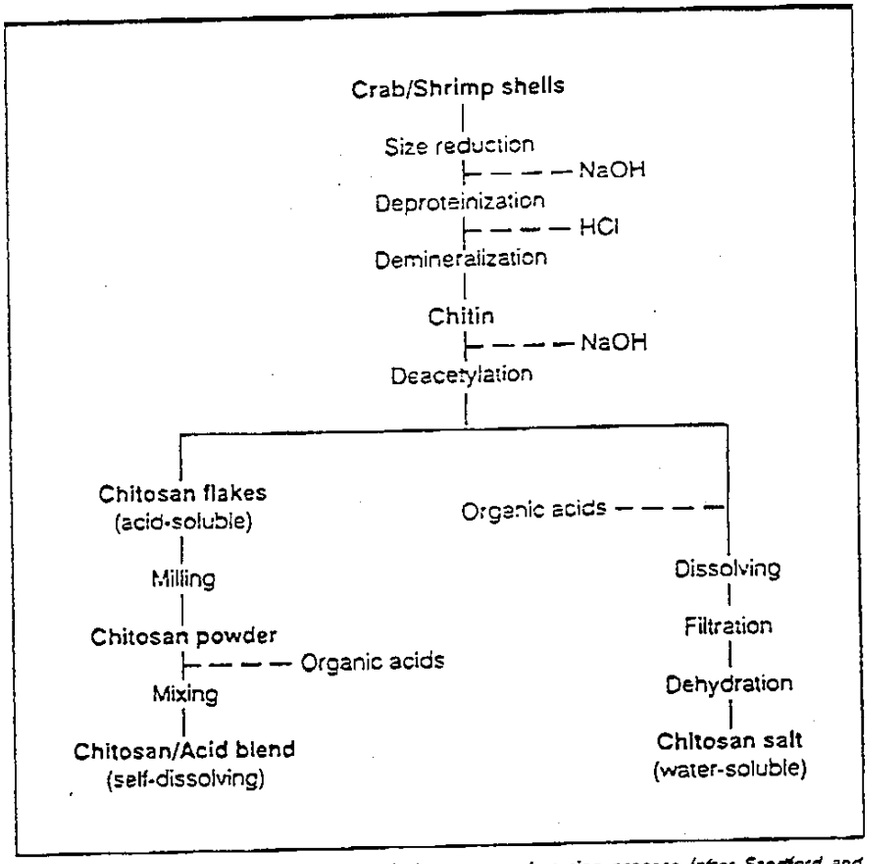

Fig. 1—Simplified Flowchart *of a chitin/chitosan manufacturing process (after Sandford and Hutchings, 1987)*

Conversion and Uses as Diet Supplements

Bioconversion of chitin to single-cell protein has been proposed by Carroad and Tom (1978) as a waste treatment alternative to the disposal of shellfish waste. The process concept consisted of size reduction of the chitin, protein and calcium carbonate containing shrimp waste. This was followed by protein removal by precipitation and by demineralization with acid. Some of the pretreated chitin was used for microbial chitinase production but the bulk of the chitin was hydrolized by chitinase. The yeast *Pichia kudriavzevii* was shown to grow well on the chitin hydrolysate at high temperature and low pH and to yield an acceptable amino acid distribution of the resulting protein fraction (Revah-Moiseev and Carroad, 1981). Based on these findings a process flow diagram and an economic analysis had been developed (Cosio et al., 1982). Screening of seventy-two strains of bacteria for ability to hydrolize chitin revealed 23 strains capable of hydrolyzing chitin (Cody et al., 1990).

Nutritional studies with broiler chicken have shown that microcrystalline chitin as diet supplements of up to 20% controlled diarrhea commonly occurring when whey is added to the chicken diet (Austin et al., 1981). According to the authors supplementation of chicken diets with chitin stimulated the growth of bifidobacteria that can synthesize lactase. Lactose has been the limiting factor for successful utilization of whey as chicken feed supplement (Spreen et al., 1984).

The effects of chitin, chitosan, and cellulose as diet supplements on the growth of cultured red sea bream, Japanese eel, and yellow tail have been investigated by Kono et al. (1990). The growth rate of all fishes fed with a 10% chitin supplement recorded the highest value indicating diet superiority. Feed efficiency in the red sea bream and Japanese eel which were fed with the 10% supplemented diet also recorded the highest values (Table 4).

Chitinase, chitosanase, and cellulose activity was measured in the stomach of the three types of fishes and only chitinase activity was de-

tected (Kono et al., 1987). The level of chitinase activity correlated with the growth rates of fish fed with the chitin supplemented diets and the authors concluded that chitin was digested and utilized by fishes with high chitinase activity in their digestive glands. This opens an interesting potential for fish farming since chitinase activity has also been detected in other fishes such as cod (Danulat, 1984). One also wonders what whales do with the 4 to 8 tons of krill (approx. 30 to 60 kg chitin) they consume daily.

The role of microbial and plant derived chitinases and their important role in the degradation of fungal cell walls should also be mentioned in this context (Oishi et al., 1989).

Hirano et al. (1990) recently provided data on chitin and chitosan digestibility by rabbits and hens (Table 5). No abnormal symptoms of chitosan supplement fed rabbits, broilers or hens were observed for up to 239 days with < 0.8 g chitosan/kg body weight/day and < 1.4 g chitosan/kg/d respectively. At concentrations of 3.6-4.2 g/kg/d physiological disorders could be observed in feeding experiments with hens for 189 days.

Chitosan supplements also decreased the concentrations of animal serum cholesterol (Table 5).

The nutritional significance and the digestion of chitinous waste materials as feedstuffs for cattle has been shown by Patton and Chandler (1975) and by Ortega and Church (1979). Watkins and Knorr (1983) evaluated the effects of dietary chitin supplements on growth and gut function of gerbils and Sugano et al. (1980) examined the effects of chitin and chitosan on growth of rats (Table 6). Up to 8.5% chitin addition and 10% chitosan addition no growth inhibition was reported. According to Arai et al. (1968) the LD50 dose of chitosan in laboratory animals is 16 g/kg body weight.

