Capitol Lake RESTORATION

Draft Environmental Impact Statement

Prepared For
DEPARTMENT OF GENERAL ADMINISTRATION
STATE OF WASHINGTON

JULY 1976

CH2M HILL

MEMORANDUM

CH2M HILL

TO: Capitol Lake Coordinating Committee

FROM: J. R. Christofferson, CH2M HILL

DATE: 16 April 1976

RE: Capitol Lake Restoration, Draft Environmental Impact Statement Working Draft

PROJECT: S9640.D0.00

The accompanying environmental information regarding the Capitol Lake restoration project represents the technical material that our staff has researched and analyzed to date. It is in the format of a Draft EIS but cannot serve this function until we are able to incorporate your comments and suggestions.

In particular, I would like you to carefully review the Existing Conditions chapter to determine whether it is complete and accurate; the chapters dealing with impacts and mitigating measures; and the distribution list to determine whether it is complete.

We hope to print and make available the Draft EIS shortly after we receive your comments. Thirty-five days will then be provided for public comment upon the draft, with subsequent printing of the final EIS.

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State of Washington
DANIEL J. EVANS, Governor

DEPARTMENT OF GENERAL ADMINISTRATION

KEITH A. ANGIER, Director

218 GENERAL ADMINISTRATION BUILDING, OLYMPIA, WASHINGTON 98504

Subject: Capitol Lake Restoration - Draft
Environmental Impact Statement

This Draft Environmental Impact Statement for the proposed restoration of Capitol Lake is submitted for your review and comments. This statement has been developed concurrently with the Engineering Report for the restoration of Capitol Lake and with a Recreation Plan Design Report and its Draft EIS.

A public meeting has been scheduled for 25 August 1976 to receive your comments and discuss the impacts of the proposed restoration. The meeting will be held in the General Administration Building auditorium at 7:00 p.m. If you wish to present written comments, please send them by 31 August 1976 to:

George C. Garris, Manager of Facilities Planning
Department of General Administration
106 Maple Park
Olympia, Washington 98504

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DEPARTMENT OF GENERAL ADMINISTRATION
STATE OF WASHINGTON

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INTRODUCTION

ACTION SPONSOR

Department of General Administration, State of Washington.

NATURE OF PROPOSAL

Lake restoration program involving: Initial dredging of approximately 360,000 cubic yards of sediment from Capitol Lake; maintenance dredging of approximately 50,000 to 60,000 cubic yards of sediment every 2 years; and a plan for disposal of dredge spoils.

LOCATION

Capitol Lake, Olympia and Tumwater, Thurston County

LEAD AGENCY

Department of General Administration, State of Washington

Responsible Official: Division of Facilities Planning

AUTHORS AND PRINCIPAL CONTRIBUTORS TO THE EIS

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P. J. Chemnick, CH2M HILL, social and human-related assessment

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Charles Lindberg, biological field work

T. W. Holz, CH2M HILL, hydraulics and hydrology assessment

F. W. Pita, CH2M HILL, soils and geology assessment

Staff, Olympia Air Pollution Control Authority, air quality

Derek Valley, Washington, State Historical Society, archeological and historical inventory and assessment

J. A. Webber, CH2M HILL, traffic analysis

R. W. Reid, CH2M HILL, air quality analysis

K. G. Clegg, CH2M HILL, noise analysis

LOCATION OF EIS BACKGROUND DATA

SEPA Information Center
Department of General Administration
106 Maple Park Avenue
Olympia, Washington

COST OF COPIES OF EIS: $5.00

DATE OF ISSUE OF DRAFT EIS: 27 July 1976

DATE BEFORE WHICH COMMENTS MUST BE RECEIVED TO BE INCOPORATED INTO FINAL EIS: 31 August 1976

DISTRIBUTION LIST

Capitol Lake Coordinating Committee

City of Olympia

City of Tumwater

Thurston County Commissioners

Thurston County Regional Planning Office (A-95 Review)

Washington State

- Governor
- Department of Ecology
- Department of Natural Resources
- Department of Fisheries
- Department of Game
- Department of Social and Health Services
- Department of Highways
- Department of General Administration SEPA Public Information Center
- Office of Community Development
- Parks and Recreation Commission
- Interagency Committee for Outdoor Recreation
- Library

U.S. Environmental Protection Agency

U.S. Coast Guard

U.S. Fish and Wildlife Service

U.S. Army Corps of Engineers

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PROPOSAL AND OBJECTIVES

This environmental impact statement assesses a program to restore Olympia's Capitol Lake as a unique aesthetic, recreational, and biological asset to the state. Funding for the studies and engineering necessary for developing a restoration program was requested by the Washington State Department of General Administration and approved in 1975 by the state legislature.

The goal of the program is to improve the lake's recreational and visual resources, improve its fish production, and preserve its biological and wildlife resources. These diverse uses are being threatened by sediment that has been accumulating in the lake since its creation in 1951.

To achieve these restoration objectives, a consultant has developed a comprehensive program to remove accumulated sediment and facilitate removal of future sediment carried into the lake by the Deschutes River and Percival Creek. The program calls for selective dredging of existing sediment and dredging of deep sediment traps that can be cleaned out as required over the next 20 years. The program includes a plan for in-basin disposal of all dredge spoils in order to provide improved public access to the lake. A protective groin will be installed along the shoreline at the undeveloped Tumwater City Park in the upper basin to direct the water flow toward the sediment trap and prevent shoreline erosion.

The process for selection of a restoration program included interaction with various state and local public agencies and private organizations.[1] Based in part upon an extensive study by Washington State University, four alternative concepts for restoration were developed by the consultant and evaluated according to cost, engineering feasibility and effectiveness, environmental impact, energy consumption, and compliance with established planning goals. The concept which best satisfied these criteria was chosen as the recommended plan.

DIRECT AND INDIRECT IMPACTS UPON THE ENVIRONMENT

Physical Environment

Earth

The depth and bottom topography of the lake's upper and middle basins will be changed by the initial dredging operation. Siltation patterns will be altered so that most of the

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1 A list of these agencies and organizations is given in appendix C of the *Recreation plan draft environmental impact statement.* July 1976. A report by CH2M HILL for the Washington State Department of General Administration.

incoming silt will collect in the sediment traps for more convenient removal by periodic dredging. Some marsh area in the upper basin will be removed and redeposited in the vicinity of the two islands now existing in the upper basin, to form a single large island. There will be a change in the lake's shoreline due to disposal of dredge spills. Fill areas will create additional shoreline access to the lake and will enhance recreational opportunities. To facilitate revegetation and use, dredge spoil fills will be installed at their finished grade rather than layered. Selective dredging of the middle basin will remove shallow-water hazards.

Air

No air quality degradation is anticipated from the program. The diesel dredge equipment has relatively low pollutant emissions, and the proposed pipeline disposal of dredge spoils will cause no air quality change.

Water

Water quality changes are not expected to be significant. Initial dredging activities will cause minor, temporary turbidity in the immediate vicinity of the dredging operation. Shoreline fills will generally have little effect on lake circulation patterns, but the proposed fill in the southwest corner of the middle basin will improve circulation.[1] Mean residence time of water in the lake will increase because of greater lake volume. Fish-rearing activities, which contribute significant quantities of nutrients and organic materials to the lake system, may increase after the lake's restoration, causing a greater impact on water quality. Increased motorboating use could create enough water mixing to promote heavier algal blooms during later summer periods. Continued saltwater flushing of the lake will be required in order to control rooted aquatic vegetation.

Flora

Temporary decreases in aquatic vegetation will occur during dredging operations, followed by rapid regeneration. Some shoreline vegetation will be removed, including willows, alders, and grasses. Fills created by disposal of dredge spoils will provide a net increase in land for terrestrial revegetation and wildlife habitat.

Fauna

Bottom organisms will be disrupted in some areas affected by dredging, but are expected to recover rapidly. Fish will

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1 Hydraulics Research Section and Environmental Research Section, Washington State University. September 1975. *Hydraulic and water quality research studies and analysis of Capitol Lake sediment and restoration problems.* A report for the Washington State Department of General Administration. Page xxiii.

also experience localized disturbance by initial dredging activities, but the lake's fishery will ultimately benefit from deeper water, slightly cooler temperatures, and the removal of sediment which now inhibits natural food production. In the upper basin there will be a small reduction in areas for fish to feed, rest, and breed.

Ducks and other waterfowl may temporarily move away from areas of dredging activity, and wilder species will suffer permanent loss of feeding and nesting habitat, especially in the upper basin. Arboreal birds will suffer some loss of roosting and nesting areas until land created by maintenance dredging is revegetated. Wilder species of mammals such as beaver and muskrat may be forced from the upper basin or may relocate to neighboring areas.

Light and Glare

The impact of dredge lights will be insignificant.

Noise

Ambient noise levels are generally expected to exceed the noise from the dredge. An occasional slight noise annoyance for the homeowners nearest the dredging operation may occur. This is expected to be insignificant because of the low noise levels of the dredging activities. Noise from dredging activities generally will be less than existing noise levels from I-5 and from power boats on the lake.

Land Use

The increase of shoreline from sediment disposal activities will create an increase of shoreline access and a potential for additional recreational activities. Land values may increase slightly because of the improved lake environment.

Natural Resources

Some areas will be altered from terrestrial to aquatic habitat, and from aquatic to terrestrial. Commitment of nonrenewable natural resources such as fuel is minor.

Human Environment

Population

There will be no impact on population size or distribution.

Economics

The estimated costs for the recommended plan are $3,099,800 for the initial dredging and for maintenance dredging over a 20-year period. Estimated salaries for the initial dredging effort will total $457,000. Spending and respending of these salaries will produce $950,000 to $1,425,000 income for the community. Estimated labor costs associated with maintenance dredging will total $570,000. Spending and respending of these salaries will generate an additional $1,140,000 to $1,710,000 in personal incomes within the community.

The program is expected to restore the value of sport and commercial salmon catches which are now reduced by as much as $450,000 a year by the accumulated sediment.

The sand and gravel in the dredge spoils have a significant market value, but the magnitude of this value cannot be determined until the sediment composition and market conditions are established at the time of dredging.

Transportation and Circulation

Traffic and parking impacts will be insignificant.

Energy

The proposed small maintenance dredge will use about 140 gallons of fuel per 20-hour operating day. Total fuel consumption, based upon 22 days a month for an estimated 12 to 15 months of initial dredging, would be about 40,000 gallons. Fuel consumption for maintenance dredging would be about 9,000 gallons every 2 years, or 90,000 gallons over the 20-year period.

Utilities

No utilities will be affected by the project.

Human Health

Safety hazards to boaters and swimmers in the middle basin will be removed by selective dredging. The floating dredge pipelines will be flagged to increase their visibility to boaters.

Aesthetics

Disposal of dredge spoils will create temporary unsightliness until vegetation regrowth occurs. Restoration of the lake environment eventually will provide a more pleasing visual appearance. See the *Recreational Plan Environmental Impact Statement*.[1]

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1 CH2M HILL, July 1976. *Capitol Lake recreation plan design report.* A report for the Washington State Department of General Administration.

Recreation

Active and passive forms of recreation will be enhanced. Sport fishing will be improved. Better shoreline access will be provided. The increase in human recreational activities may frighten some animal species from the basin. Recreational activities may be hindered near dredging operations for the 12 to 15 months of initial dredging and the approximately 3 months of maintenance dredging every 2 to 5 years.

Archeological and Historical Significance

No archeological or historical sites will be affected by the proposed program. Construction of a protective groin will prevent further erosion of the prehistoric fishing village situated on the northwest shore of the upper basin at the City of Tumwater's park.

ALTERNATIVES

Three major alternatives to the recommended program were considered. They are:

A. Dredge the upper basin to the original 1949 contours, dredge the middle basin to a minimum 6-foot depth, and provide a sediment trap in the middle basin (Initial Dredging Concept 2, *Design Engineering Report*).

B. Leave the upper basin in its existing state and provide a sediment trap in the middle basin (Initial Dredging Concept 3, *Design Engineering Report*).

C. No restoration action, allowing the lake gradually to fill and change to a marsh and river channel.

Alternative A would virtually eliminate the marsh environment and wildlife in the upper basin. Noise and disruption of fish and wildlife would be greater than for the recommended plan. The larger amount of sediment to be removed may require out-of-basin disposal. Recreation in the upper basin would become more active. The upper basin would act as a sediment trap, reducing the need for maintenance dredging in the middle basin.

Alternative B would cause no disruption of the upper basin ecology but would allow that basin to continue to change to a river delta. The growth of upper basin islands and the increase of sediment deposition between 1964 and 1970 are shown in the WSU report.[1] Fish and waterfowl numbers would

1 WSU report, op.cit, p. 22.

eventually be reduced. Recreation would change from lake- to land-oriented. More maintenance dredging, with its impacts, would be required in the middle basin. Initial dredging costs would be lower.

Alternative C would cause no immediate disruption of the lake's environment and no cost for dredging. The upper basin would change to a river delta, and the middle basin would continue to fill with sediment. The lake's fishery would gradually be lost. There would be eventual loss of the lake as a local, state, and regional recreational resource.

MEASURES TO MITIGATE ADVERSE IMPACTS

Disposal of dredge spoils will be accomplished in stages and behind dikes or baffles with overflow weirs to reduce turbidity of the return flow. Turbidity will be further reduced by use of chemical polymers and settling.

Use of a small dredge for maintenance dredging will produce minimum turbidity. Loss of aquatic and shoreline habitat will be partially offset by creation of the single island in the upper basin and shoreline fills. Disruption of bottom organisms and their habitat by dredging will be offset by alteration of sediment deposition patterns, allowing rapid regrowth to occur in areas away from sediment traps.

UNAVOIDABLE ADVERSE IMPACTS

Some turbidity and siltation will result from dredging and disposal. There will be both temporary and permanent relocation of some wildlife species. Dredging activities will interfere slightly with recreational activity. Fuel will be used and public funds expended.

DESCRIPTION OF THE PROPOSAL

NAME OF PROPOSAL

Capitol Lake Restoration

SPONSOR

Washington State Department of General Administration

LOCATION OF PROJECT

Cities of Olympia and Tumwater, Thurston County (see figure 1)

TIMING

The restoration program activities have been divided into two sections: initial dredging and maintenance dredging. Initial dredging is expected to begin in 1977 and last 12 to 15 months. Maintenance dredging schedules will depend on the results of periodic inspections to determine the condition of the sediment traps. The upper basin sediment trap is expected to be dredged approximately every 2 years, and the middle basin sediment trap every 5 to 10 years.