Table 4—Diet Supplements. Effect of Chitin, Chitosan, and Cellulose as Diet Supplements *in rearing of cultured fish during 30 days (after Kono et al., 1987)*

Fish type	Diet	Growth rate[a] %	Feed efficiency %
Red sea bream (N = 70)	Control	541	19.0
	5% chitin	550	19.2
	10% chitin	577	20.4
	20% chitin	548	19.1
Red sea bream (N = 40)	Control	253	12.6
	10% chitin	326	17.7
	10% chitosan	175	9.5
	10% cellulose	318	16.0
Japanese eel (N = 200)	Control	89	26.5
	10% chitin	95	29.8
	10% chitosan	24	7.3
	10% cellulose	61	18.2
Yellow tail (N = 50)	Control	177	20.0
	10% chitin	188	21.2
	10% chitosan	125	14.8
	10% cellulose	179	21.5

[a](Weight gain/initial body weight) × 100

Table 5—Serum Cholesterol Values. *Effects of chitin and chitosan supplements on their digestibility by rabbits and hens and on their serum cholesterol values (after Hirano et al., 1990)*

Supplement[a] (%)	Feeding period (d)	Digestibility (%)	
		Rabbits	Hens
Chitin (2)	25	35	—
	12	—	92
Chitosan (2)	5	41	—
	15	82	—
	39	83	—
Chitosan (5)	12	—	98
Chitosan (10)	12	—	67
		Total cholesterol serum (mg/dL)	
None	—	79 ± 4	—
Chitosan (1)	15	76 ± 0	—
Chitosan (2)	15	76 ± 0	—
Cholesterol (0.7)	39	850 ± 21	—
Chitosan (1) + cholesterol (0.7)	39	690 ± 13	—
Chitosan (2) + cholesterol (0.7)	39	300 ± 13	—
None		—	210 ± 10
Chitosan (5)	74	—	120 ± 10
Cholesterol (0.7)	81	—	370 ± 15
	189	—	670 ± 0
Chitosan (2) + cholesterol (0.7)	81	—	250 ± 15
	189	—	420 ± 0

[a]to basal diet

Biosorption of Heavy Metals, Dyes, and Pesticides

Higher awareness of the ecological and health effects of heavy metals and pesticides and their accumulation through the food chain has promoted a demand for purification of industrial waste waters prior to their discharge or their reuse. Conventional methods for the removal of metals from industrial waste solutions such as chemical precipitation or oxidation, filtration, electrochemical treatment, ion exchange, application of membrane technology and evaporation recovery, may be ineffective or expensive, espe-

cially when metals are available at low concentrations (Volesky, 1987). Naturally abundant biosorbents such as shellfish chitin/chitosan or chitin/chitosan containing microorganisms (Knorr and Klein, 1986) have been applied successfully. Muzzarelli and Tanfani (1982) presented data on the chelating ability of fungal waste mycelia which had been treated with boiling 40% sodium hydroxide to obtain insoluble chitosan-glucan complexes, for various metal ions. The effectiveness of crosslinked N-carboxymethyl chitosan in removing lead and cadmium from drinking waters has recently been demonstrated (Muzzarelli et al., 1989). Examples of adsorption of metal ions by chitosan from different sources are presented in Table 7.

It is also noteworthy that growth inhibition of *Chorella* cultures in the presence of copper and mercury ions was reduced in the presence of chitin and chitosan (Blair et al., 1982).

Adsorption of dyestuffs from processing effluents onto chitin has been reported by McKay et al. (1982) and dye binding properties of chitin have been investigated by Knorr (1983). In a pH range between 1 and 7 binding properties of chitin for FD&C Red No. 40 remained practically unchanged. Dye binding was between 0.7 and 0.8 mg dye per g chitin or chitosan. The kinetics of sorption of dyes on chitosan and the effects of temperature, particle size of chitosan, and pH of the dye solution have been examined by Venkatrao et al. (1986).

Purification of polychlorinated biphenyl (PCB) contaminated water with chitosan was shown to be apparently more effective than activated charcoal (Van Daele and Thomé, 1986; Thomé and Van Daele, 1986). It is interesting to note that these authors used the common barbel *(Barbus barbus)* as a biological test system for the efficiency of the process.

Table 6—Weight Gain. *Effect of chitin and chitosan on weight gain, and liver weight of gerbils and rats (after Sugano et al., 1980, 1988; Watkins and Knorr, 1983)*

Dietary manipulation	Weight gain (g)	Liver weight (g/100 g body weight)
Control[a]	137 ± 7[A]	3.6 ± 0.1[A]
2% chitosan supplement[a]	137 ± 6[A]	3.6 ± 0.1[A,B]
5% chitosan supplement[a]	121 ± 11[A,B]	3.4 ± 0.1[A,B]
10% chitosan supplement[a]	96 ± 5[B]	3.2 ± 0.1[B]
Cellulose control[b]	144 ± 6	5.1 ± 0.1
25% chitosan[b]	135 ± 6 to 148 ± 7	4.3 ± 0.2 to 4.5 ± 0.2
Cellulose control[c]	218 ± 12	5.0 ± 0.1
4% chitosan	189 ± 5	3.0 ± 0.5
Cellulose control[d]	145 ± 5	4.7 ± 0.1
5% chitosan	104 ± 8 to 123 ± 7	3.6 ± 0.1 to 3.8 ± 0.2
	Weight (g)	
Control[e]	46.4 ± 3.4[A]	3.3 ± 0.3[A]
2.1 chitin[c]	49.5 ± 3.8[A]	2.8 ± 0.7[A]
4.2 chitin[e]	51.3 ± 2.8[A]	2.6 ± 0.3[A]
8.5 chitin[e]	51.8 ± 3.0[A]	2.8 ± 0.6[A]

[a]20 days experiment, age of rats at start of experiments 52 days (N = 6)

[A,B] values in the same column in each experiment sharing common superscript letters are insignificantly different at P > 0.05 to 0.01

[b]22 days experiment, initial age of rats 100 g, N = 12

[c]28 days experiment, initial weight of rats 100 g, N = 5

[d]21 days experiment, initial weight of rats 134 g, N = 3

[e]17 days experiment, gerbils, N = 4

Protein Recovery

Data on the effectiveness of chitosan for the recovery of proteins from food processing wastes are presented in Table 8 and a comparison of various coagulating and flocculating agents is given in Table 9. These data indicate slightly higher reduction of turbidity and total suspended solids when chitosan was used at lower concentrations as compared to other commercially applied coagulating and flocculating agents.

Chitosan was also utilized as a coagulant for amino acids from crawfish processing waste water (No and Meyers, 1989) and flocculation of microalgae could be achieved at chitosan concentrations between 10 and 80 mg/L (Lubian, 1989).

Table 7—Rate of Adsorption of Metal Ions *by chitosan from different sources (after Ramachandran Nair and Madhavan, 1982)*

Metal ions	Chitosan source: Crab	Prawn	Squid	Squilla
	mg of metal adsorbed per g of chitosan[a]			
Fe^{3+}	17.6/23.4/23.4	11.7/15.7/23.4	17.6/20.5/23.4	14.6/17.6/29.3
Co^{2+}	4.1/ 4.7/ 5.9	5.3/ 7.1/ 7.1	4.7/ 4.7/ 7.4	4.7/ 4.7/ 4.7
Ni^{2+}	35.2/55.2/64.6	47.0/64.6/82.1	29.3/64.6/82.1	29.3/52.8/76.3
Hg^{2+}	241/281/321	311/331/341	321/346/366	351/381/411
Cu^{2+}	21.1/36.2/39.3	30.2/42.3/66.4	27.2/45.3/51.3	42.3/60.4/60.4

[a]First number = 30 min, second = 60 min, third = 120 min of treatment. 1 g of chitosan powder was added to 100 ml of 0.1 M solution of the metal ions.

Table 5—Use of Chitosan in the Recovery of Proteins

Protein source	Chitosan concentration (mg/L)	pH	Crude protein content of coagulated solids (% dry matter)	References
Cheese processing	2.5–15	6.0	78	Bough and Landes (1976); Wu et al. (1978)
Fruitcake processing	2	4.5	13-22	Bough (1976)
Meat processing	5-30	6.0-7.3	41	Bough (1976);
	15-40	7.4	32-51	Castellanos Perez et al. (1989)
Poultry processing	6-30	6.4-6.7	34-68	Bough (1975), 1976)
Crawfish processing	150	6.0	27	No and Meyers (1989)
Mussel processing	40	4.5	28	Holland and Shahbaz (1985)
Shrimp processing	60-360	5.5-6.0	*	Senstad and Almas (1986)

*55% protein recovery

Reduction of Microbial Counts

The antimicrobial potential of the polycationic chitosan has been discussed recently (Papineau et al., 1990; Popper and Knorr, 1990). Based on data on the effectiveness of chitosan for protein removal and recovery, a design for a combined process was attempted where microorganisms are removed by chitosan with concurrent protein removal/recovery.

The effects of various fining agents on turbidity and microbial counts of apple juice inoculated with *Lactobacillus plantarum* are demonstrated in Figure 3. These data suggest an effective reduction of turbidity as well as a reduction of microbial counts at ambient temperatures. This is of interest because of the current consumer demand for minimally processed foods. Even more dramatic effects on microbial populations could be observed when chitosan treatment was followed by a homogenization step (Popper and Knorr, 1990).

Affinity Purification

Chitosan, a natural polyligand rich in N-acetyl-D-glucosamine was—because of its specificity—effective in affinity precipitation of wheat germ agglutinin (Senstad and Mattiasson, 1989a). Since the polyligand is soluble at pH levels below 6.5 and precipitates at higher values it coprecipitated associated wheat germ agglutinin (WGA). The authors reported on overall yield of WGA of (70% and scale up of the procedure. Bloch and Burger (1974) used chitin as a ligand matrix and obtained an agglutinin that was homogenous with respect to polypeptide chain molecular weight, that had a blocked amino terminus and was free of proteolytic and β-N-acetyl-glucosaminidase activity.

Affinity-precipitation using chitosan as ligand carrier has been introduced by Senstad and Mattiasson (1989b). These authors indicated that this procedure presented a new and efficient way of utilizing affinity interactions in free solution and recovering the target molecule simply by precipitation. Trypsin could be precipitated at almost 100% using a soybean trypsin inhibitor-chitosan solution as the heterobiofunctional ligand.

Clarification of Beverages

Acid soluble crabshell chitosan and water soluble chitosan salt proved equally effective as fining agent for apple or carrot juices (Imeri and Knorr, 1988; Soto Peralta et al., 1989). The one step chitosan application was also found to be equal in effectiveness to the more cumbersome conventional silica sol/gelatin/bentonite treatment. As shown in Figure 2, 0.8 kg chitosan per m^3 of apple juice were sufficient to reach zero turbidity.

Biodegradable Packaging Films and Wildlife Protection

Environmental damage may occur through improper disposal of petrochemical based plastics such as six-pack straps. Bade and Wick (1988) reported that an estimated 30 percent of the fish in the world's oceans have pieces of plastics in their stomach that interfere with digestion. Based on the fact that chitin and chitosan have proven film forming properties (Averbach, 1978) and that chitosan degrading microorganisms are abundant (Fenton et al., 1978), Bade and Wick 1988) suggested the use of biodegradable

Table 9—Space Effect of *various coagulating and flocculating agents on the reduction of turbidity and total suspended solids of meat packing waste effluents (after Castellanos-Perez et al., 1989)*

Product	Concentration (mg/L)	Turbidity (final NTU)	Flocculation efficiency (%)	Total suspended[a] solids (mg/L)	Reduction of suspended solids (%)
Shrimp chitosan	20–40	2.0–4.9	94-98	4.5-11.1	95-98
Crab chitosan	15	4.4	96	14.0	95
Aspergillus niger chitosan–glucan complex	50–100	5.3-7.4	93-95	11.5-15.5	94-95
Cat-Floc[b]	40	4.4	96	17.7	93
$FeCl_3$	120	5.0	95	10.7	96
$Al_2(SO_4)_3$	150	5.2	95	11.7	95

[a]Initial concentration = 250 mg/L

[b]Commercial polymeric flocculating agent (Calgon Corp., Mexico City)

chitinous polymers for environmental protection and waste reduction. Mayer et al. (1989) recently demonstrated that underivatized chitosan had superior oxygen barrier properties but less tensile strength and flexibility compared with synthetic packaging films such as mylar and polypropylene.

When chitosan was crosslinked with epichlorohydrin the tensile strength of mylar and polypropylene was approached (Mayer et al., 1989). Also, an interesting concept was presented by Yang and Zall (1984) who fabricated alkali and acid resistant reverse osmosis membranes by acetylation of chitosan membranes.

What's Next?

The recovery of chitin and chitosan has become more sophisticated over the years resulting in highly purified or water soluble products. However, the recovery process itself could still be improved. For example, it seems imaginable that proteases are being utilized for protein removal and it is surprising that chitosan is not being utilized for the recovery of crab/shrimp proteins or amino acids during the processing of chitin. In addition, chitin and chitosan could have a significant impact on the seafood industry as dietary supplement in fish farming and waste removal including proteins, heavy metals, and pesticides.

The removal of proteins, heavy metals, dyes, and pesticides from liquid food systems by chitin or chitosan is of general importance for the food and feed industry. Also, affinity purification, clarification of beverages, reduction of microbial counts are important features of chitosan applications for waste management and reduction.

Finally, due to the biodegradability of the chitinous polymers, chitin and chitosan can provide essential contribution to the reduction of packaging waste and to wildlife protection.