ENGINEERING ACTIVITIES

The engineering activities of the proposal are summarized below. A more detailed description is provided in the *Design Engineering Report*.[1]

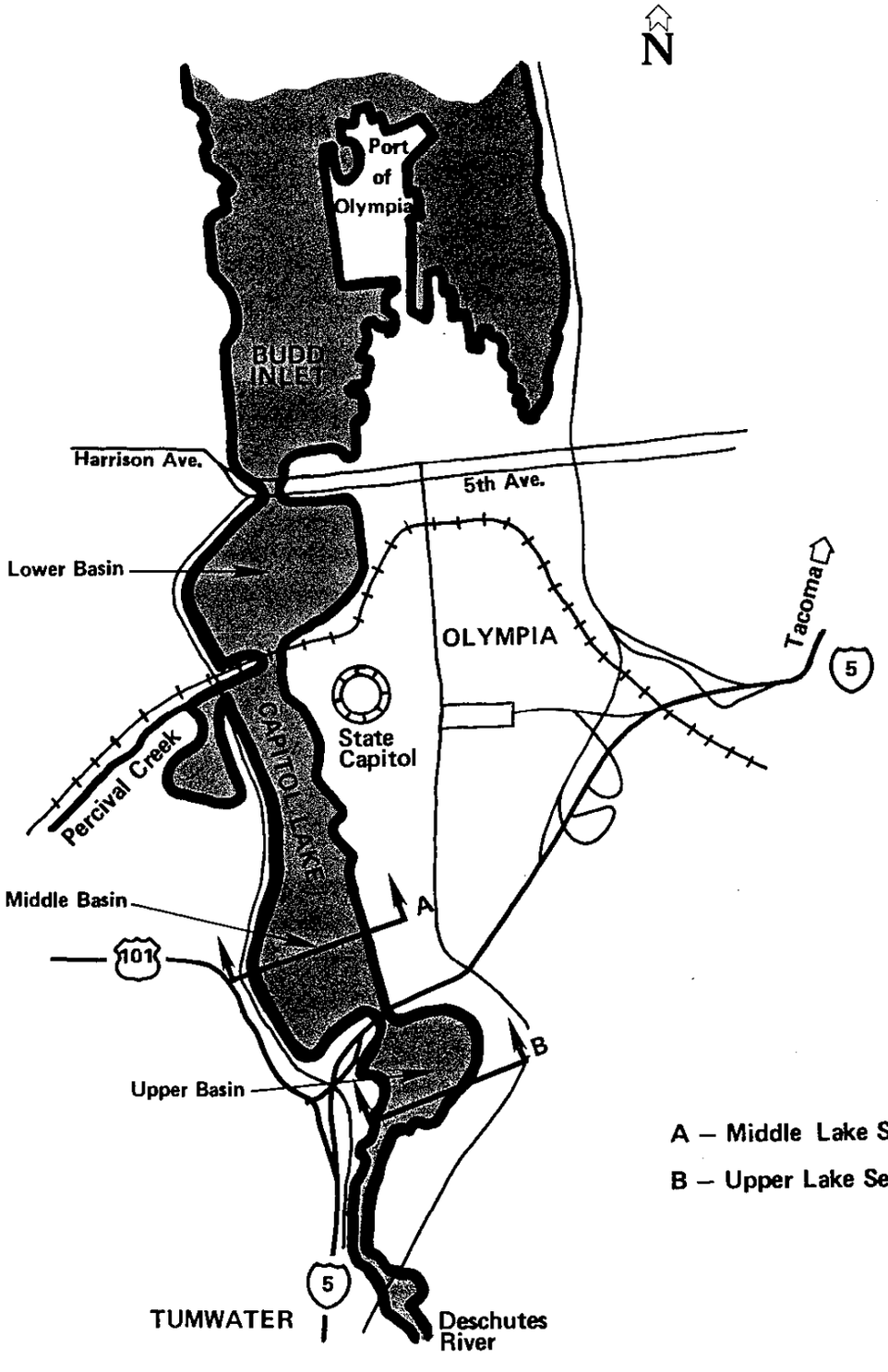
Initial Activities

Phase 1

The initial dredging work will provide sediment traps in the upper and middle basins, and will remove sediment from shallow areas in the middle basin. Percival Cove will be dredged to allow complete drainage during the annual lake drawdown and to provide a sediment trap at the mouth of Percival Creek. This incorporates initial dredging concept 1 as described in the *Design Engineering Report*, page 6.

A small portion of the dredged material will be deposited in the upper basin to form a larger island and a protective groin. The remainder will be deposited in the middle basin to improve

1 CH2M HILL. July 1976. *Capitol Lake restoration design engineering report.* A report for the Washington State Department of General Administration.



Vicinity Map 1

water circulation, as recommended in the Washington State University hydraulic study report.[1]

Debris will be removed from the lake basins and disposed of in a landfill.

To prepare for the biennial maintenance dredging, the state would acquire the existing gravel pit just north of Percival Creek as a dredge material transfer, handling, and disposal site.

Phase II

The disposal sites selected for biennial maintenance dredging would be prepared. At the end of each biennial maintenance period, some grading would be necessary at the disposal site.

Phase III

In the event identified in-basin disposal sites are not available when needed, out-of-basin disposal will be necessary. To prepare for this option, the state would acquire a disposal site within 2 miles of the lake, right-of-way to the site, and the additional pipe and pumps to transport the dredged material to this out-of-basin site.

Biennial Maintenance Dredging

Future accumulation of sediment will be removed from the sediment trap in the upper basin approximately every 2 years, and from the middle basin sediment trap every 5 to 10 years depending on rate of accumulation.

CONSISTENCY WITH PROPOSED LAND USE AND ZONING

The proposed action is fully consistent with all proposed land use plans and zoning ordinances for the affected area.

Much of the lake's 4-mile shoreline is publicly owned and is designated for recreational uses in existing land use plans. The Thurston County Regional Shoreline Management Plan designates most of the shoreline as a conservancy environment that would limit development to ensure continuous use for public recreation.[2]

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1 WSU report, op. cit.

2 Washington Shoreline Management Act. 20 June 1975. *WAC 173-16-040(4)(b)(ii) conservancy environment, and WAC 173-16-060(14) landfill.*

EXISTING CONDITIONS

PHYSICAL ENVIRONMENT

Earth

Capitol Lake is situated in a deep gorge cut in glacial deposits by the Deschutes River. The glacial deposits were laid down during the Pleistocene epoch as advance and recessional outwash and as glacial till. At the retreat of the Vashon glacier (about 15,000 years ago), sea level in the area was lower than it is now, enabling the Deschutes River to cut a deep gorge. With further retreat and subsequent melting of the continental ice sheets, the sea level rose and changed the lower portion of the gorge into a marine bay (Budd Inlet), and initiated delta formation at the mouth of the Deschutes River. After Capitol Lake was formed in 1951, sediment deposition by the Deschutes River became largely confined to the lake.

The bottom of the lake consists of fine-grain sediments, with coarser sediments lining the main channel of the Deschutes River. Clayey silts and sandy silts are found along the lakeshore, in all shallow areas of the upper basin, and in the off-channel portions of the middle basin and Percival Cove. Sands and gravels lie under the deeper channels of Capitol Lake and Percival Cove.

The glacially derived materials rimming Capitol Lake have weathered to loamy fine sand and gravelly, sandy, loam soils.

Air

Data from the Olympic Air Pollution Control Authority indicate that air quality in the study area is generally good.[1] The primary source of pollution is vehicle emissions along Interstate 5. The prevailing direction of the wind is south to southwest during the winter and lighter and more variable in the summer. The wind during most of the year is strong enough to disperse air pollutants rapidly. Air pollution episodes occur in late fall and winter, under conditions of clear skies and light winds.

Water

Capitol Lake's water level and flow rates are controlled by a tide gate located at the Fifth Avenue Dam. During periods of high tide, normally occurring twice per 24-hour period, flow through the lake virtually stops. When

1 The Olympic Air Pollution Control Authority. 1 August 1975. Staff report.

the tide drops, the gate opens, varying the lake's level only slightly under normal conditions.

Flow through the lake averages 405 cubic feet per second (cfs) from the Deschutes River and 30 cfs from Percival Creek. Lake volume is exchanged 130 times a year and as frequently as 3.5 times a day during high flow periods.

Flows for the 2-year and 10-year floods are 3,900 and 7,400 cfs, respectively. The flood-of-record measured at Olympia was 6,650 cfs on 26 January 1964. The largest instantaneous peak flow of 7,780 cfs was recorded at Rainier on 15 January 1974.

Sources of sediment are bank erosion and logging activities in the upper watershed of the Deschutes River and urban runoff in the Percival Creek watershed. According to U.S. Geological Survey data, almost 90 percent of sediment reaching Capitol Lake comes from the upper watershed of the Deschutes River above its confluence with Mitchell Creek near LaGrande. The soils in the upper watershed are highly erodable and the terrain is steep. Natural erosion due to very heavy rainfall occurs near the 1,500-foot level.[1] U.S. Geological Survey and Washington State University investigators believe that channel erosion of the upper river main stem is not a sediment source because the channel is rocky and the banks are well established. Small tributaries draining the steeper portions of the watershed are more probable sources.

Logging activities in the watershed have been occurring for about 100 years, but activity has increased over the last 2 decades. It is assumed that some part of the sediment load to Capitol Lake is due to road-building and channel disturbances from logging activities. The significance of logging on sediment production in the Deschutes Basin should receive further study to determine if maintenance dredging frequency can be reduced by alterations in silvicultural practices. Sediment accumulates at an average of 25,000 to 30,000 cubic yards a year, and ranges from 4,000 to 60,000 cubic yards a year.

The I-5 highway bridge constricts flow of the river through the upper basin, causing a backwater in this basin and high velocities under the bridge during periods of high discharge. Flow in the upper basin is primarily through two channels. During low flow, most of the water is routed near the west shore; during periods of high flow and more pronounced backwater conditions, a larger percentage of flow is routed along the east shore and over the shallow areas between.

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1 Personal communication, Thomas Holz, CH2M HILL, with Leonard Nelson, U.S. Geological Survey, and John Orsborn, Washington State University.

Sediment deposit and scour have almost reached a balance in the upper basin,[1] with continuing buildup only in a few recessed areas such as the boat ramp location. Islands between the braided channels may shift, but deposits of material in the main channel during periods of low flow are scoured away by high flows. Sediment is coarser in the upper basin than in the middle and lower basins.

The main channel enters the middle basin from the upper basin, and generally meanders along the east bank before spreading toward the west shore near the railroad trestle. (See figure 7.) A large slow eddy is formed in the southwest corner. Flow contracts and accelerates through the railroad trestle. The trestle causes a slight backwater effect in the middle basin during periods of high flow. Sediments in the middle basin were first deposited near the Interstate 5 overpass. As the lake became shallower in this area, velocities increased and material was carried farther until a fan of sediment now occupies about half the middle basin. Average water depth in the south half is about 5 feet; in the north, about 10 feet.

Flow through the railroad trestle follows nearly a straight line to the outlet gate, forming small eddies along each shore. Only the fine sediment reaches the lower basin. The water is 15 feet deep in the middle 20 percent of this basin.

The water quality in Capitol Lake has been contaminated by sewage discharge in the past, and the lake was closed to swimming in July 1975. (See appendix A.) The problem still exists today. Plankton and algae blooms also have reached levels which required swimming closures. The lake's surface was covered with a dense growth of plants classed as rooted macrophytes (*Elodea canadensis* and *Potamogeton pectinatis*) in 1969-1971. Saltwater flushing of the lake has been implemented to control the aquatic growth problems.

Ground water around the Capitol Lake shoreline can be found at the surface. Wells along the east shore are artesian and flow up to 30 gallons per minute. The east half of the lake basin has mostly high-yield wells and abundant ground water, although most wells have been abandoned in the City of Olympia. The west half of the basin contains mostly low-yield wells.

Flora

A great diversity of terrestrial and aquatic vegetation is found in the study area. Figure 2 shows the general distribution of these species. A detailed species list is shown in appendix B.

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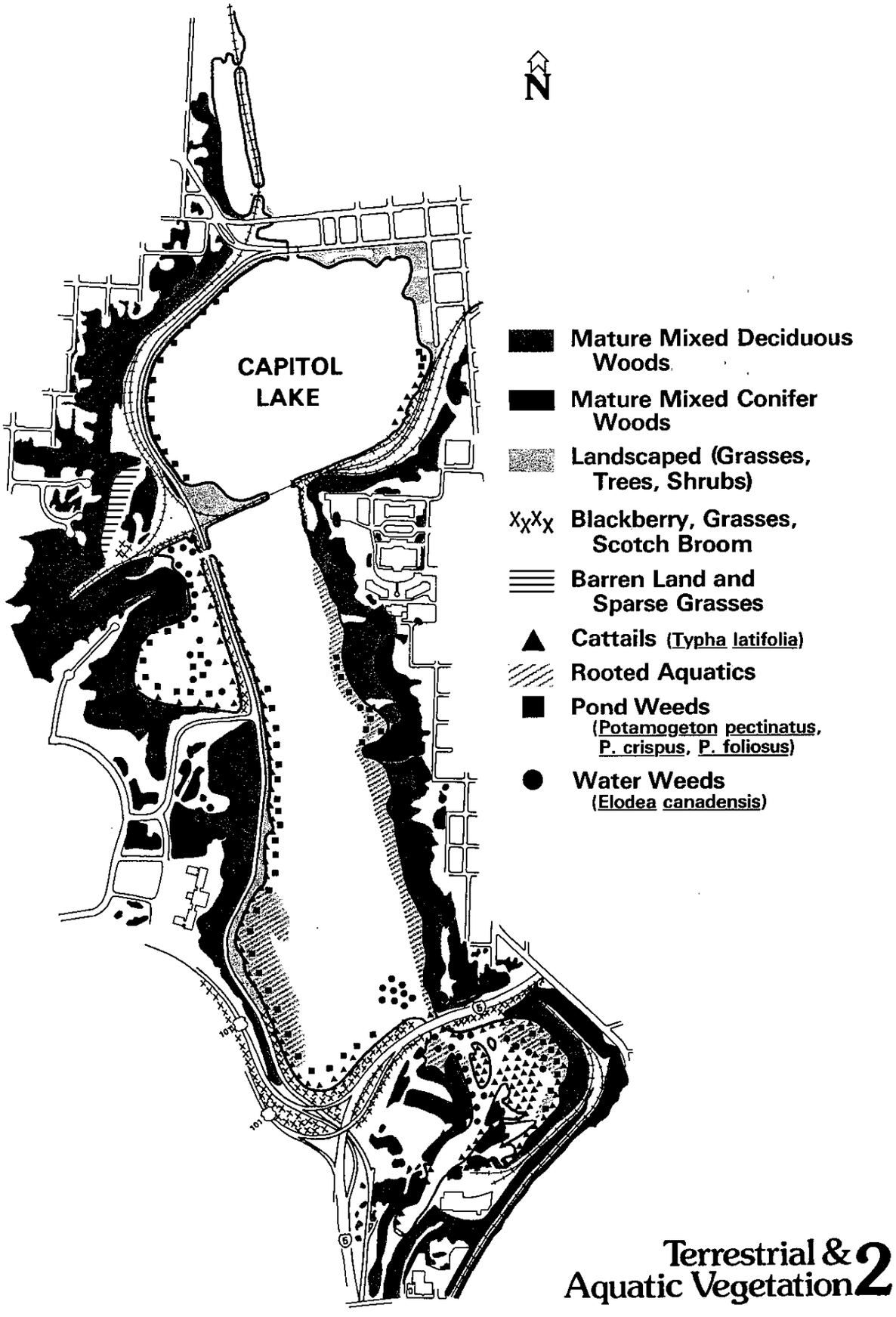
1 The upper basin will be filled in within 6 to 8 years if no dredging takes place. See *Design Engineering Report*, p. 1.



Terrestrial & Aquatic Vegetation 2

The terrestrial flora includes cattail growth along the perimeter of the lake. Mature Douglas-fir stands are distributed throughout the basin. Secondary trees include generous growths of maple, alder, and willow trees. Thickets of vine maple, salmonberry, and blackberry are also abundant.

A narrow strip of landscaping between the Deschutes Parkway and the western shoreline of the middle basin has grass, shrubs, and flowering cherry trees. A park in the southwest corner of the lower basin and a swimming and parking area in the northeast corner of tha basin have been landscaped.

The upper basin is particularly rich in a wide range of vegetation that supports a diversity of wildlife. Flora is typical of an area in transition from aquatic to terrestrial plants. Elodea, cattails, and alder are common.

Only a few private property owners have altered the vegetation along the shoreline. Some have cut trees to gain a better view from the eastern ridge, while a few others have replaced natural shoreline vegetation with landscaping.

There are no known rare or endangered plant species in the basins.

The aquatic flora consists primarily of the plant *Potamogeton pectinatus,* a change from 4 to 6 years ago when dense growths of *Elodea canadensis* were noted. *Elodea canadensis* has been controlled by saltwater flushing. Nearly equal quantities of *Potamogeton pectinatus* and *Elodea canadensis* are found in Percival Cove and the middle basin at depths of 5 feet or less.

Occasionally heavy blooms of *Spirogyra* and *Volvox* have been noted.[1] Some heavy growths of *Cladophora*[2] were noted in the upper and middle basins. This problem is lessened by the relatively rapid movement of water through the lake system.

Fauna

The upper basin provides an unusual diversity of bird and mammal species. Many of the area's wilder species seek refuge in the upper basin and provide a rare educational opportunity for nature observation. The ecological balance in the upper basin is sensitive to change due to the small scale of the basin.