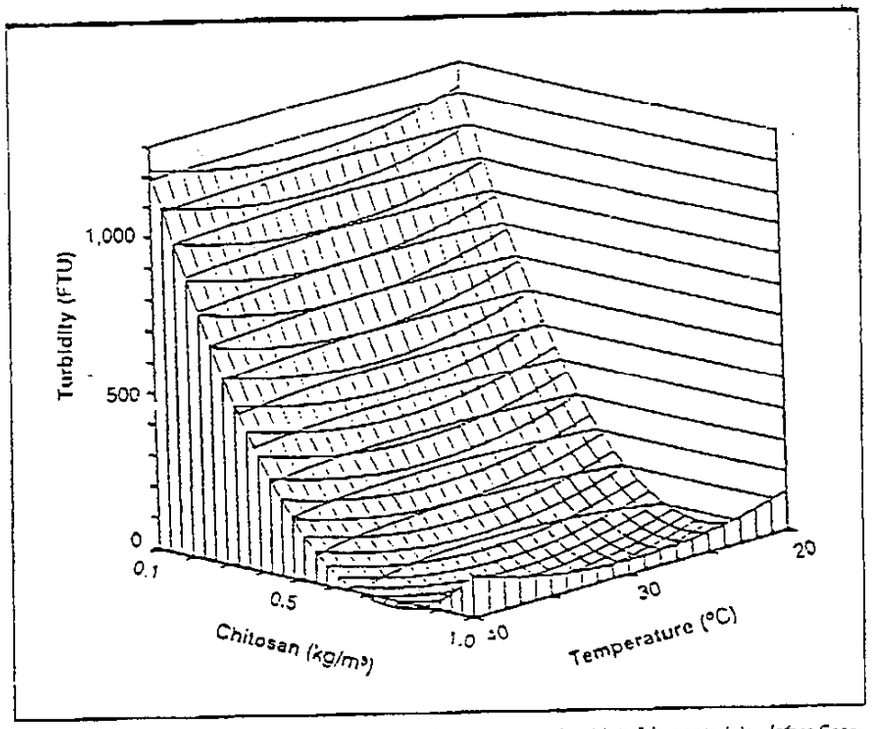

Fig. 2—Effect of Water Soluble Chitosan *on the reduction of turbidity[a] in apple juice (after Soto-Peralta et al., 1989*
[a]formazin turbidity units

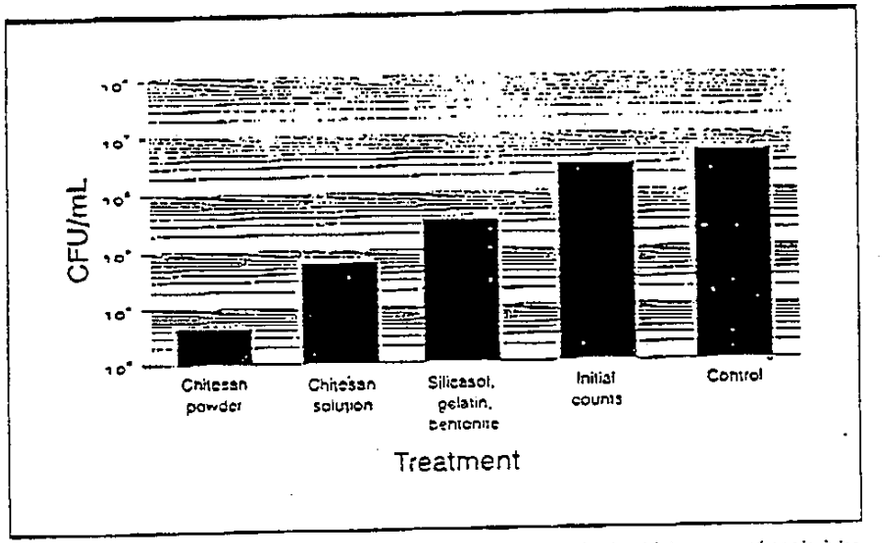

Fig. 3—Effects of Various Fining Agents *on turbidity and total microbial counts of apple juice inoculated with* Lactobacillus plantarum *(after Boguslawski et al., 1990). Chitosan powder (1g/L), chitosan solution (2g/L), silicasol (3g/L)/gelatin (0.1g/L)/bentonite (0.5g/L); control = fining treatment without polymer addition*

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PRONOVA
BIOPOLYMER

P R O D U C T S P E C I F I C A T I O N

Product name : PROFLOC 340

Generic name : Chitosan

Product code : 27430040

				SME No:
Viscosity	:	> 200	mPas	4004
pH	:	6.5 - 8.0		4003
Loss on drying	:	< 10	%	4018/4019
Insolubles		< 2.0	%	4013
Deacetylation	:	> 70	%	4001
Ash content		< 2.0	%	4020
Particle size	:		Ground coarse	

SME: Pronova Biopolymer Standard Method
Methods available upon request

Drammen, January 1, 1993
Pronova Biopolymer, Fine Chemicals

PRONOVA BIOPOLYMER

CHITOSAN AND ALGINATE IN WASTE WATER TREATMENT

USE

Chitosan and alginate are effective as a coagulant and flocculent for waste water treatment. These biopolymers make it possible to comply with effluent standards with reduced dosage of metal coagulant. Use of chitosan and alginate in waste water treatment offers several advantages.

ADVANTAGES

Environmental and health:

- Chitosan and alginate are natural, nontoxic polymers and are safe chemicals for plant operators to handle.
- Use of chitosan reduces the specific sludge production. Furthermore the sludge from the treatment process has a reduced metal content, making it more suitable for use in agriculture.
- Chitosan an alginate are biodegradable.

Process:

Chitosan and alginate have been tested as coagulant and flocculent for waste water treatment. Test results show that use of chitosan makes it possible to reduce the metal dose and thereby reduce sludge production. In addition, the use of alginate results in a sludge with good settling properties facilitating high hydraulic loading of sedimentation basins.

High loading of sedimentation basins result in:

- Low investment cost for sedimentation basins.
- Low energy consumption for heating in cases were the treatment plant is covered.

Low sludge production results in:

- Reduced cost for investment and operation of sludge storage, treatment and dewatering.
- Reduced amount of sludge for disposal in landfills or agriculture.