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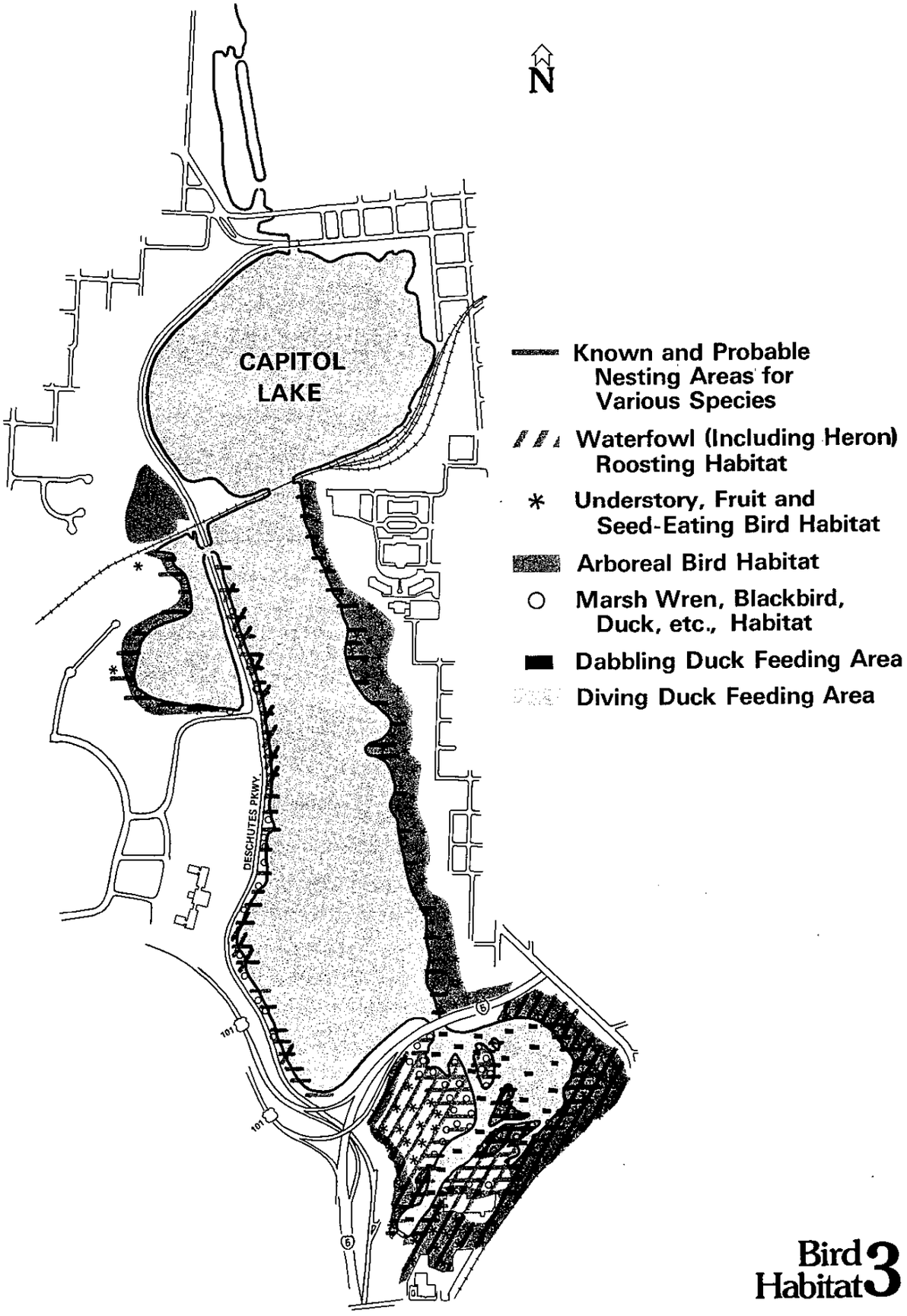
1 Identified by C.A. Lindberg, Biologist, Olympia, Washington. 1975.

2 Kral, K.B. 1970. *Water weed chemical control program in Capitol Lake in 1969. Progress report.* Washington State Department of Fisheries. Unpublished.



Bird Habitat 3

The island and shallows in the upper basin are particularly important as protective cover and nesting and feeding areas for waterfowl. Muskrat, deer, mink, otter, and beaver have occasionally been observed on the islands. The shallows and protective vegetation provide a highly productive nursery for juvenile salmon and steelhead migrating downstream.

Dabbling ducks (mallard, pintail, widgeon, and teal) are abundant in the upper basin and in the shallow shoreline areas throughout the lake. These birds graze on submerged vegetation and thrive in the shallow water. Their feeding habits help control some growth of rooted aquatics.

The aquatic and shoreline vegetation is also habitat for a variety of insects. A large number of birds, including wrens, finches, sparrows, and blackbirds, are attracted to this source of food and have been observed in the upper basin during summer and early fall.

Diving ducks (canvasbacks, merganser, goldeneye, and scaup), as well as kingfishers and grebes, have been observed in the upper basin. This indicates the presence of fish and crustaceans, which are the primary food sources for these species.

The fallen trees and underbrush along the lake's banks provide cover for small fish and crayfish. This habitat also offers a resting and feeding stop for birds, particularly waterfowl migrating along the Pacific flyway.

The trees along the steep slopes throughout the study area provide feeding and nesting habitat for arboreal birds (warblers, siskins, chickadees, etc.). Old-growth conifers provide roosting sites and potential nesting sites for hawks and owls. Herons are also found here. Bird habitat types and locations within the study area are shown in figure 3. A list of animal species found in the study is included in appendix B.

Capitol Lake, particularly at Percival Cove, is one of Washington State Department of Fisheries' largest impoundments for fish rearing. Three major salmon culture programs are conducted in the basin.

- Five to ten million fall chinook are transferred annually from nearby hatcheries. These fish are reared and fed in the lake and Percival Cove for approximately 60 days and released to Puget Sound as 3-inch fingerlings. An estimated 75,000 are caught by Washington and Canadian trollers and sport fishermen. Approximately 5,000 are harvested annually by Indian net fishing within inner Puget Sound.

- About 600,000 fall chinook and some spring chinook are transferred to Percival Cove annually as 4-inch fish when summer water temperatures permit. These are reared until March and released as 8-inch fish. The primary contribution is in the southern Puget Sound sport fishery and, to a lesser degree, a terminal net fishery. Adult salmon are passed upstream for natural spawning.

  Egg-taking facilities are located at Tumwater Falls. At these facilities as many as 10 million eggs are taken each fall for use by the Department of Fisheries.

The lake has a natural run of salmon in addition to the state's program, comprised of selected salmon allowed to escape from the egg-taking facility. Capitol Lake serves as an important feeding area before this run enters Puget Sound. A 1975 study of the fishery observed: "Much of the middle basin of Capitol Lake is no longer available for natural fish production because the deposits of sand are not a suitable substrate for insect (chironomid) production. Natural salmon production in terms of returning adults to Capitol Lake correlates inversely with the increased deposits of sediments in the lake, although other factors such as changing sport and commercial fisheries are involved."[1]

The magnitude of the problem is emphasized by estimates that dredging of these deposits may increase the lake's natural fish production by 50 percent, raising the value of the lake's sport and commercial salmon catches by up to $450,000 per year.[2]

Steelhead and cutthroat trout are also found in the lake. Other fish are present but are not significant in numbers or importance at this time. Figure 4 illustrates the seasonal activity of fish in the lake.

Noise

There are numerous noise sources around Capitol Lake that cause a relatively high ambient noise level[3] for a recreational lake. Major generators include: Interstate 5 which crosses the lake on an elevated structure; the Burlington Northern railroad marshalling yard on the southeast corner of the lower basin; traffic on the Deschutes Parkway and around the bathing beach parking facility; and motorboat and seaplane activity.

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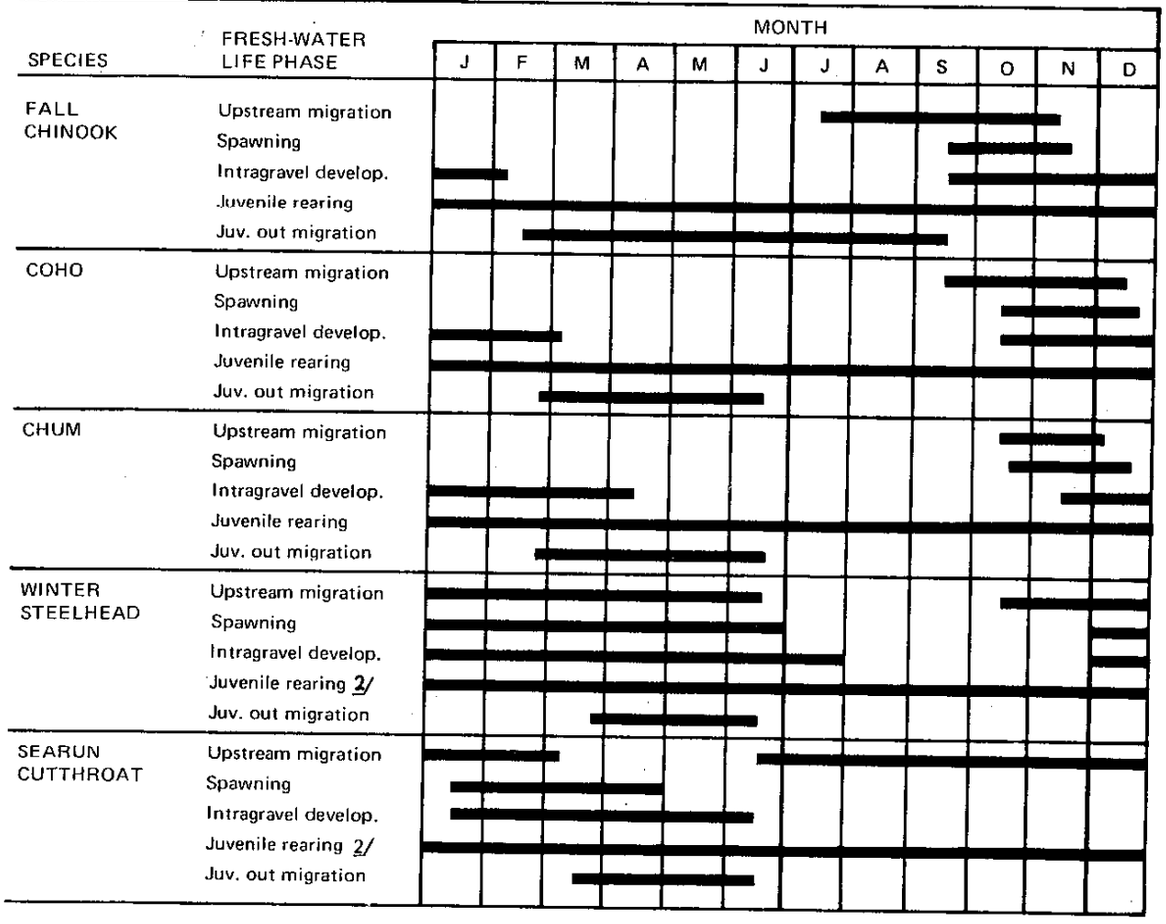
1 Finn, Earl L., Jr., and Tarr, Marvin A. March 1975. *Chemical and biological factors for consideration in the management of the Deschutes River-Capitol Lake.* State of Washington, Department of Fisheries, Management and Research.

2 Washington Department of Fisheries, position memorandum of 18 November 1975.

3 Ambient noise level measurements made by CH2M HILL staff have been used in determining impacts of the proposed plan.

Timing of salmon and searun trout activity in Deschutes Basin[1]



1/ Data supplied by Washington State Department of Fisheries
2/ Normally extends over a two year period

Land Use and Land Ownership

Much of the lake's 4-mile shoreline is publicly owned and is designated for recreational use in existing land use plans (figures 5 and 6). Although most of the steep slopes around the lake are privately owned, they have not been developed significantly.

Private residential property is found along the east shore of the middle basin. About half the upper basin is in private ownership, with the Olympia Brewing Company owning the largest area. Burlington Northern Railroad owns land which includes a marshalling yard in the southeast corner of the middle basin.

The Washington Department of General Administration has legal responsibility for management of the lake. The State Department of Natural Resources has responsibility for adjacent state-owned uplands, and the state maintains a strong interest in the fishery resources of the lake. The Cities of Olympia and Tumwater, and the Thurston County Regional Council of Governments share planning jurisdiction over the surrounding study area.

All comprehensive plans designate the lake and publicly-owned shorelands for recreational use. The City of Tumwater maintains an undeveloped park on the southwest shore of the upper basin. The City of Olympia's Six-Year Capitol Improvement Program calls for development of a park at the mouth of Percival Creek on the land immediately abutting Capitol Lake and on the slopes on both banks of the creek. The state already maintains a park in the southwest corner of the lower basin and along the Deschutes Parkway.

The Thurston County Regional Shoreline Management Plan designates most of the shoreline as a "Conservancy Environment" limiting development to ensure continuous use for public recreation.

Burlington Northern has considered developing its marshalling yard as a complex of condominiums, apartments, and housing for the elderly at some point in the future, but the market cannot support such a project at the present time.

HUMAN ENVIRONMENT

Population

Population[1] in 1976 for the Olympia-Tumwater-Lacey area was 85,900; for Thurston County, 91,751. The county population has been increasing at an annual growth rate of 3 percent.

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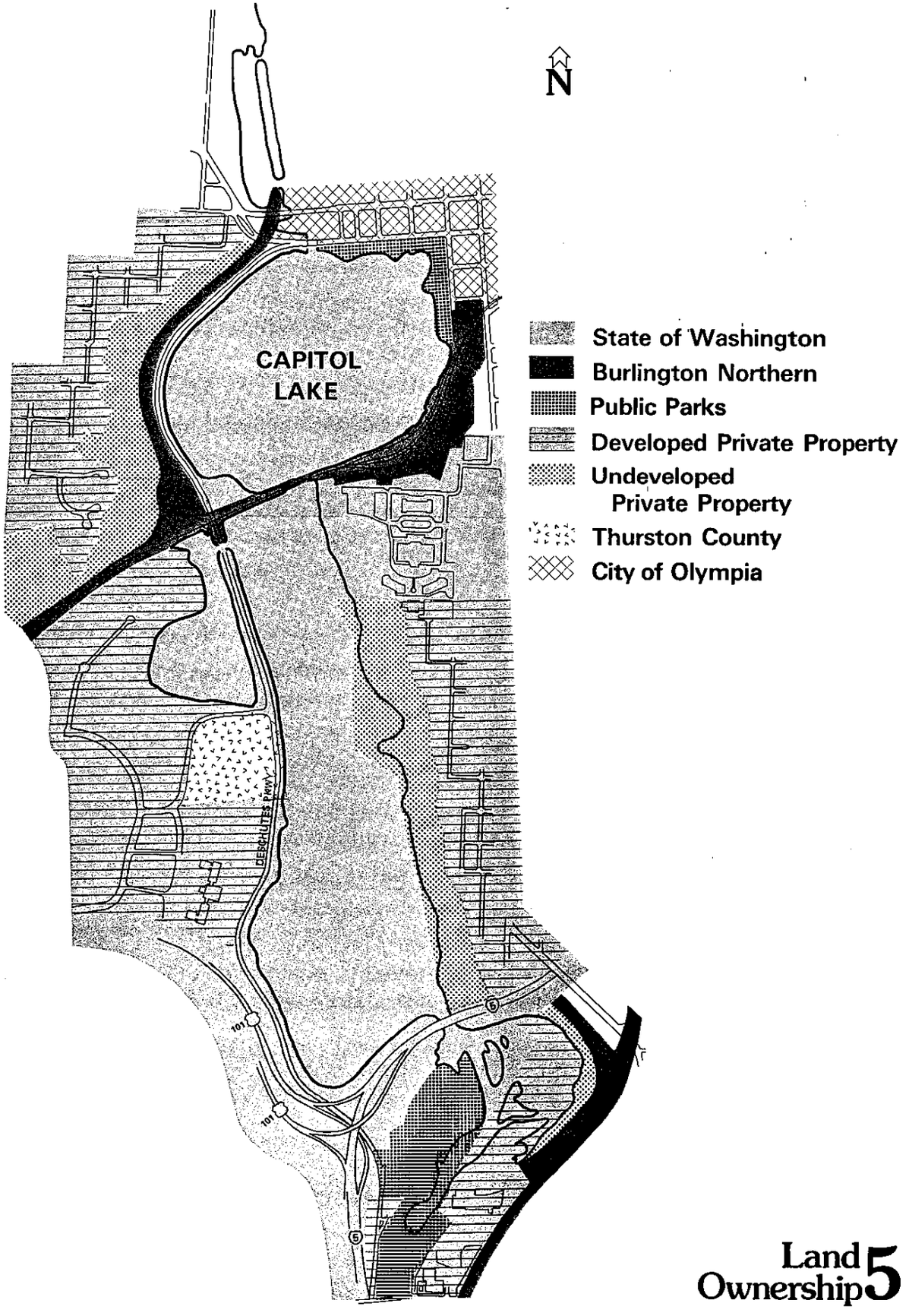
1 Statistics in this section were obtained from the Thurston County Planning Office.