Figure 1. Schematic description of coagulation and flocculation

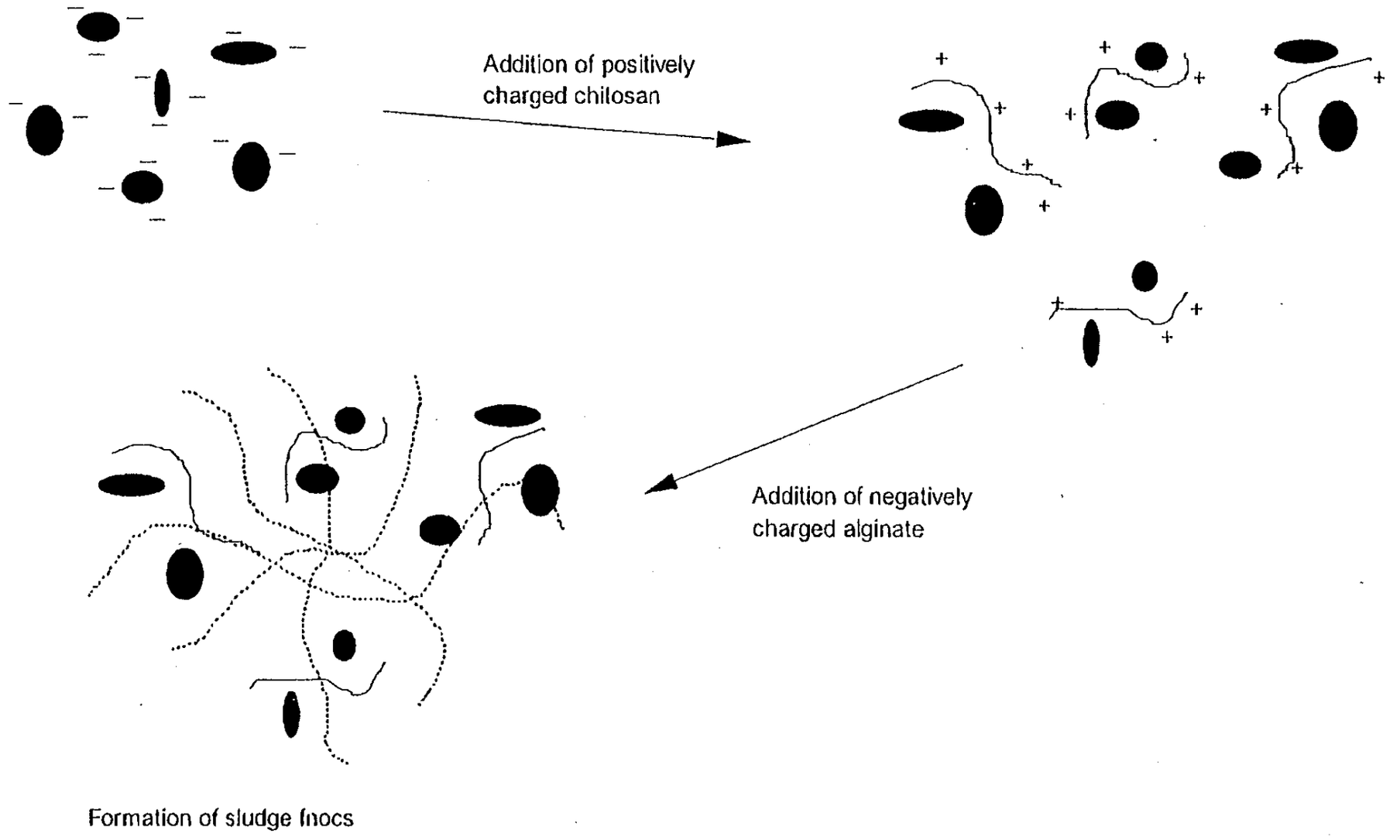
PROCESS SCHEME:

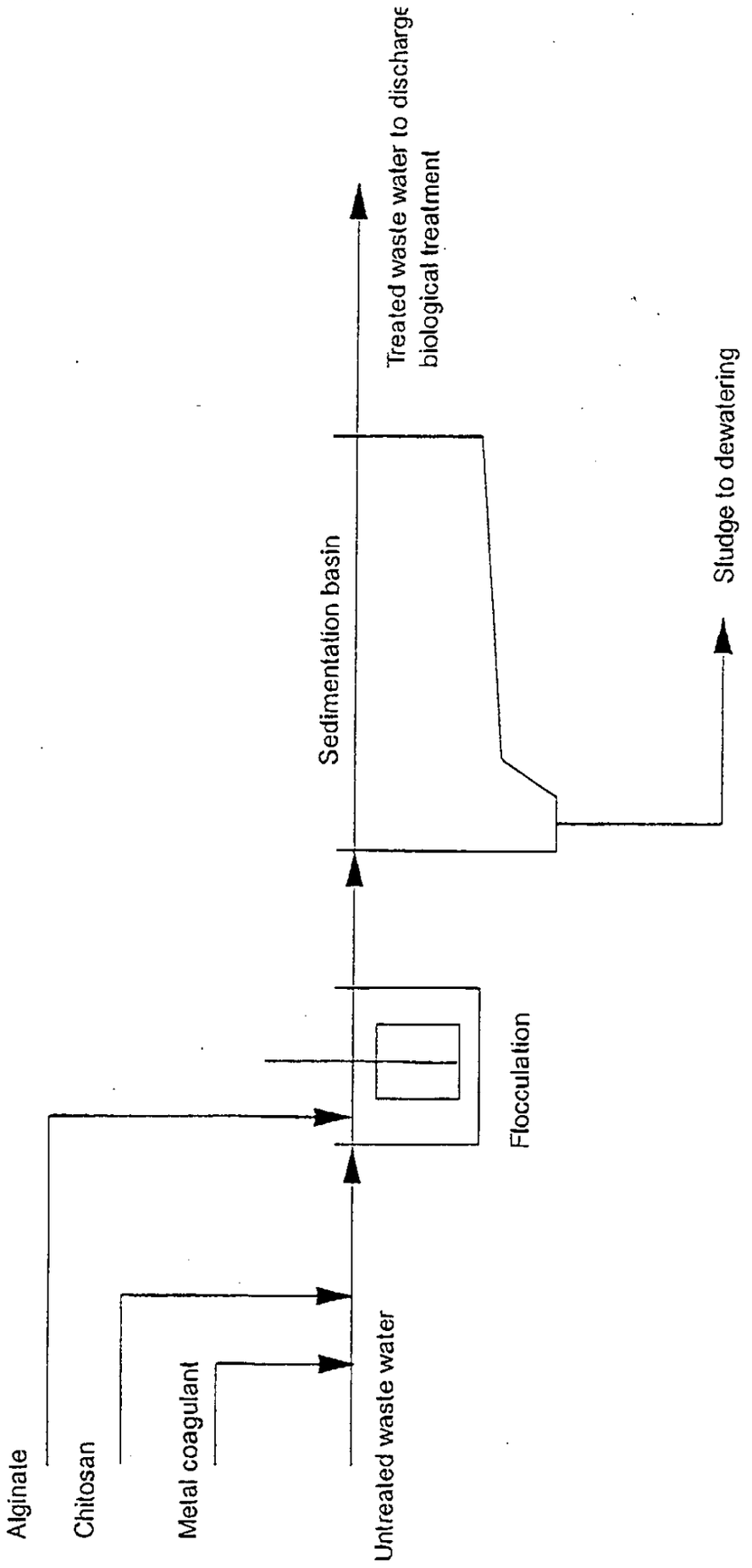
Figure 2. Typical process scheme for waste water treatment with chitosan and alginate.

Pronova Biopolymer, Inc.
Suite 201
135 Commerce Way
Portsmouth, NH 03801

Tel.: (603) 433-1231
Wats: (800) 223-9030

Fax: (603) 433-1348


Colloids with negative charges to be removed by coagulation and flocculation
Addition of positively charged chitosan
Coagulation of colloids due to neutralisation of negative charges on the colloids
Addition of negatively charged alginate
Formation of sludge flocs


Alginate
Chitosan
Metal coagulant
Untreated waste water
Flocculation
Sedimentation basin
Treated waste water to discharge
biological treatment
Sludge to dewatering

CHITOSAN AS A COAGULANT FOR TREATMENT OF POTABLE WATER

PRONOVA BIOPOLYMER

USE

Chitosan is an effective coagulant for treatment of potable water. This biopolymer makes it possible to comply with potable water standards with a reduced dosage of aluminium coagulant. Use of chitosan in treatment of potable water offers several advantages.

ADVANTAGES

Environmental and health:

- Chitosan is a natural, nontoxic coagulant and a safe chemical for plant operators to handle.
- Reduction of the necessary aluminium dosage reduces the risk of increased levels of aluminium in treated water in cases of plant malfunction.
- Use of chitosan reduces the specific sludge production. Furthermore, sludge from the treatment process has a reduced aluminium content, making it more suitable for use in agriculture.
- Chitosan is biodegradable

Process:

Chitosan has been tested in a coagulation - direct filtration process. Test results show reduced sludge production, sludge with good settling properties and long filter runs at normal filter loading. Alternatively one may operate with a higher hydraulic loading of the filter.

Long filter runs result in:

- Low consumption of water for backflushing.
- Low energy consumption for backflushing
- Reduced area requirements for treatment of backflushing water

High filter loading results in:

- Low investment cost for filters.
- Low energy consumption for heating in cases were the treatment plant is covered.

Low sludge production and good settling properties result in:

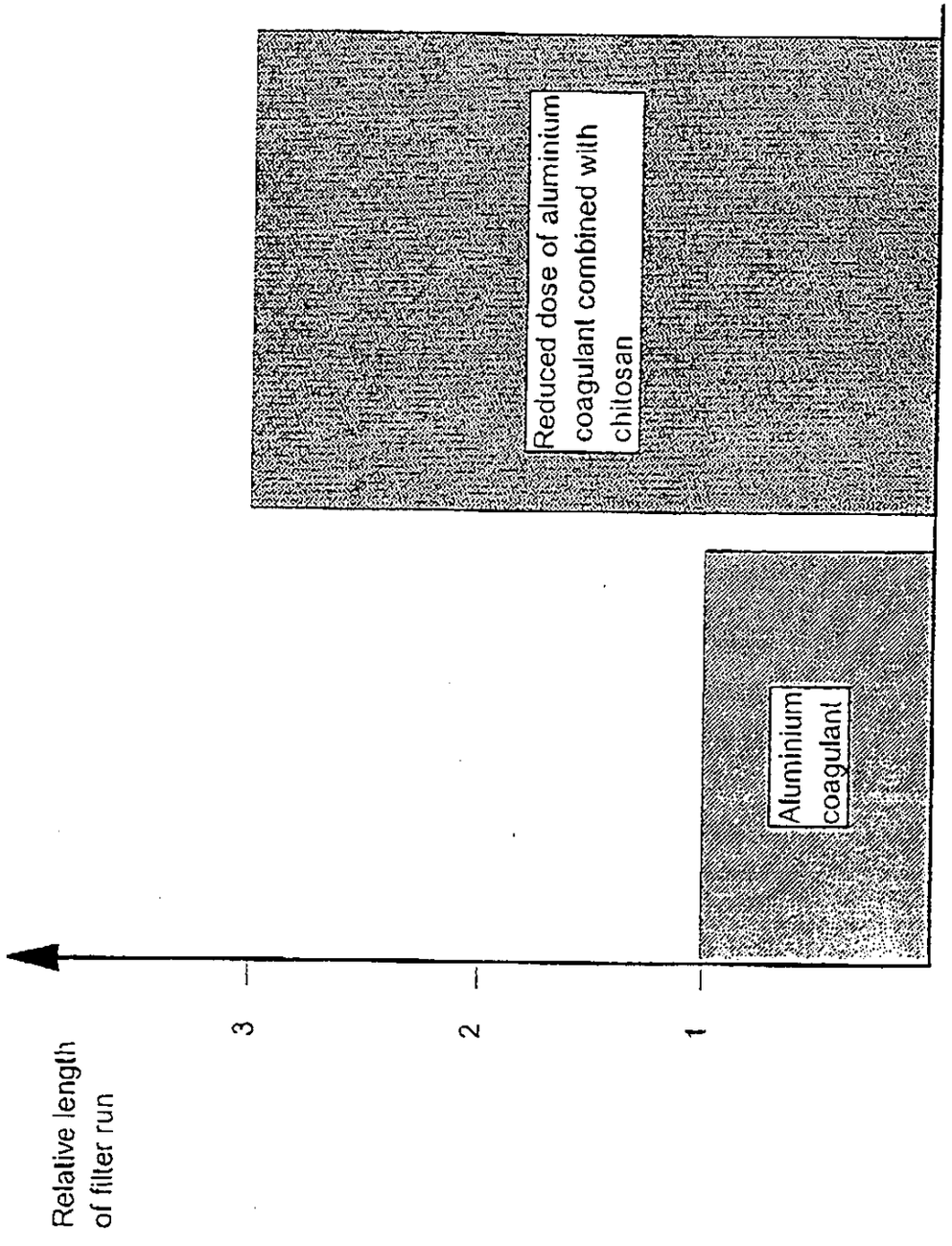
- Reduced cost for investment and operation of sludge storage, treatment and dewatering.
- Reduced amount of sludge for disposal in landfills or agriculture.

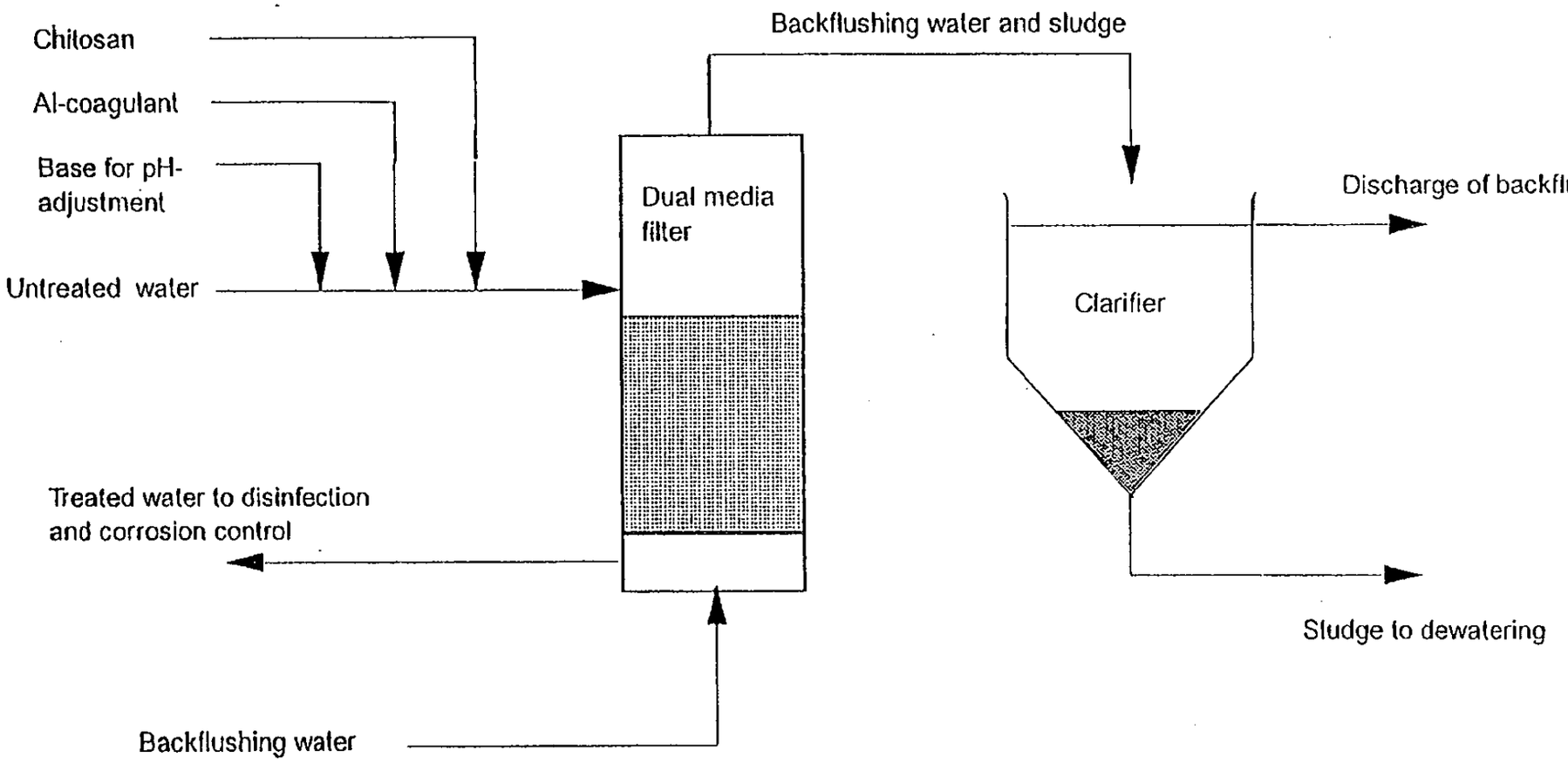
Figure 1. Length of filter run with use of Al-coagulant in combination with chitosan, relative to use of only Al-coagulant