Land Ownership 5

Total employment in the county was 32,037 in 1972. The largest employers were the government, with 13,875; retail trade, with 4,278; and manufacturing, with 2,566. The estimated current median income of $15,200 is growing at an annual rate of 6.4 percent.

Economics

The economic value of Capitol Lake and Percival Cove centers on its use as a local recreation area and as one of the largest salmon-rearing facilities in the State of Washington.

Recreational uses are more thoroughly covered in a following section. Activities include boating, swimming, fishing, and passive recreation such as sightseeing, birdwatching, and leisure driving.

About 6 million fish were reared in Percival Cove in 1973. A plant of 5 million salmon in Capitol Lake, costing about $20,000, would "contribute about 112,000 salmon having an approximate harvest value of $1,500,000 to the sport and commercial fisheries,"[1] according to the State Department of Fisheries. This major program is the mainstay of chinook (blackmouth) production for the sport fishing industry of Southern Puget Sound.

Traffic

The Deschutes Parkway along the west side of the lake serves as an alternate north-south traffic route for Olympia's central business district. In the master street plan, it is considered a local street. Connections to other streets at the south end of the lake are poor, and rely heavily on the bridges in the vicinity of the Olympia brewery.

Interstate 5 crosses the lake on an elevated structure dividing the upper basin from the middle basin. Connection to it near the lake is difficult. There is an off-ramp from Interstate 5 south of the brewery; an on-ramp ties in directly in front of the brewery, but it can only be approached from the south or from the east. Traffic from the north or in the vicinity of the lakes cannot negotiate the sharp turn required to use that on-ramp. The only other access to I-5 in the vicinity of the lake is from SR 101.

SR 101, a 4-lane expressway, interchanges with Interstate 5 at the south end of the lake. Evergreen Park Drive forms an at-grade intersection with SR 101 less than 1 mile west of Interstate 5.

The only surface-street arterial corridor with east-west continuity is the system formed by Martin Way, the State-Fourth one-way couplet, Fourth Avenue as a two-way roadway,

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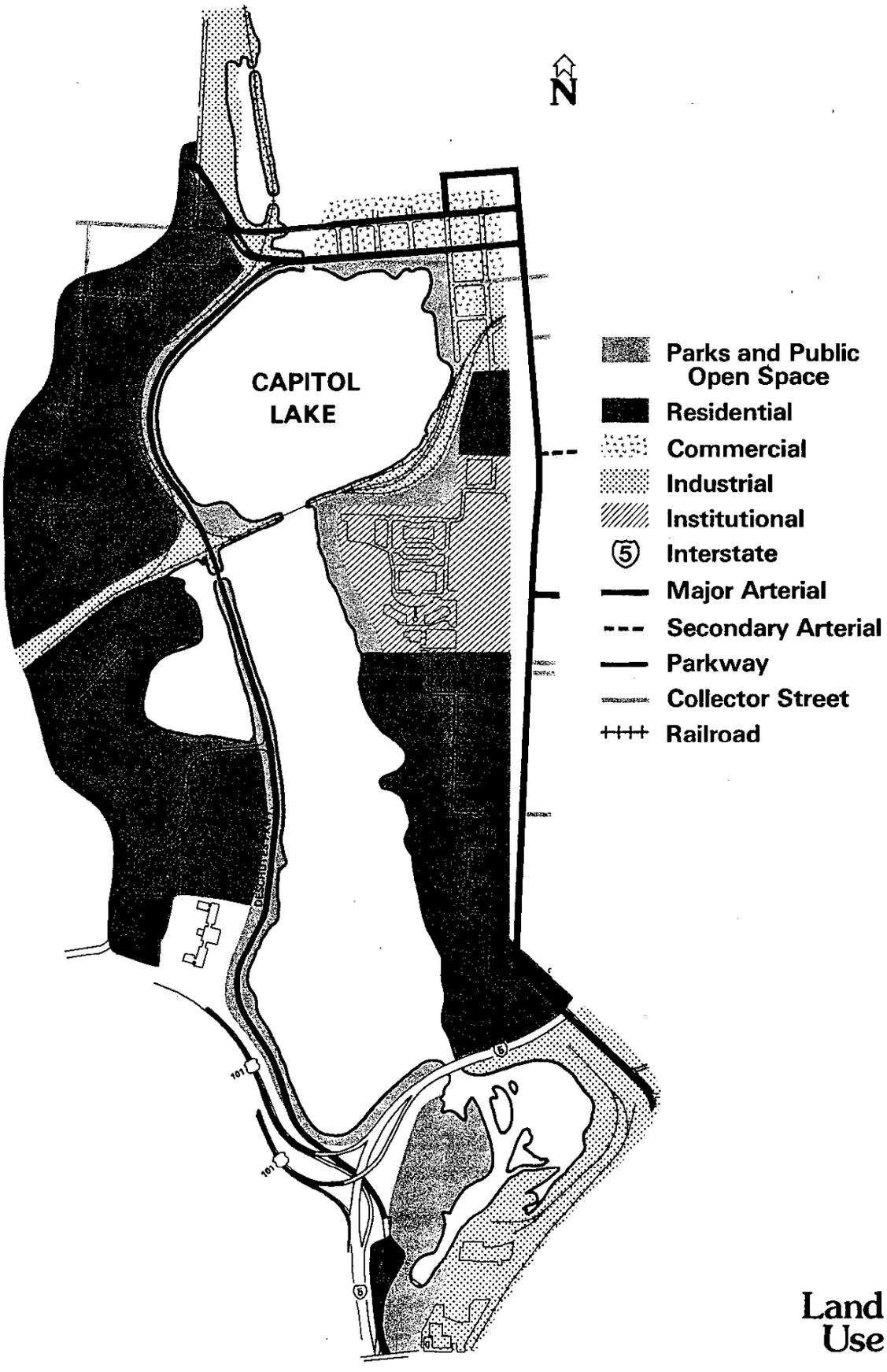
1 Letter from Washington State Department of Fisheries to Capitol Lake Coordinating Committee, 13 May 1973.


N
CAPITOL
LAKE
Parks and Public Open Space
Residential
Commercial
Industrial
Institutional
Interstate
Major Arterial
Secondary Arterial
Parkway
Collector Street
Railroad

Land Use 6

Harrison Street, and Mud Bay Road. The City of Olympia recently let a contract to upgrade all the traffic signals along the State-Fourth one-way couplet. The work on this contract will proceed from now through October 1976, but will not affect the lake's planned restoration activities. Traffic volume on each leg of the one-way couplet is fairly heavy with moderate congestion created by local circulation. Operating speeds are low despite the fact that the signals are timed to allow adequate progression.

The one-way couplet becomes a two-way street on Fourth Avenue in the vicinity of Water Street. From this point westerly, both Fourth and Fifth Avenues are two-way streets which carry all traffic across the bridges over the Capitol Lake outlet. The only access to the Deschutes Parkway from this east-west street system is from Fifth Avenue.

The lakeshore streets are sometimes used for parking overflow for state business.

Utilities

Sewer and storm sewer outfalls enter Capitol Lake and Budd Inlet at the locations shown in figure 7. An elevated powerline and a submerged sewer main in the upper basin are the only utilities with a right-of-way in the study area. Parking lot and watershed drainage from the Greenwood Inn area flow into the south end of the middle basin, causing sediment deposits.

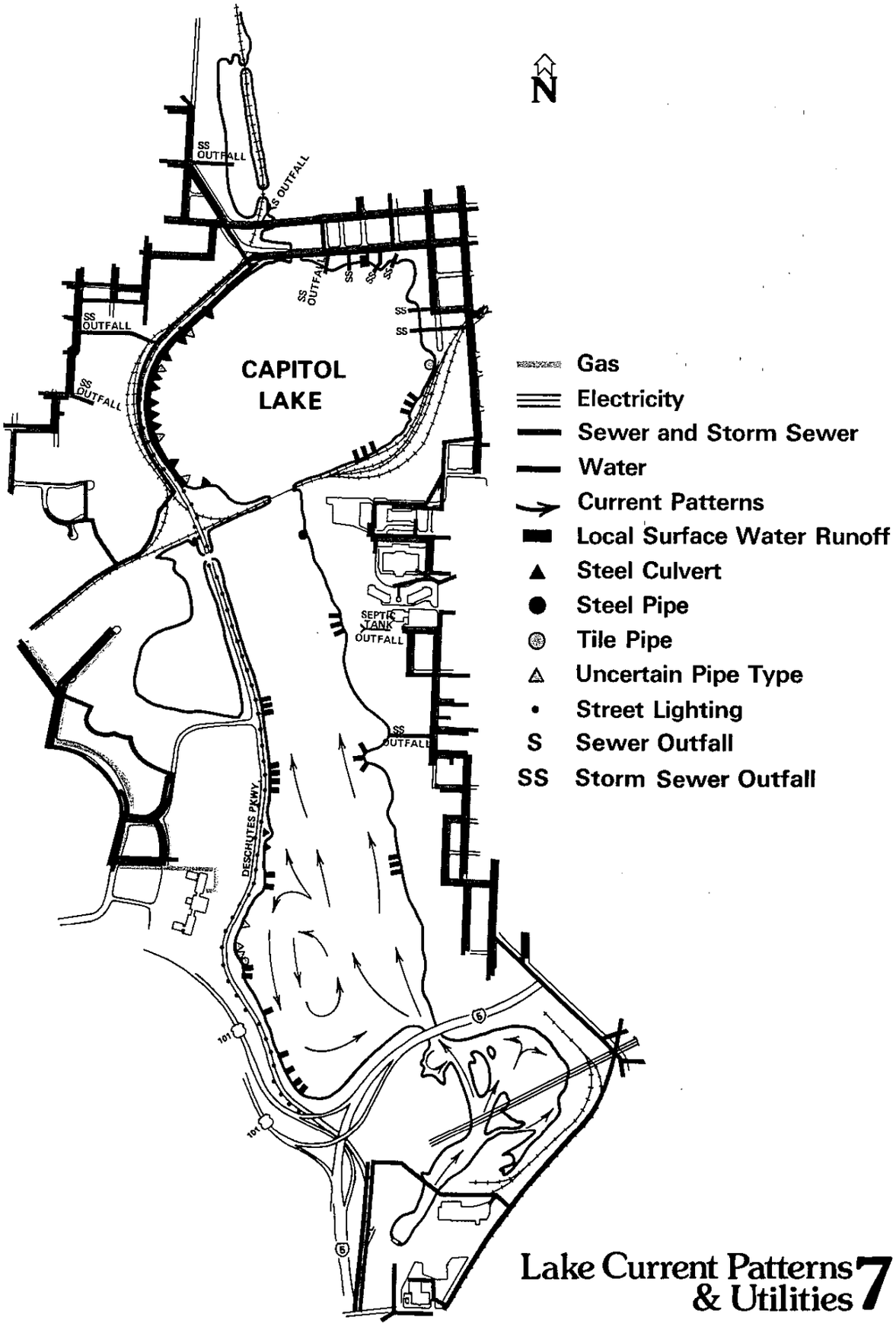
Health

Capitol Lake has been closed to swimming in the past due to high coliform counts in the water. Extremely poor visibility (6 inches) caused by algae blooms has hindered and endangered swimmers.

The coliform bacteria count has been reduced by new lake management policies controlling the discharge of raw sewage and providing for saltwater flushing of the basin. However, the nutrients in the accumulated sediment may influence water quality and swimmer safety. Shallow and mucky areas along the shoreline pose a hazard to boaters and swimmers, and hinder fishermen.

Aesthetics

As a scenic focal point for the land surrounding it, the lake provides an aesthetically dramatic setting for the state capitol buildings. A most striking feature is the view of the Capitol Campus and wooded slopes reflected in



Lake Current Patterns & Utilities 7

the lake surface. Many photographers and visitors have commented on this unique panorama. The lake can be viewed from vistas on surrounding hills that rise as much as 125 feet above the lake, as well as from the lakeshore and parkway (figure 8). Exceptional views of the lake are afforded from several points along the edge of the Capitol Campus, and from the proposed courthouse complex site. Nearly the entire eastern shoreline of the lake, to the crest of the hillside, is undeveloped and undisturbed. The contrast of dense forest, lake, and capitol structures provides a scenic quality that is extremely unusual in an urban setting.

Recreation

The recreational value of Capitol Lake is one of its most important features. Activities include boating, swimming, fishing, sightseeing, birdwatching, photography, and picnicking.

A special attraction on the lake is the annual Capitol Lakefair. The purpose of this event is to provide recreation, fun and fellowship and to bring attention to Capitol Lake as an important recreational area. More than 50 events occur during this 3-day festival each July. The president of Lakefair has noted:

> "The economic effect of Lakefair cannot be measured in dollars which come into the community. Nor can the number of visitors drawn to this community for the first time as a result of Lakefair be measured. The growth of Capitol Lakefair today may have reached its limits unless measures can be taken to rehabilitate Capitol Lake. In the summer of 1975 the middle basin was closed to motorboating, thereby cancelling the annual dragboat races and water skiing competition. Other events were shifted to an overcrowded lower basin without adequate facilities."[1]

Boating and swimming, although sometimes hindered or prevented by the lake's condition, take place in the lower and middle basins. Several property owners on the eastern shore of the middle basin have small boat docks. One boat ramp and launch facility is located in the northwest corner of the upper basin. The City of Tumwater presently proposes that this facility be improved and become a part of its park, which lies immediately adjacent to it.[2]

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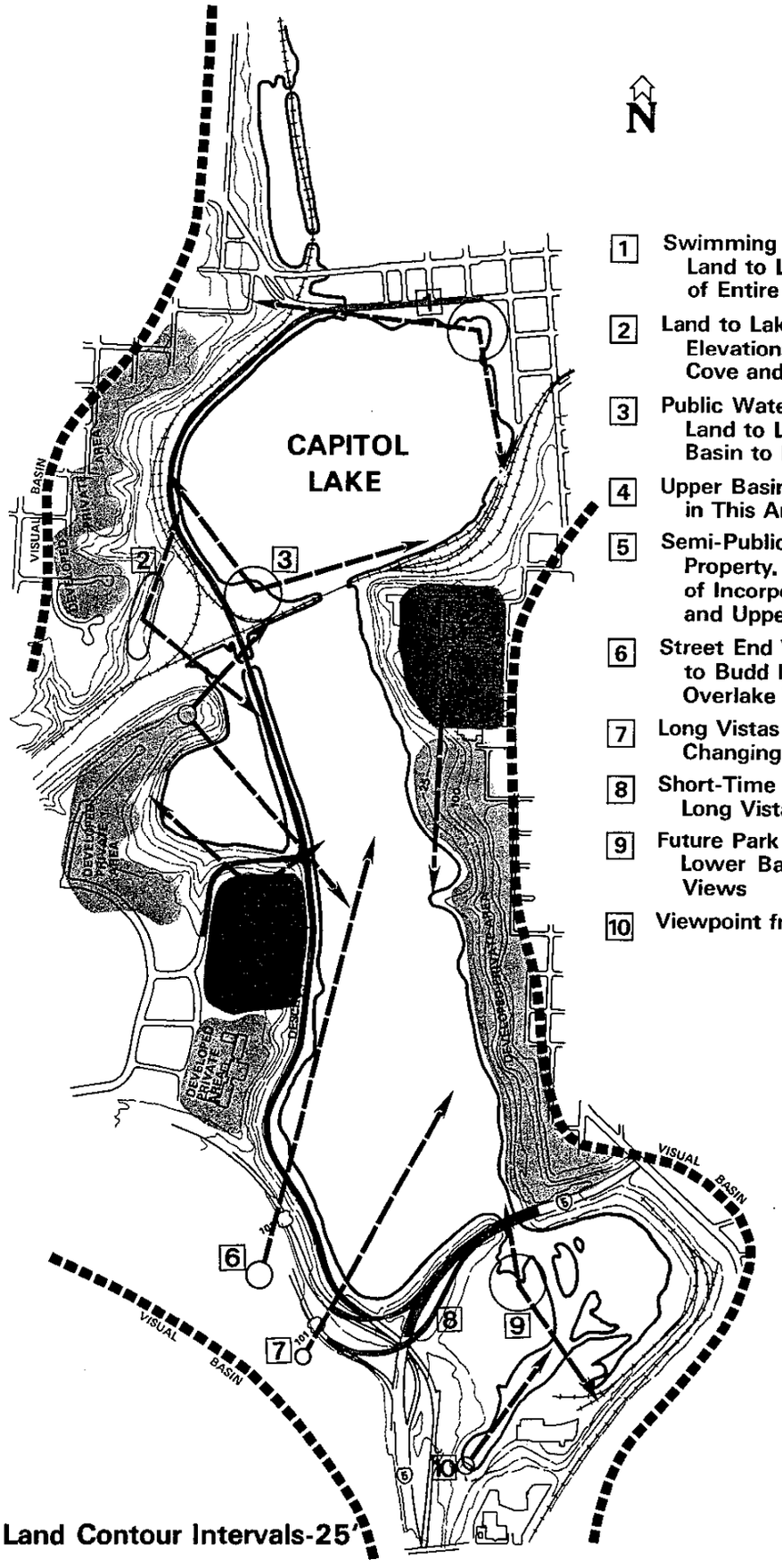
1 Statement by Steve Masini, President, Capitol Lakefair, Inc., 20 October 1975.

2 Department of Planning and Community Development. January 1975. *Comprehensive plan, City of Tumwater, park and open space element, preliminary draft.*



1. Swimming Beach and Public Park Land to Lake Unrestricted Views of Entire Upper Basin Area
2. Land to Lake Overviews from Higher Elevations, Upper Basin, Percival Cove and Portions of Middle Basin
3. Public Waterfront Facility Land to Lake Views of Entire Upper Basin to Budd Inlet and Beyond
4. Upper Basin Overviews from Buildings in This Area
5. Semi-Public Area, County Owned Property. Percival Cove Overview of Incorporated Portions of Middle and Upper Basins
6. Street End Viewpoints. Long Vista to Budd Inlet, Land to Lake and Overlake Views. Undeveloped
7. Long Vistas of Middle Basin. Changing Panoramas
8. Short-Time Interval Views Long Vistas Land to Water
9. Future Park Site. Panorama of Entire Lower Basin Area. Land to Water Views
10. Viewpoint from Falls

Land Contour Intervals-25'

Visual Impact 8

In a cost report, the city noted:

> "If the sediment problem is not resolved, the city will lose use of the boat ramp and launch area because the area is being filled in. As the deposits continue, the shoreline area will extend farther to the east along the western edge of the upper basin, and the basin in many areas will be too shallow for motorized boats. Since the deposition area is very unstable and will not sustain human activities, it is not usable and will further limit access to the water environment. As the ecological transformation of the upper basin continues, a large mud flat will emerge with several meandering channels cutting through the silt area."[1]

Fishing is another popular year-round sport on the lake. Salmon have long been abundant. An estimated 12,840 man-hours of sportfishing took place on the lake in the 1973-74 season.[2] A major increase in steelhead fishing has developed in the last 3 years, with as many as 68 fishermen counted on a single day during the steelhead season. The Washington Game Department places the annual Deschutes River catch at 759, based on reports by fishermen.

Each year, many tourists and school children enjoy watching salmon return to the hatchery at Tumwater Falls Park. The fish are also viewed as large salmon are counted, measured, and released upstream. As many as 5,000 spectators a day observe special demonstrations of artificial spawning and egg taking.

Community attitudes toward recreational activities were obtained from three primary sources.[3] The first was the *Survey of Community Attitudes Toward Park and Recreational Use in Thurston County*.[4] The major need identified was for additional beach access, both salt- and freshwater, in the county. This is registered as an extremely strong need by a ratio of 9:1. The survey also identified fishing, biking, and boating as the three top outdoor activities desired by respondents. The construction of more trails was cited as one of the most critical facility needs.

A second survey[5] was conducted in order to obtain community opinions on recreational activities more specifically related to Capitol Lake. Respondents to the survey indicated that Capitol Lake is visited frequently even in its present state. The list of favored activities was topped by swimming, with 89 percent of the respondents indicating the need was felt to be either important or very important. Picnicking

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1 City of Tumwater. 1974. *Deschutes Way Park. Cost estimates for park development.*
2 Letter from Washington Department of Fisheries to Port of Olympia, 7 July 1975.
3 Summaries of the three surveys are given in the *Recreation Plan Design Report,* appendix C.
4 C. Montgomery Johnson & Assoc. March 1976. Report for the Thurston County Parks and Recreation Department.
5 GMA Research Corp. May 1976. *Capitol Lake opinion survey.*

was second and fishing was third followed by fish-viewing, nature study, nonpower boating, hiking, ball sports, bird-watching, water skiing, motorboating, and train-watching.

Regarding the question of what was most appreciated about Capitol Lake, the largest number of responses concerned the *visual and scenic quality* of the lake setting. Swimming, fishing, and the convenience of outdoor receational opportunities within an urban setting also rated high.

Dislikes cited by respondents centered on the lake's filling in with silt and on its pollution and algae growth problem.

By far the majority of respondents wished the lake to maintain the types of activities and facilities that are presently provided. Other facilities and activities noted as desirable at Capitol Lake included tennis courts, picnic and cooking areas, and bicycle and walking paths. A number of other individual suggestions were recorded.

The third source consisted of a more detailed version of the telephone survey, printed and distributed at meetings held during the planning process. The responses were generally consistent with the telephone survey. The questionnaire also measured public opinion toward the goals developed by the concerned organizations, and elicited more specific responses to the plan design. The results are discussed further in appendix C of the *Recreation Plan Design Report*.

Archeological and Historical Significance

Capitol Lake, particularly the area around the upper basin, was the site of significant prehistoric and historic activities (figure 9). Information prepared for the State Capitol Museum[1] indicates that American settlers began the original settlement of Tumwater in 1845 at the approximate site of Deschutes Way Park.

Two sites along the lake have been registered with the Washington Archeological Research Center in Pullman as prehistoric resources. One 2-acre site in Tumwater City 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 lake was probably occupied for hunting and fishing activities. A third site recently discovered along the lake's west shore was most likely a fishing location and contains scattered cultural materials.[2]

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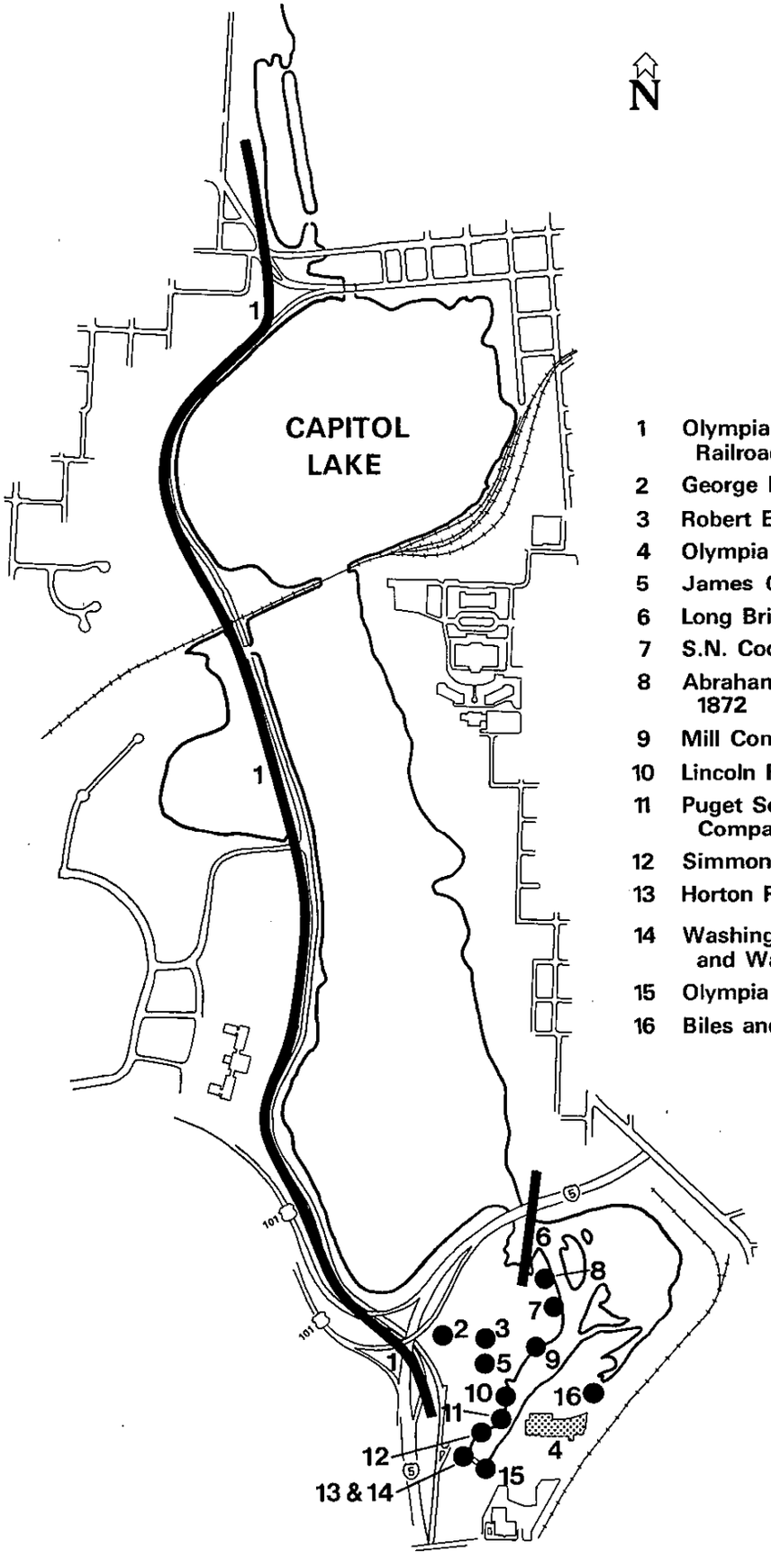
1 Valley, D. Studies on Tumwater for the State Capitol Museum. See appendix C.
2 Exact locations of these sites have not been given in this document to avoid the possibility of unauthorized removal of archeologically important materials.



1 Olympia-Chehalis Valley Railroad - 1878
2 George Biles House - 1860
3 Robert Esterly House - 1895
4 Olympia Brewery - 1896
5 James Ott House - 1895
6 Long Bridge - 1860
7 S.N. Cooper Mill - 1886
8 Abraham Whitemarsh Mill - 1872
9 Mill Complex - 1870
10 Lincoln Flour Mill - 1864
11 Puget Sound Milling Company - 1847
12 Simmons Mill - 1846-1847
13 Horton Pipe Factory - 1868
14 Washington Waterpipe Mfg. and Water Company - 1870
15 Olympia Light and Power - 1905
16 Biles and Carter Tannery - 1860

Historical Sites 9

Historic resource sites or structures within the Capitol Lake basin consist of:

- The Olympia-Chehalis Valley Railroad Line (1877). This 15-mile narrow-gauge railroad paralleled the Deschutes River to its mouth and north to Butler Cove.

- Crosby House (1858). A 2-story Gothic style home, this structure is on the National Register of Historical Places and is being preserved and maintained by the Olympia Chapter of the Daughters of the Pioneers.

- The George Biles House (1860). A large 2-story structure of Gothic Revival style similar to the Crosby residence.

- Robert Esterly House (1895). This was a 2-story Victorian style home having an exterior with scrollwork and gingerbread ornamentation.

- Olympia Brewery (1896). Included in the original structures were a boiler or heating plant, an aging house, two brewhouses, a wellhouse and a wharf. Subsequent construction has altered many of the original structures, but the 1907 brewhouse remains.

- James Ott House (1895). A small wood frame structure with scrollwork on the front.

- Long Bridge (1860). A wagon bridge connecting Tumwater and Olympia over Budd Inlet. It was about 1,150 feet long and 15 feet wide. The bridge section over the Deschutes River channel rotated to create a 20-foot channel passage for ships.

- S. N. Cooper mill (1866). (Washington Saw and Planing Mill Co.) Produced doors, sashes, and blinds.

- S. N. Cooper house (1895). Recent information indicates tht this was a single-story wood frame structure located south of the Esterly home.

- Abraham Whitemarsh mill (1872). A large 2-story structure at the south end of the Long Bridge.

- Mill complex (1870). A collection of mills and factories including the Kendall sawmill, the Esterly mill, and the Pressey chair factory.

- Lincoln flour mill (1864). A 6-story wood structure, water powered, 4-story grist mill with a capacity of 50 bushels per day.

- Puget Sound Milling Company (1847). The foundation and piling are still visible.

- Simmons mill (1846-47). This log structure was located at the base of the falls and on the west bank of the Deschutes River.

- Horton pipe factory (1868). Wood water pipes were made from wood poles by water-powered drills.

- Washington Waterpipe Manufacture and Water Company (1870). The former Horton pipe factory, it was converted to a sawmill in 1880.

- Olympia Light and Power Company (1905). A second powerplant was constructed from cement and stone block at the base of the falls. A metal penstock ran upriver to the dam at the upper falls. The powerplant produced up to 4,500 kilowatts for the Olympia-Tumwater trolley car system and for public use.

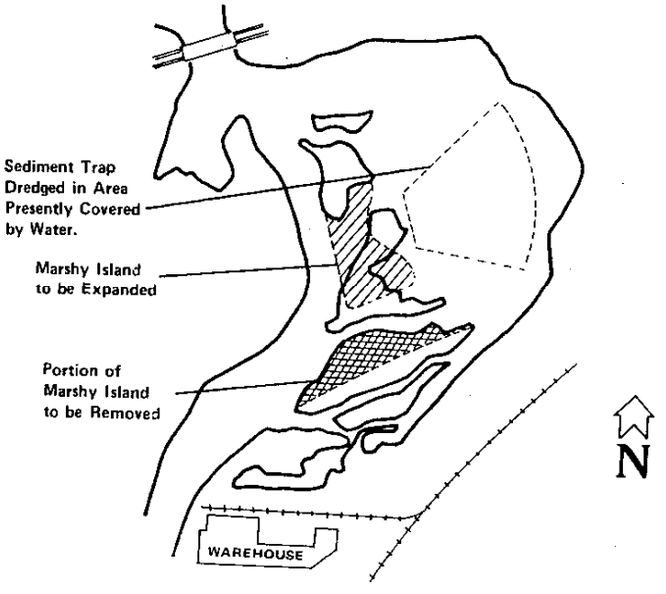
- Biles and Carter tannery (1860). A series of wood frame buildings and several small out-buildings.

DIRECT AND INDIRECT IMPACTS UPON THE ENVIRONMENT

PHYSICAL ENVIRONMENT

Earth

Significant changes will occur in the siltation pattern of the Deschutes Waterway. Dredging, by its nature, will temporarily disturb bottom sediments and alter the topography of the lake bottom. The upper basin will become 12 feet deeper in the sediment trap location. The fill from this operation will change the configuration of the two major islands in the area, forming a single island about 3.5 acres in size. The specific contours of this island have not been determined, but it will have an irregular shoreline along the east side to maximize wildlife habitat. The remainder of the terrestrial area in the upper basin will remain undisturbed. Figure 10 shows the extent of the proposed changes in the upper basin.



Upper Basin Dredging Impact **10**

The deposition pattern in the upper basin will change, with most of the coarse silt being caught in the sediment trap instead of being spread throughout the basin as at present. Some soil material will be moved in the upper basin to build a protective groin. This will slightly increase the size of the northwest shoreline. The groin, to be fronted with rock-filled wire mesh baskets, is intended to reduce the

erosion now occurring on that embankment and to direct the current into the sediment trap.

The middle basin, which now varies between about 0 and 16 feet in depth, will be dredged to a minimum depth of 6 feet. This will change its bottom topography. The sediment trap in the basin's southern end will be 12 feet deep, and will alter sedimentation patterns in the basin. The sediment load carried to the middle basin will consist primarily of fine silt materials, and will be deposited in the trap instead of throughout the basin as at present.