PROCESS SCHEME:

Figure 2. Typical process scheme for direct filtration process with use of chitosan.

ova Biopolymer, Inc.
201
Commerce Way
mouth, NH 03801
Tel.: (603) 433-1231
Watts: (600) 223-9030
Fax: (603) 433-1348


Relative length of filter run
3
2
1
Aluminium coagulant
Reduced dose of aluminium coagulant combined with chitosan



Material Safety Data Sheet

CHITOSAN PROFLOC 340
Identity (Trade Name As Used On Label)

Pronova Biopolymer, Inc.
Manufacturer

1725 Ocean Avenue N.E.
Address

Raymond, WA 98577, USA

+1-206-942-5552
Phone Number (For Information)

+1-206-942-5552
Emergency Phone Number

Telex*

MSDS Number*
902-76-4

CAS Number*

January, 1993
Date Prepared

Mr. Gordon Sargent
Prepared By*

Note: Blank spaces are not permitted. If any item is not applicable, or n information is available, the space must be marked to indicate that

SECTION 1 - MATERIAL IDENTIFICATION AND INFORMATION

COMPONENTS — Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Deacetylated product of Poly-N-Acetylglucosamine	> 90			
Water	<10			
Non-Hazardous Ingredients				
TOTAL	100			

SECTION 2 - PHYSICAL / CHEMICAL CHARACTERISTICS

Boiling Point	N/A	Specific Gravity (H_2O = 1)	0.15 - 0.30 g/cm^3
Vapor Pressure (mm Hg and Temperature)	N/A	Melting Point	N/A
Vapor Density (Air = 1)	N/A	Evaporation Rate (= 1)	N/A
Solubility in Water	Soluble in various dilute acid pH<6	Water Reactive	
Appearance and Odor	Tan to white powder		

SECTION 3 - FIRE AND EXPLOSION HAZARD DATA

Flash Point and Method Used	None	Auto-Ignition Temperature	Flammability Limits in Air % by Volume	LEL	UEL
Extinguisher Media	CO_2, dry chemical or water		N/A		
Special Fire Fighting Procedures	None				
Unusual Fire and Explosion Hazards	None				

*Optional

SECTION 4 - REACTIVITY HAZARD DATA

STABILITY: ☐ Stable ☐ Unstable
Conditions To Avoid: Avoid elevated temperatures (>280°C)

Incompatability (Materials to Avoid): Avoid strong oxidants

Hazardous Decomposition Products: None

HAZARDOUS POLYMERIZATION: ☐ May Occur ☒ Will Not Occur
Conditions To Avoid: None

SECTION 5 - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY: ☐ Inhalation ☐ Ingestion ☐ Skin Absorption ☐ Not Hazardous

CARCINOGEN LISTED IN: ☐ NTP ☐ IARC Monograph ☐ OSHA ☐ Not Listed

HEALTH HAZARDS
Acute:
Chronic: Chitosan - LD_{50} >16 g/kg body weight orally (mice)

Signs and Symptoms of Exposure:

Medical Conditions Generally Aggravated by Exposure:

EMERGENCY FIRST AID PROCEDURES - Seek medical assistance for further treatment, observation and support if necessary.

Eye Contact:

Skin Contact:

Inhalation:

Ingestion:

SECTION 6 - CONTROL AND PROTECTIVE MEASURES

Respiratory Protection (Specify Type): Not required in normal use, dust mask recommended

Protective Gloves: Recommended

Eye Protection: Safety goggles recommended

VENTILATION TO BE USED: ☐ Local Exhaust N/A ☐ Mechanical (general) Generally adequate ☐ Special N/A ☐ Other (specify) N/A

Other Protective Clothing and Equipment: Eyewash facility recommended

Hygienic Work Practices: Keep covered to avoid contamination

SECTION 7 - PRECAUTIONS FOR SAFE HANDLING AND USE / LEAK PROCEDURES

Steps to be Taken if Material Is Spilled Or Released: Sweep up and dispose as a solid organic waste in accordance with local State and Federal government regulations

Waste Disposal Methods:

Precautions to be Taken in Handling and Storage: Store in a cool, dry place

Other Precautions and/or Special Hazards: N/A

NFPA Rating* Health ___ Flammability ___ Reactivity ___ Special ___ HMIS Rating* Health ___ Flammability ___ Reactivity ___ Personal Protection ___

*Optional

Leukocyte proliferation stimulated in red drum

A major route of signal transduction in mammalian lymphocytes is the phosphatidyl inositol (PI) pathway. Modulators of the PI pathway such as phorbol ester and calcium ionophore act synergistically to stimulate proliferation of teleost peripheral blood leukocytes (PBL). Red drum PBL also proliferated strongly in response to phorbol ester alone, at doses which were not mitogenic for catfish PBL. Dose titration studies with a panel of kinase inhibitors suggested that mitogenic and synergistic doses of phorbol ester primarily targeted an enzyme activity similar to protein kinase C (PKC). These studies have suggested that PKC isoforms and membrane ion pumps unique to the lower vertebrates may participate in regulation of the cell cycle.

K. G. Burnett, L. K. Schwarz, 1994. Leukocyte proliferation mediated by protein kinase C in the marine teleost fish, *Sciaenops ocellatus*. *Developmental and Comparative Immunology*, 18(1):33-43, 1994.