An increase in total accessible shoreline will occur as dredged materials are deposited around the lakeshore. Capitol Lake presently has an unusually small amount of access for a lake of its size. Selective deposition of dredge spoils will improve lake hydraulics and offer much greater potential for recreational enjoyment of the lake. Some of the changes to the shoreline will be gradual due to periodic disposal of maintenance dredge spoils.

Percival Cove will also be dredged to allow it to drain, and a sediment trap will be constructed at the mouth of Percival Creek. A limited quantity of dredge spoils will also be deposited along the Deschutes Parkway shoreline for improved access and hydraulic movement.

Air

No air quality degradation is anticipated from the dredging activity. The diesel-powered dredge will produce emissions during the initial and biennial maintenance dredging. Any possible odor from lake-bottom materials being exposed to the air could be eliminated or reduced by covering the drying bottom with sand or soil. However, as noticed during previous drawdown of the lake, this odor is expected to be less than that from Budd Inlet at low tide.

Water

A primary objective of the proposed plan is to channel and control sedimentation patterns to facilitate maintenance dredging. Washington State University's Environmental Engineering Department used a model of the lake to test the effects of this dredging plan. The following conclusions resulted: [1]

- Shoreline fills from sediment disposal will have little effect on the circulation pattern.

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1 W.S.U. report, op.cit.

- Effects of dredging on water quality and major lake uses are not expected to be significant.

- The increased water volume due to dredging will increase the mean residence time of the lake's water, but this change will not significantly affect weed and algae growth patterns.

- Deposition of sediment which now limits weed growth will continue, especially in the areas of the middle basin most conducive to weed growth.

- Bottom changes will not significantly affect the bottom organism habitat.

- Temporary impairment of water quality expected during initial dredging may be minimized by appropriate scheduling and management of dredging and disposal operations. The best time for dredging is toward the end of the annual high flow period.

- Sediment composition and light penetration will not be factors in determining dredging depths. Depths should be established by factors other than potential biological or water quality effects.

- A deep channel should be retained in the middle basin to guarantee water quality in that basin.

- The lakefill locations have little potential for adverse effects on water quality.

- Fish-rearing activities contribute significant amounts of nutrients and organic materials which could increase weed and algae growth if these activities are increased.

- If heavy algae growth problems develop, a reduction of mixing caused by power boat use could partly correct the problem.

- Continuation of saltwater flushing to control rooted aquatic vegetation is strongly recommended.

The proposed lake restoration program will not correct the existing coliform contamination problem. This problem is being studied by the Department of General Administration.

Water quality could also be degraded to some degree by increased motorboating usage after lake restoration.

This degradation should be minimal if motor size and speeds are restricted as proposed in the *Recreation Plan Design Report*.[1]

Flora

Some vegetation will be removed on the eastern shoreline of the middle basin and new areas for additional growth will be created. Some varieties may increase or decrease slightly in quantity, and there will be a redistribution of plant species in the basin.

In the upper basin the rooted aquatics will be diminished by the initial dredging. This vegetation loss will be temporary. There will also be a temporary loss of willows, alders, and grasses resulting from the alteration of the islands and the construction of the protective groin.

The dredging in the middle basin will have minimal impact on vegetation. Where areas near the shoreline are affected, there will be a loss of some rooted aquatics. No terrestrial vegetation will be removed.

The stand of willows and alders along the east shore of Percival Cove will be retained where possible during disposal. A small portion of vegetation will be lost in places where the present grade is low. Rooted aquatics will be lost initially, but will probably be re-established after the inlet's dredging and filling are finished.

The fills which develop around the lake during maintenance dredging will create additional land for terrestrial vegetation. The extent to which this adds a diversity of species will depend on grading and landscaping. The sediment deposited will provide generally fertile soil for plant growth.

Fauna

As with vegetation, there will be a redistribution of some wildlife species. Varieties may increase, decrease, or, in some cases, be displaced entirely.

The lake's fishery will be a primary beneficiary of the project. Deeper water and slightly cooler temperatures in the middle basin will be more suitable than existing conditions for sea-run cutthroat and salmon fry, which are abundant in the lake. Control of sedimentation will improve water quality and food production for all fish. Fish migration and behavior patterns may be disrupted slightly during the initial dredging activities; however, this will be minimized

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1 Richard Haag and Associates; Royston, Hanamoto, Beck and Abey; CH2M HILL. July 1976. *Capitol Lake recreation plan design*. A report for the Department of General Administration.

by the use of a small dredge. Some habitat will be destroyed when low-lying cover and marsh areas are removed. Lakefill will temporarily destroy some sources of food and protection for fish. However, most vegetation will regenerate rapidly, with almost complete revegetation within 2 years.

Loss of some shallow areas in the upper basin will adversely affect the ability of the basin to serve as a nursery for juvenile salmon and steelhead. Creation of new marshy areas will help to mitigate this loss, but the areas affected by channel widening and sediment trap dredging represent a permanent loss. There will probably be a small reduction in areas for feeding, resting, and breeding, and fish will pass through the basin more rapidly than at present. An exception will be in the protective groin area where deep pools could provide resting areas for salmon, steelhead, and cutthroat trout.

The loss of shallows will also affect insect production, which will have an adverse effect on bird population. The magnitude of this impact is not known.

The maintenance dredging program in the upper basin may cause minor disruption of fish patterns and loss of habitat in the immediate vicinity of dredging operations. The use of the smaller dredge for maintenance dredging will considerably minimize any potential impacts. Present planning calls for less frequent maintenance in the middle basin, reducing the adverse impacts there.

Bottom organisms, an important link in the lake's food chain, will suffer a slight disruption of their habitat. There will be a reduction of bottom organisms in the sediment trap of the upper basin due to sedimentation, but a rich benthic environment will be created in the marsh areas of the islands. The existing sandbar in the middle basin's planned sediment trap location is now almost sterile due to the rapid influx of sandy sediments. The reduction of the sedimentation rate here will improve the environment. Regeneration of benthic organisms will be rapid, with near total recovery within 2 years.

Ducks, particularly those in the upper basin, will temporarily be adversely affected by the project. The activity of the dredging operations will probably cause temporary displacement of waterfowl to quieter locations.

Removal of shallow waters throughout the upper basin will eliminate food for dabbling ducks and temporarily eliminate some nesting habitat. A small amount of marshy island area will be lost through dredging, but this will be partially offset by the creation of new marsh areas. Ducks are less

abundant in the affected areas of the middle basin and Percival Cove, so the impact there will be reduced. However, waterfowl will be adversely affected wherever dredging removes shallow areas and vegetation.

Some roosting and nesting areas for arboreal birds will temporarily be lost. However, as land surrounding the lake is increased by maintenance dredging, habitat for these species could be improved.

Mammals which now inhabit the upper basin could relocate to newly created or neighboring areas as a result of this program. The islands to be modified in the upper basin are feeding areas for beaver and muskrat. The disruption of this vegetation and the increase in human activity expected after deeper waters are created could cause displacement of these animals.

Noise

The diesel engines and pumps on the dredge are the only noise generators associated with the proposed project. The dredge will produce about 70 dBA[1] at 50 feet, a noise level lower than commonly produced by motorboats.

The homes on the bluffs above the west bank of the middle basin and west of Percival Cove are the most sensitive land use that could receive noise from this operation. However, the nearest of these dwellings is about 500 feet away and 150 feet above the equipment, so that little sound is expected to reach residences even when the dredge operates at night. Freeway and railroad yard noise are expected to be greater than the dredging noise reaching residences.

Recreational activity will also be affected by noise from the project. Picnicking and other activites will not be desirable immediately adjacent to the operation. However, the noise from this equipment will have less impact than that of a powerboat operating at high speed.

An indirect impact from the lake restoration will be the effect of noise from increased power boating. The magnitude of this impact on activities on and around the lake should be slight and within acceptable limits if proposed motor size and speed limitations are enforced.

Wildlife will probably remain at a distance from the operating equipment.

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1 dBA is a noise level scale that includes human hearing characteristics in the determination of loudness.

Land Use

The dredging portion of the project is not expected to cause significant short-term impacts on the use of land around the lake. Initial dredge spoil deposition and construction of the protective groin in the upper basin and along Percival Cove's east bank will provide desirable increases in recreationally usable shoreline.

In the long term, maintenance dredging will significantly increase land available along the shoreline for recreational use. However, the project is not expected to cause long-term changes in current land use patterns or land ownership.

Natural Resources

Most of the sediment dredged by this project will be incorporated into the lake's shoreline in order to improve lake hydraulics and provide additional public access. Natural resources may be altered by replacing aquatic habitat with terrestrial habitat and terrestrial with aquatic.

There is always a potential for an accidental diesel oil spill from the dredge on the lake. This should not present a major threat, because of the relatively small consumption rate of 140 gallons per day. However, because of the long water retention time in the lake, any spillage could be significant. Safeguards should be incorporated into the contract and operations program to reduce this possibility. Safeguards would include storage and handling regulations and emergency cleanup measures to be followed.

The Percival Cove gravel pit to be utilized for spoils deposition is no longer in use and all marketable sand and gravel have been removed from the site.

HUMAN ENVIRONMENT

Population

The proposed project will not cause any impact on population size or distribution in the study area.

Economics

Detailed cost information is found in the engineering section of this report. The initial cost is estimated at $2.34 million, and maintenance costs would average $76,320 every 2 years over a 20-year period.

Salaries for the initial dredging effort would include about $250,000 for dredging and about $225,000 for groin construction and debris and deadhead removal, for a total of $475,000. Spending and respending of these salaries would generate a total increase of $950,000 to $1,425,000 in personal incomes within Thurston County.[1]

Labor costs associated with maintenance dredging include about $220,000 for dredging[2] and $350,000 for disposal site preparation costs, for a total of $570,000. These salaries would generate an additional $1,140,000 to $1,710,000 income within the county.

Removal of sediment from the lake will increase recreational opportunities and safety, especially for boating. Aesthetic value to the public would also be improved. These improvements could have a positive impact on property values along the lake.

The Department of Fisheries has estimated that removal of silt from the lake could result in an increase in natural fish production of 40 to 50 percent. The value of this increased production is estimated as high as $450,000 annually.[3]

The sand and gravel in the dredge spoils have a significant market value, but the magnitude of this value cannot be determined until the sediment composition and market conditions are established at the time of dredging.

Transportation and Circulation

Because materials will be pumped and disposed of inside the basin, their transfer will have no impact on traffic. Persons on the small work force would probably drive their cars to work. Ample parking is available along the parkway and in Tumwater's park adjacent to the northeast shore of the upper basin.

Initial transport and setup of the large dredge could create brief, temporary traffic disruption along local access roads. The undeveloped Tumwater Park site would probably be used for this activity.

Energy

The dredge uses an estimated 140 gallons of diesel fuel per 20-hour operational day. For the estimated 12- to 15-month initial dredging period (based on 22 working days per month),

1 Based on a 10-man crew in 2 shifts, 20 hours per day, for the 12- to 15-month initial dredging period.
2 Based on a 10-man crew in 2 shifts, 20 hours per day, for a 3-month period.
3 Memorandum from Department of Fisheries to Department of General Administration. 18 November 1975.

total fuel consumption for the dredge would be 40,000 gallons. For each 3-month maintenance dredging period (which would occur every 2 years in the upper basin, and every 5 to 10 years in the middle basin), total fuel consumption would be about 9,000 gallons, or about 90,000 gallons over the 20-year period. Although total energy requirements are not insignificant, they are less than that which would be used if similar construction were carried out with conventional earthmoving equipment.

Utilities

No utilities will be affected by the project. All sewer outfalls have been identified and will be avoided or provided for when materials are disposed along the lakeshore.

Human Health

There will be an improvement in swimmer and boater safety in the middle basin resulting from removal of shallow areas and underwater debris. The potential hazards associated with the dredging pipelines are expected to be quite low. The floating pipelines carrying sediment for disposal will be halfway above the surface and will be well marked.

No significant impact on the lake's water quality is anticipated.

Aesthetics

The relative visual appeal of a dredged lake versus a filled river delta is subjective. Many people who have considered the issue feel that the basin would be more aesthetically pleasing if it were restored and preserved as a lake. The proposed dredging program attempts to achieve this goal in the middle and lower basin, while maintaining the major portion of the upper basin in its present marshy state to provide maximum diversity.

The dredging operation will create temporary unsightliness. The equipment itself will be visible from some of the shoreline and from ridges above the southern portions of the lake and Percival Cove. When sediment is initially deposited, it will destroy existing ground cover and terrain and worsen disposal site appearance until grading and revegetation can be completed. The long-term impact of additional land and vegetation around the lake should improve the basin's appearance.

Recreation

Recreational use of the lake will be improved after the temporary disruption from dredging activities. The benefits[1] of this project include:

- Increasing the depth increases the recreational opportunities and provides for more use during the summer when the demand is high.
- Dredged material can be used to create on-site park areas to provide additional access to the lake.
- Dredging provides cooler and deeper water in summer; opportunities for improved sports fishing; greater diversity and area of usable fishing habitat; removal of sand bars, deltas, and other boating hazards; and, by use of dredge spoils, increased public access to lake shoreline.
- The east half of the upper basin will offer increased water area for fishing and boating. The existing islands and marsh area on western half of basin will remain a marsh for more passive recreation.
- Increased aesthetic value to the public.
- Lake rehabilitation will enhance and increase the recreational benefits and use of the lake.

Sport fishing will generally be improved throughout the lake. The protective groin area will provide an excellent vantage point for catching the salmon, steelhead, and cut-throat trout which will rest in the deep pools it creates. Better fishing areas will also be created in Percival Cove.

Increased recreational use of the upper basin will benefit humans, but it will have a partial adverse impact on the wildlife of the basin. Increased boating, fishing, and other activities may drive some species from the basin. Some of these activities could be restricted by local regulations and management policies.

Archeological and Historical Significance

The most important archeological site which could be affected by this project lies on the northwest shore of the upper basin. Remains of a prehistoric fishing village which may have been a permanent settlement of the Nisqually Indian tribe are found here. Cultural materials including stone

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1 Bachmann, J.W. *Saving a beautiful lake.* A report for the Capitol Lake Coordinating Committee.

and bone tools have been collected and analyzed. The area near this site will be used for temporary equipment storage and for construction of the protective groin. Care will be taken to assure that no disposal or earth-disturbing activities destroy artifacts that remain. After construction, the groin will protect this land from the flooding and erosion that now occurs. Development and use of Tumwater's park will probably have a greater impact on this land than will the dredging program.

The lake area is also historically significant as the location of several important wood and flour mills in the late 1800's. Only deteriorated fragments of these structures remain. The decaying wood piling pieces that remain from a railroad trestle in Percival Cove will be removed.

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The objective of the dredging program is to restore the basin's use as a lake environment, rather than permitting its continued siltation and ultimate transformation to a river delta.

As documented in this report, Capitol Lake in its 25 years of existence has become a unique visual, recreational, and biological resource in the Olympia-Tumwater region and the state. Since most of its shoreline is publicly owned and remains undeveloped, numerous recreational activities take place in and around its waters. Capitol Lake, and particularly Percival Cove, is one of the state's most important fish-rearing impoundments. The lake's diverse terrestrial and aquatic vegetation provides abundant habitat for a variety of wildlife, making it a valuable biological resource in an urban setting.

These values have been increasingly threatened in recent years by the magnitude of sedimentation in the basin. Concern for this problem and statements of the need to reverse the trend have been expressed by a variety of groups in the Olympia-Tumwater area and by state agencies. Because the sedimentation in this artificial lake has been caused primarily by man's restriction of the natural water flow, it seems appropriate for man to take further steps to repair the damage and save the lake. Action to protect the lake's aquatic environment will permit a greater diversity of species, balanced between aquatic and terrestrial varieties, to exist in the Capitol Lake basin.

The dredging for this project will allow removal of accumulations of sediment and debris as well as efficient removal of future sediment. This will make it possible to preserve the lake environment for use by future generations and will permit a greater diversity of species to remain in the Capitol Lake basin.

It is unavoidable that decisions regarding dredging and disposal locations foreclose future options for designing the lakeshore. The decision to dredge will prevent the Deschutes Waterway from becoming a river delta. Although it would be possible to alter a dredged area or relocate a lakefill, the level of expense required would make such decisions infeasible.

The recommended plan is phased to permit the development of a comprehensive recreational plan for the basin. This

strategy permits the gradual buildup of that basin's recreational lands. The long-term goals of improving the lake's diverse environmental, recreational, and aesthetic values can be fulfilled by a carefully designed plan.

If the long-term goal is to save Capitol Lake, then the short-term impacts from implementing this project as soon as possible appear justified.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Because the dredged sediment will be incorporated into the lakeshore, no natural resources in the study area will be irretrievably committed to this project.

The diesel fuel consumed by dredge equipment is a nonrenewable natural resource. The quantity of fuel involved, described under "energy impacts," is not considered excessive.

The capital cost of the project represents an irretrievable commitment of equipment and labor.

ADVERSE ENVIRONMENTAL IMPACTS WHICH MAY BE MITIGATED

Most of the adverse effects resulting from the project can be reduced or eliminated through scheduling and design techniques. Some of these procedures have already been mentioned in the section on impacts.

Dredging in the main channel of the Deschutes River will be scheduled between June and September. The Deschutes River is at low flow during this period, reducing erosion potential and controlling turbidity created by the dredging operation. This will reduce impacts on both water quality and soils. In addition, this time period will avoid the total migration period of any fish species shown in figure 4. Although the end of one run and the beginning of another may be affected, there will be minor danger of interrupting an entire migration.

To further reduce the problem of siltation from dredge spoils return water, special disposal techniques will be adopted. These include the use of settling and treatment ponds to reduce the turbidity of water returning to the lake from the dredge slurry, compacting the spoils in appropriate increments, and building dikes around spoils holding sites.

Gabions will be used to form the protective groins in the upper basin to reduce the visual impact of these facilities. (A gabion is a strong wire mesh container filled with rocks.) The groins will protect Tumwater's park, the prehistoric site, and the new island from erosion and flooding. Not as unsightly as steel or concrete bulkheads, the gabions will permit the growth of some vegetation on their surface.

As discussed in the impact section, there will be a loss of terrestrial habitat caused by the project. However, this will be offset by the creation of new habitat. Loss of marsh habitat in portions of the upper basin will be replaced by marsh areas developed at the new island in the upper basin and, to a more limited extent, in the southwest corner of the middle basin. Likewise, the disruption of bottom organisms by dredging in shallow areas will be partially offset by the creation of the marshes and by slowing the rate of sedimentation in the middle basin.

ALTERNATIVES TO THE PROPOSED PROJECT

Three major alternatives to the recommended plan were considered. They are:

- Alternative A. Extensive dredging[1] in the upper basin, returning it to the 1949 contours; dredging in the middle basin and Percival Cove to a minimum 6-foot water depth; depositing dredge spoils as with the recommended plan, excluding the upper basin; and conducting maintenance dredging every 2 to 5 years with spoils incorporated in the middle and lower basins.

- Alternative B. No action in the upper basin; dredging[2] in the middle basin to a minimum 6-foot depth and providing a sediment trap; dredging in Percival Cove; depositing spoils as with the recommended plan, excluding the upper basin; and conducting maintenance dredging every 2 years with spoils incorporated in the middle and lower basins.

- Alternative C: No action in Capitol Lake.

Before these three major alternatives were identified, each of the possible subsystem alternatives was evaluated according to environmental impact, cost, engineering feasibility, and energy consumption. The possible subsystem alternatives are:

- Initial dredging locations and extent
- Dredging methods
- Periods between maintenance dredging
- Alternative disposal sites both within and outside the basin
- Method of transporting spoils

As a result of this evaluation process, smaller dredges were found to be preferable to the larger dredges due to considerations of cost, noise levels, and disturbance to the lake's ecosystems. The disadvantage of smaller dredges is the substantially longer periods of operation and the labor costs that are as high as for the larger dredge. The proposed program recommends the small dredge for dredging.

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1 Incorporates initial dredging concept 2 from *Design Engineering Report,* page 8.
2 Incorporates initial dredging concept 3 from *Design Engineering Report,* page 8.

Longer periods between maintenance dredging were found desirable due to improved opportunities for revegetation of bottom aquatic plants, less harm to sediment organisms, and less disruption of recreational activities on the lake. However, longer periods between maintenance dredging were determined to be not as critical a consideration as the other factors. Disposal sites within the lake area were preferred to out-basin sites because of cost considerations and the possibility of providing additional usable shoreline access to the lake. In the event spoils transportation out of the lake basin is necessary, the advantage of pumping to a site was found to far outweigh rail or truck transportation, due to energy considerations, noise, cost, and traffic congestion.

The three alternative concepts shown above, then, incorporate the preferable subsystem feature wherever possible. Both action alternatives and the recommended plan are predicated on use of a small dredge for both initial and maintenance dredging, with a 2- to 5- year maintenance recurrence. The major differences between the major alternative concepts shown above involve the location and extent of dredging activity in the lake.

When the recommended plan was selected, contingency options within this plan were developed. The details of these variations are explained in the *Design Engineering Report*.

The environmental impacts of the alternatives and the recommended plan are compared in the matrix shown as figure 11. The positive and negative impacts of the three project alternatives are discussed in the remaining pages of this chapter.

ALTERNATIVE A. EXTENSIVE DREDGING IN THE UPPER BASIN

Although this plan was not tested on the Washington State University model because of the model's physical constraints, this plan is expected to significantly reduce further sedimentation in the middle basin. The upper basin would, in effect, be transformed into a sediment trap for the Deschutes River. The middle basin would be dredged to a minimum of 6 feet, but no sediment trap will be provided. The same dredging operation proposed in the recommended plan would occur at Percival Cove.

Major positive impacts of this plan include:

- Control of sedimentation and ultimate preservation of the lake.

Environmental Factors

Alternative	Wildlife and Vegetation	Fish	Water Quality and Hydraulics	Geology and Soils	Air	Noise	Visual	Economics	Recreation	Land Ownership and Land Use	History/Archeology	Transportation and Energy
RECOMMENDED PLAN (WSU) Dredge sediment traps in upper and middle basins; dredge middle basin to minimum 5' depth with sediment trap. Dredge Percival Cove. Maintenance dredging every 2 years. Initial and maintenance dredge material disposal within the lake basin	INITIAL DREDGING Upper Basin Redistribution of limited amount of marsh area, including grasses, willows, alder and rooted aquatics Temporary loss of habitat used for cover, nesting and food by birds and waterfowl (mainly dabbling ducks) Loss of some lake bottom organisms Temporary disruption of present wildlife behavior patterns Possible loss of habitat for beaver, muskrat, and other wilder species Reduction in potential for flooding Middle Basin Removal and improvement of sterile lake bottom environment in sediment trap area Temporary dislocation of aquatic species INITIAL DISPOSAL Opportunity to provide additional access to lake and enhance recreational activities Temporary disturbance of wildlife behavior patterns and habitat, followed by possible improvement of the area MAINTENANCE DREDGING Periodic, minor disruption of terrestrial wildlife during operations Removal of some lake bottom organisms Good opportunity for regrowth of disturbed ecosystems MAINTENANCE DISPOSAL In middle and lower basins, temporary reduction in shoreline habitat for ducks; eventual increase in marsh habitat Significant increase in shoreline access and recreation opportunities	INITIAL DREDGING Temporary minor disruptions in immediate vicinity of dredging. Permanent loss of a portion of habitat used for food and cover in upper basin INITIAL DISPOSAL Loss of some shallow lake area especially in upper basin Creation of new habitat areas for food and cover along shoreline MAINTENANCE DREDGING Biennial disruption of fishery for short time periods Destruction and loss of minor quantities of food organisms in dredged areas MAINTENANCE DISPOSAL Minor, temporary disturbance of habitat used for food and cover	Temporary turbidity during operation, probably more severe in middle basin than in the upper basin Change in mean residence time may produce weed/algae growth in lake Potential for increased fish production could result in increase in nutrient load and decrease in water quality	Permanent change in topography of lake bottom Potential permanent change in configuration of lake's shoreline Change in topography of disposal areas outside basin if used Dredge material in upper basin are approximately 90% sand with some gravel, 10% silt. Material in middle basin is 95% silt, 5% sand. Sands would be suitable for fill or foundation material. Silts would be suitable for fill or for increasing agricultural productivity of poor soil	No significant impacts on air quality	No significant increase in lake's ambient noise levels Dredge noise on lake for about 20 hours/day, possibly affecting some residents. Dredge would produce 70 dBA at 50'.	Alteration in appearance of upper basin, but restoration of lake scenery Potential improvement in appearance of disposal sites outside basin if used Eventual improvement of appearance of lake shoreline	Positive impact on local economy Probable increase in lakeshore property taxes	Probable improvement in sport fishing following temporary disruption in upper basin Continuation of lake-oriented activities with possible reduction in variety of terrestrial wildlife to be observed Conforms with goals for lake restoration stated by Capitol Lake Coordinating Committee Long term improvement in active lake recreation such as boating	Primarily state owned property involved Land values of private ownerships with lake views or access will be improved Some out-of-basin disposal sites are privately owned and would be affected if used Development potential for out-of-basin sites could be improved Grading and design of in-basin disposal sites would improve lake access	No adverse impacts to significant sites. Proposed work in upper basin could protect archeological sites from flood damage Remnants of Olympia—Chehalis Valley Railroad line built in 1878 would be removed from Percival Cove	No significant impact on traffic from any portion of this operation Quantities of diesel fuel used are relatively low for a construction effort of this size
ALTERNATIVE A Extensive dredging in upper basin. Dredge upper basin to 1969 contours. Dredge middle basin same as for Recommended Plan. Dredge Percival Cove. Dredge material disposal same as for Recommended Plan	INITIAL AND MAINTENANCE DREDGING Virtual elimination of marsh habitat and dependent wildlife from upper basin. Only slight aquatic revegetation between dredging due to concentration of silt in upper basin DISPOSAL Impacts similar to Recommended Plan, except more immediate and extensive effects on the sites in the basin with reduced long term effects on out-of-basin sites	INITIAL DREDGING Upper Basin Similar to Recommended Plan with more extensive disruption of fishery Middle Basin Improved conditions due to primary role of upper basin as sediment trap MAINTENANCE DREDGING No significant impact INITIAL AND MAINTENANCE DISPOSAL No significant impact	Increased turbidity in upper basin, decreased turbidity in middle basin. Change in mean residence time may produce weed/algae growth in lake Potential for increased fish production could result in increase in nutrient load and decrease in water quality	Similar to Recommended Plan	No significant impacts on air quality	Similar to Recommended Plan with probability of longer duration and more noise sources on upper basin during initial dredging	Extensive change in upper basin from marsh/lake appearance to lake only. Middle basin same as for Recommended Plan	Similar to Recommended Plan	Same as for Recommended Plan except that recreational use of the upper basin would change from passive to more active forms, and water-related activities in the middle basin would experience loss interruption due to dredging (less maintenance dredging required)	Similar to Recommended Plan	Similar to Recommended Plan	Similar to Recommended Plan
ALTERNATIVE B No dredging in upper basin, dredge middle basin same as for Recommended Plan. Dredge Percival Cove. Dredge material disposal same as for Recommended Plan	INITIAL DREDGING Upper Basin No direct impact on ecosystems in this area, except for possible periodic loss of vegetation and habitat from flooding Gradual transition from aquatic lake environment to dominance of grasses, alder, willow and dependent terrestrial wildlife Middle Basin Same as for Alternative A Disturbance would be for longer duration INITIAL DISPOSAL Same as for Recommended Plan MAINTENANCE DREDGING Impacts similar to those described for Recommended Plan. However, the longer period between maintenance operations would facilitate regrowth and the establishment of wildlife habitats	INITIAL DREDGING Upper Basin No immediate impact; eventual reduction in number of fish as upper basin fills in Middle Basin Same as for Recommended Plan INITIAL AND MAINTENANCE DISPOSAL; MAINTENANCE DREDGING No significant impact	Gradual degradation of water quality in upper basin and significant alteration of water flow and circulation patterns Temporary turbidity in middle basin with initial dredging and maintenance operations Change in mean residence time may produce weed/algae growth in lake Potential for increased fish production could result in increase in nutrient load and decrease in water quality	Gradual change in topography of entire upper basin from silt Change in topography of out-of-basin disposal sites (if used) Gradual change in lake's shoreline due to maintenance dredging deposition	No significant impacts on air quality	Similar to Recommended Plan, except noise limited to middle basin	Eventual loss of lake appearance in upper basin as it transforms to a marsh and a river channel Other impacts same as for Recommended Plan	Costs for dredging upper basin at a later date (if proven necessary) would increase due to effects of inflation and greater magnitude of sediment to be removed	Eventual degradation and loss of sport fishery in upper basin Eventual loss of lakefront environment for Tumwater's Deschutes Park Transition from lake-oriented recreation to river and land activities Does not meet Capitol Lake Restoration goal of maintaining upper basin as a lake	Similar to Recommended Plan	Gradually decreased capacity in upper basin could result in periodic flooding and possible damage to archeological/historical sites	Similar to Recommended Plan
ALTERNATIVE C No Action	No immediate impacts Gradual transition in species beginning with increased waterfowl followed by shifts to terrestrial species Upper Basin: Eventual transition of vegetation and wildlife as described in Alternative B Middle Basin: Increased occurence of shallow areas with consequent beneficial impacts on dabbling ducks Increase in rooted aquatic vegetation communities in shallow areas	No immediate impacts Rapid deterioration and loss of fishery in upper basin; slow loss of fishery in middle basin	Gradual and constant reduction of lake capacity as silt is deposited	Gradual alteration and elevation of topography of lake's bottom as fill takes place Eventual, significant change in shoreline as lake fills in	No significant impacts on air quality	No impact	Gradual loss of scenic resource of lake and ultimate change to terrestrial form	No employment generated Gradual reduction in value of lakefront property Loss of one of the state's largest fish rearing waters	Eventual loss of Capitol Lake as water-oriented recreational resource Eventual reduction in sport fishery Impacts to upper basin same as for Alternative B Continued deterioration of middle basin's suitability for boating and other water sports Does not meet Capitol Lake Restoration goal of maintaining upper basin as a lake	Potential transition from lake-oriented uses to terrestrial uses as lake fills in	Same impacts as for Alternative B	No direct impacts

Impacts of Alternative Restoration Plans 11

- Improved recreation throughout the basin because of greater water depth and removal of hazards.

- The same benefits to the state's fishery program as with the proposed plan.

- Improved environment for the lake's natural fishery, except in the upper basin.

- Less frequent maintenance dredging (every 5 to 10 years), permitting regrowth of vegetation and benthic organisms. This also minimizes the disruption of wildlife and recreation during maintenance.

In the final evaluation, the negative impacts from alternative A outweighed the positive. Negative impacts include:

- Almost complete destruction of the biologically and aesthetically valuable marsh environment in the upper basin. Many wildlife species, including beaver and muskrat, will be eliminated from the area. There will be significant reductions in habitat for dabbling ducks and other waterfowl. This impact on wildlife is much more severe than with the recommended plan, and no new marsh areas could be provided to offset the loss.

- This plan does not fulfill the goals of the Capitol Lake Coordinating Committee. This group, representing 20 public and private organizations, called for preserving the wetland environment in the upper basin while assuring its maintenance as a lake.

- Although the deeper, generally cooler water provides an improved environment for fish, some habitat suitable for feeding and resting will be permanently lost.

- Removing a large quantity of dredged material from the basin may require that the silt be drained before it is transported if pumping cannot be employed. Sites were considered on the southeast shore of the upper basin, near the old Olympia brewery, and on Tumwater's park site. Some habitat will be temporarily destroyed by this process. This disadvantage would also apply to any of the other action alternatives.

- If materials were transported by truck, several adverse impacts would result. Road access to the area is limited, and traffic problems could result from the movement of about 100 trucks per day to

and from the site. The noise and emissions of these vehicles will cause considerable local environmental degradation. Trucking will also increase project cost. This potential adverse effect would also be associated with any of the other action alternatives.

ALTERNATIVE B. NO ACTION IN THE UPPER BASIN

With this alternative, no action would be taken in the upper basin. The basin would eventually cease accumulating any sediment and gradually become a marsh and river delta.