■ SCSGC-R-94-003; 11pp.; available from K.G. Burnett, Ft. Johnson Rd., Charleston, SC 29412.

WASTE DISPOSAL AND MANAGEMENT

Chitosan as a water treatment plant coagulant

A natural organic polymer, chitosan may provide an alternative to the use of alum or other inorganic metal salts as a coagulant in water treatment. Chitosan is abundant, biodegradable, and nontoxic. This paper reports results of jar tests with samples from the Cambridge, Massachusetts water department, comparing the performances of chitosan, alum, and other coagulants with regard to turbidity, color, pH and alkalinity. Comparisons with tests conducted by others are included, along with equations for evaluating sludge production and estimating relative costs of alum versus chitosan plus bentonite at the Cambridge Water Treatment Plan.

Susan Murcott, D. R. F. Harleman, 1993. MIT jar tests of the natural polymer chitosan with fresh pond water from the Cambridge water department: November-December, 1992.

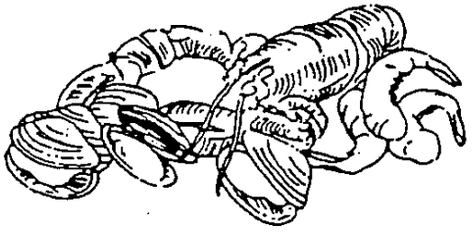
■ MIT-T-93-003 (93-22); 40pp.; $5.00 ($6.50 for overseas requests).

Chitosan coagulation testing in water reservoirs

To comply with new U.S. Safe Drinking Water Act regulations, the Massachusetts Water Resources Authority's Water Division is anticipating building a large water treatment plant at Wachusett Reservoir. Researchers conducted jar tests of chitosan at Wachusett Reservoir to demonstrate the effectiveness of the organic polymer as a substitute for alum or ferric chloride. This paper presents findings for principal factors affecting coagulation, including raw water characteristics, chemical type and dose, mixing time and speed, order of chemical addition, pH and alkalinity, and temperature. Equations are given for evaluating sludge production and estimating relative costs of using alum and a polymer versus chitosan and bentonite. An appendix with figures illustrating findings for different test dates supplements the main text.

Susan Murcott, D. R. F. Harleman, 1993. MIT jar tests of Wachusett Reservoir water using the natural polymer chitosan with bentonite.

■ MIT-T-93-004 (93-23); 41pp.; $5.00 ($6.50 for overseas requests).



Wastewater treatment for seafood processors

This manual reviews the principles of wastewater management, including why waste management must be a high priority for seafood processors; options for treating wastewaters; and general requirements for disposing wastewaters on the land, to rivers and streams, and to the ocean. Ways that wastewaters can be treated to reduce both pollutants and water quality impacts are discussed, and characteristics of seafood processing waters are reviewed. Further references and a glossary are included.

Bruce Neilson, 1993. A guide to wastewater management for seafood processors.

■ VSGCP-H-93-001 (VSG-93-11); 57pp.; $5.00.

WATERFRONT USE AND DEVELOPMENT

Safety management for waterfront businesses

Because ocean recreation businesses operate near, in, or on the open ocean, they are looked upon as high-risk operations. And indeed, there is always the potential for fatal accidents in water-contact activities. An accident incurs such costs as hospitalization and medical treatment of employees and clients, property/equipment repairs, increased premium for the same or reduced coverage, reduction in number of bookings, and delays in obtaining permits and licenses. Most of the accidents that occur can be prevented, if proper attention is paid to the use of safe procedures and the maintenance of equipment in top operating order. The particular concerns addressed by this manual are clientele and operational safety to reduce the number of preventable accidents and thereby reduce potential risks.

R. T. Pfund, 1993. Safety check manual for ocean recreation businesses.

■ HAWAU-H-93-001 (MB-94-01); 14pp.; no charge for up to 10 copies.

Development needs of underwater preserve communities

Seven Michigan underwater preserve committees were assisted by a facilitator in producing a comprehensive list of facilities, services, or other resources that may be beneficial in developing their preserve area into an aquatic park. The committees then identified the most important facilities, services, or resources needed for development of an aquatic park, a preferred management framework, and a preferred means of funding this development and management. Results are based in social science theory and method in group decision making.

K. J. Vrana, 1993. An analysis of the development needs of Michigan bottomland (underwater) preserve communities using the nominal group technique.

■ MICHU-T-93-001 (93-201); 58pp.; $10.00

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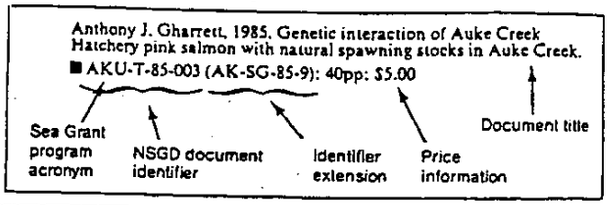

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Seattle, WA 98105

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no person indicated	Black Hills Audubon Society
no person indicated	Sasquatch Group Sierra Club

Veena Tabbutt - Request for information

From: "Edward J. Walawender III" <ewalawender@martinnelsonco.com>
To: <tabbutv@co.thurston.wa.us>
Date: 06/30/2003 09:50 AM
Subject: Request for information

Dear Veena,

At your convenience can you please make a data set for New Residential Units for Years 1997-2002 for Thurston Fire Protection District No. 5 you may email or fax to me at (206) 695-7139? These tables are from The Profile website for Thurston County.

I would like to have a data set for all Thurston County Fire Districts, similar to the one below for School Districts- is this something you can create as well? Please let me know by email or phone (888) 342-6864. Thank you!

Sincerely,

Edward J. Walawender, III
Municipal Bond Analyst
Martin Nelson & Company
1500 Westlake Avenue, Suite 200
Seattle, Washington 98109-3031

New Residential Units by School District in Thurston County 1990 - 2002

School District	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Centralia	2	3	7	8	1	3	2	7	2	7	3
Griffin	74	94	111	83	53	56	55	35	52	43	40
North Thurston	1,066	756	700	1,035	878	861	849	790	850	647	571
Olympia	633	482	556	342	491	239	529	273	348	623	275
Rainier	62	70	107	69	47	50	67	58	51	43	55
Rochester	144	145	145	150	167	141	162	195	249	226	191
Tenino	68	115	100	114	108	99	123	109	98	100	87
Tumwater	552	307	376	394	648	228	224	199	276	249	137
Yelm	188	244	292	316	364	352	244	200	250	231	190
Total	**2,789**	**2,216**	**2,394**	**2,511**	**2,757**	**2,029**	**2,255**	**1,866**	**2,176**	**2,169**	**1,549**

Note: Includes only those portions of the school district falling within Thurston County.
Source: TRPC.

Back to School District Data Page

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Many of TRPC's datasets can be queried on a variety of geographies, including:

- School district boundaries
- Census tracts, block groups or blocks
- Cities and Urban Growth Areas
- Fire Districts
- Traffic Analysis Zones
- Watersheds

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