The middle basin would be dredged in a pattern similar to that of the recommended plan, but the sediment trap would be larger and deeper to catch the increasing silt loads that will be expected. Percival Cove would be dredged as in the recommended plan.

Positive impacts of alternative B include:

- Sedimentation will be controlled.
- No immediate adverse impact on the ecology of the upper basin will occur nor will wildlife be disturbed.
- Recreation will be improved and hazards will be removed in the middle basin.
- The environment will be improved for the lake's natural fishery, except for areas silted in with the upper basin. The same benefits to the state's fishery program will result as with the proposed plan.
- Initial dredging costs will be lower than for alternative A and the recommended plan. Costs will be increased due to inflation and increased sediment accumulation if a subsequent decision were made to dredge the upper basin.

Negative impacts include:

- A gradual transition of the upper basin to a marsh will occur with a gradual reduction in aquatic species in the basin. However, the new marsh will create habitat for terrestrial species.
- The committee's goal of preserving a wetland environment would not be met.
- Because dredging in the middle basin would be more extensive, greater disruption of recreational activities and potential interference with fish migration would occur in that basin.

ALTERNATIVE C. NO ACTION

With alternative C, no effort would be made to remove accumulations of sediment in Capitol Lake.

The positive impacts of this plan include:

- Saving fuel from discontinuing dragboat 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 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 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 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 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 lakeshore development.[1]

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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 a park-like atmosphere...Capitol Lake and its preservation is one of the keys to Olympia's future."

UNAVOIDABLE ADVERSE IMPACTS

Temporary adverse impacts that cannot be reduced are:

- Some turbidity and siltation will occur from dredging and disposal. This will be minimized by use of a small dredge.
- Dredge operation could cause minimal interference with recreational activity. The degree of interference will vary according to the exact time and place within the lake.
- Dredge operation will create some noise, possibly interfering with passive recreational activities. However, boating generally creates more noise than is expected from the dredge.

None of these unavoidable impacts will significantly degrade the Capitol Lake environment.

A permanent adverse impact will be the loss of some shallows in the upper basin. This will directly affect the productivity of that basin in terms of fish and insects, and the birds that prey on them. Loss of some marsh areas may result in the permanent relocation or loss of the wilder species of birds and mammals.

The possibility exists that algal blooms will increase with longer retention time of water in the lake and without diversion of nutrients.

Capitol Lake

Appendix A

BACTERIAL CONTAMINATION OF THE CAPITOL LAKE SWIM AREA

During the summer of 1975 the Thurston-Mason Health District determined that the waters of Capitol Lake in the vicinity of the swimming area at the northeast corner of the lower basin were in excess of state standards for bathing beach waters and declared the swimming areas unsafe. Total coliform levels in the swimming area that led to the declaration were:

Date	Location	Coliform Level (Most probable number per 100 ml)
6 May	Beach	240
17 June	Swimming area	240
1 July	Swimming area	150
15 July	Dock	430
15 July	Wading area	2,300
22 July	Dock	930
23 July	Wading area	7
29 July	Beach	930
29 July	Beach	240
30 July	Wading area	4,300

A dense, surface-scum-forming, algal bloom also contributed to the declaration of the waters as unsafe for swimming.

Systematically collected coliform bacteria (total coliform and fecal coliform) and streptococcus bacteria information for Capitol Lake and the lower Deschutes River sufficient to determine a source of the presumed fecal contamination does not exist. The available reconnaissance studies are somewhat anomalous; the source could lie within the Capitol Lake watershed or in the lower Deschutes River basin. There is, therefore, no reason to expect the proposed Capitol Lake dredging project to have any beneficial impact on the bacterial water quality of the lower basin swimming areas. A total water quality study of the lake system directed towards answering the bacterial contamination questions is necessary.

Capitol Lake

Appendix B

PLANT SPECIES LIST

These plants have been identified in the Capitol Lake study area[1].

CATTAIL BEDS

Cattails *Typha latifolia* L.*
Burred *Sparganium* sp.
Wild rice grass *Zizania aquatica* L.
Spike rush *Eleocharis* sp.
Rush *Juncus* sp.
Pond weeds *Potamogeton pectinatis**, *P. foliosus**, *P. crispus**, *Elodea canadensis**
Waterplaintain *Alisma* sp.
Green alga *Spirogyra**
Sedges *Volvox** and *Cladophora**

ALDER THICKETS

Alder *Alnus rubra Bong.**
Willow *Salix* sp.*
Salmonberry *Rubus spectabilis Pursh**
Himalyan blackberry *Rubus discolor* Weihe & Nees*
Evergreen blackberry *Rubus ursibus* Cham. & Schlecht*
Wild rice grass *Zizania aquatica* L.

HEAVY DECIDUOUS FOREST

Maples *Acer macrophyllum Pursh**
Alder *Alnus rubra Bong.**
Not investigated fully but presumably also has Salmonberry *Rubus spectabilis*, Evergreen blackberry *Rubus ursinus*, Salal *Gaultheria shallon* Pursh, etc.

HEAVY CONIFEROUS FOREST

Old mature Douglas fir *Pseudotsuga menziesii* (Mirbel) Franco*
Otherwise similar to deciduous forest

MISCELLANEOUS

Freeway bank grasses
Rubus discolor Wiehe & Nees
Scotch broom *Cytisus scoparius* (L.) Link*
Plaintain *Plantago major* L.
St. John's wort *Hypericum perforatum* L.
Timothy grass *Phleum pratense* L.
Orchard grass *Dactylis glomerata* L.

NOTE: * indicates species identified during 29 October 1975 field observations by Charles Lindberg and Christopher Dlugokenski, researchers.

1 Species usage from Hitchcock, C. L., and Cronquist, A. 1973. *Flora of the Pacific Northwest.* Seattle and London: University of Washington Press.

Blackberry (trailing)
Birch
California hazelnut
Cedar
Cottonwood
Devil's club
Fern (2 species)
Gordon mock orange
Hemlock
Madrona
Oregon grape (2 species)
Salal
Skunk cabbage
Trillium
Vine maple
Wild cherry

CAPITOL LAKE WILDLIFE POPULATION

The following animals, or recent signs of their presence, were observed in the Capitol Lake area on a field trip conducted 29 October 1975 by Charles Lindberg and Christopher Dlugokenski.

MAMMALS

Deer *Odocoileus* sp.
Muskrat *Ondatra zibethica*
Striped skunk *Mephitis mephitis*
Raccoon *Procyon lotor*
Voles *Microtus* sp., *Clethrionomys* sp.
Mink *Mustela vison*
Mountain beaver *Aplodontia rufa*
River otter *Lutra canadensis*
Deer mouse *Peromyscus maniculatus*
Bushytail woodrat *Neotoma cinerea*
Pacific mole *Scapanus orarius*
Bat *Myotis* sp.

AMPHIBIANS

Frogs
Turtles
Lizards

BENTHIC ANIMALS

Crayfish
Snails

FISH

Salmon
Steelhead
Cutthroat trout

CAPITOL LAKE AREA BIRD POPULATIONS

These populations were compiled from the lists of the Black Hills Audubon Society, and are concerned with the area of the lake between the I-5 bridge and Tumwater Falls.

WINTER RESIDENTS

Common loon ***
Horned grebe*
Eared grebe*
Western grebe*
Pied-billed grebe*
Double-crested cormorant*
American bittern
Gadwall*
Pintail*
Green-winged teal*
American widgeon*
Northern shoveler
Ring-necked duck*
Canvasback**
Greater scaup ***
Lesser scaup*
Common goldeneye***
Barrows goldeneye***
Bufflehead*
Ruddy duck*
Hooded merganser*
Common merganser ***
Red-breasted merganser*
American coot*
Common snipe*
Spotted sandpiper
Least sandpiper
Dunlin ***
Western sandpiper
California gull
Ring-billed gull*
Mew gull
Bonaparte's gull*
Winter wren ***
Varied thrush ***
Golden-crowned kinglet
Ruby-crowned kinglet ***
Northern shrike
Evening grosbeak ***
Golden-crowned sparrow ***
Fox sparrow ***

PERMANENT RESIDENTS

Great blue heron ***
Green heron ***
Mallard*
Sharp-shinned hawk**
Cooper's hawk ***
Red-tailed hawk
California quail
Ring-necked pheasant*
Killdeer ***
Glaucous-winged gull*
Belted kingfisher*
Common flicker ***
Pileated woodpecker ***
Yellow-bellied sapsucker
Hairy woodpecker*
Downy woodpecker
Steller's jay ***
Common crow*
Black-capped chickadee
Chestnut-backed chickadee*
Common bushtit ***
Red-breasted nuthatch ***
Brown creeper
Dipper ***
Bewick's wren*
Long-billed marsh wren*
American robin ***
Cedar waxwing
Starling ***
Hutton's vireo ***
Yellow-rumped warbler*
House sparrow ***
Red-winged blackbird ***
Brewers blackbird ***
Purple finch ***
House finch*
Pine siskin*
American goldfinch
Rufous-sided towhee ***
Dark-eyed junco*
Song sparrow*

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* Indicates birds observed 29 October 1975, Charles Lindberg, Christopher Dlugokenski, and Douglas Canning, researchers.
** Indicates species that are unusual for the area.
*** Indicates species seen since 20 October 1975.
NOTE: Bald eagle observed 21 April 1976.

SPRING AND SUMMER RESIDENTS

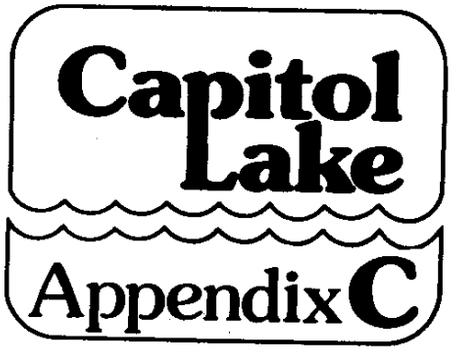
Turkey vulture
Band-tailed pigeon**
Common nighthawk
Rufous hummingbird ***
Violet-green swallow ***
Tree swallow
Rough-winged swallow
Barn swallow ***
Cliff swallow ***
Solitary vireo ***
Red-eyed vireo
Warbling vireo
Swainson's thrush
Orange-crowned warbler***
Yellow warbler
Black-throated gray warbler
Yellowthroat ***
Wilson's warbler
Brown-headed cowbird
Western tanager
Black-headed grosbeak
Savanah sparrow
White-crowned sparrow ***

BREEDING BIRDS AND POTENTIAL BREEDERS

Green heron
Blue grouse**
Ruffed grouse**
California quail
American coot
Killdeer
Screech owl
Great horned owl
Saw-whet owl**
Rufous hummingbird
Belted kingfisher
Common flicker
Pileated woodpecker
Yellow-belled sapsucker
Hairy woodpecker
Downy woodpecker
American robin
Varied thrush
Swainson's thrush
Golden-crowned kinglet
Ruby-crowned kinglet
Cedar waxwing
Starling
Hutton's vireo
Violet-green swallow
Tree swallow
Rough-winged swallow
Barn swallow
Cliff swallow
Steller's jay
Common crow
Chestnut-backed chickadee
White-breasted nuthatch
Red-breasted nuthatch
Brown creeper
Dipper**
House wren
Winter wren
Bewick's wren
Long-billed marsh wren
House sparrow
Red-winged blackbird
Brewer's blackbird
Western tanager
Black-headed grosbeak
Evening grosbeak
Purple finch
House finch

Solitary vireo
Red-eyed vireo
Warbling vireo
Orange-crowned warbler
Yellow warbler
Yellow-rumped warbler
Yellowthroat
Wilson's warbler

Pine siskin
Rufous-sided towhee
Dark-eyed junco
Savannah sparrow
White-crowned sparrow
Song sparrow


Capitol
Lake
Appendix C

ARCHEOLOGICAL AND HISTORICAL RESOURCES, CAPITOL LAKE BASIN

Principal Investigator: Mr. Derek Valley
State Capital Museum
Olympia, Washington

This report includes a description of the known cultural resources in the area of Capitol Lake. The cultural resources include both prehistoric and historic material of significance to the residents of the Olympia and Tumwater area.

Native Americans, probably Nisqually, occupied the area and utilized the natural resources including fish, shellfish, and land animals. During the period of European exploration and fur trading, the area was often frequented. In 1845 American settlers came to the area to live. The Americans realized the assets of the Deschutes River and Budd Inlet. The reasons for the choice were the availability of water power of the Deschutes River falls, the proximity of the saltwater port for shipping and sea travel, the abundance of timber, and good farming land. The town of New Market, later Tumwater, was settled; factories, businesses, and residences were established; and Tumwater thrived from the 1860's to the early 1900's.

In the early 1850's Smithville, later Olympia, was settled and became the territorial capital. In 1889 it became the capital city of Washington State.

PREHISTORIC RESOURCES

Two of the three sites have been formally recorded with the Washington Archaeological Research Center, Pullman, Washington. The unnumbered site has not yet been recorded. Details of the sites are recorded in the center's site survey forms.

1. This site, designated 45TN40, is located on about 2 acres of alluvial fan and beach terraces in Tumwater Park. Remains of this fishing village and shellfish collecting site are evident in up to 1 meter of cultural deposits. No permanent structural remnants have yet been located but the site quite possibly was a permanent village of the Nisqually Indian tribe. The shell midden site was an historically and prehistorically occupied site with cultural material indicating that it may have been occupied for 500 years or more. Samples of cultural materials have been

collected and analyzed. The shell midden accumulation consists of various species of marine shellfish intermixed with bones of fish, bird, and mammal species. Artifacts recovered by amateur collectors and a series of test excavations include lithic and bone tools and cultural features.

2. The site 45TN5 is a shell midden site located on the eastern shore of Capitol Lake. The cultural material collected includes shell, bone, charcoal, and fire-cracked rocks. Artifacts collected include projectile points. The site was probably occupied for hunting and fishing activities.

3. A third occupational site which has been recently discovered but not recorded is located on the west shore of the lake. This site would have been an excellent fishing location for salmon and other species of fish. The evidence of cultural material is sparse and scattered. A more thorough survey of the site area to determine the extent and nature of the cultural material is needed.

HISTORIC RESOURCES

The list of historical structures includes the significant structures along or near the shore of Capitol Lake.

1. Olympia-Chehalis Valley Railroad Line (1878): The narrow gauge railroad was started at Warren Point in 1877 and extended from Budd Inlet to Tumwater paralleling the Deschutes River and going south to Tenino, a distance of 15 miles. The train hauled light freight and was a passenger train making stops at five stations. Construction was by the Thurston County Railroad Construction Company. The railroad line was later bought by the Port Townsend Company which eventually was bought by the Northern Pacific Railroad who used the line as a spur.

2. George Biles House (1860): A large two-story structure of Gothic Revival style similar to the Crosby Residence.

3. Robert Esterly House (1895): Two-story Victorian style with clapboard siding on the lower story, wood frame with shingles on the upper story. A portico and second story porch, widow walk, with a square dormer dominating the exterior of the structure. The exterior also had scroll work and gingerbread ornamentation.

4. Olympia Brewery (Olympia Brewery Company Property, Desoto Way) (1896): Commercial-style brick structures with some wood frame structures of the original buildings.

   Boiler or heating plant: One-story structure of wood with high stack and several smaller out-buildings.

   Aging House: Long one-story structure, wood frame structure with clapboard siding and roof dormers.

   Brewhouse: (1896) Four-story structure of wood, commercial style with few windows on the building.

   Brewhouse: (1907) Large brick structure, five-story brick and steel structure with three-story tower, commercial style with Italianate-style windows and copper-sheathed roof.

   Well House: Small wood frame structure housing two wells of 80 and 100 feet for the supply of artesian water.

5. Jacob Ott House (1895): Small wood frame structure with scrollwork on the front of the single-story structure.

6. Long Bridge (1860): A wagon bridge connecting Tumwater and Olympia over Budd Inlet was approximately 1,150 feet long, 15 feet wide, and 6 to 10 feet above mean tide level. The bridge section over the Deschutes River channel, approximately 40 feet wide rotated, creating a 20-foot channel passage to allow ships to pass.

7. S. N. Cooper Mill (1886): Washington Saw and Planing Mill Co. A small frame structure located at the sound end of the Long Bridge. Produced doors, sash, and blinds.

8. Abraham Whitemarsh Mill (1872): Tumwater Sash, Door, and Blind Factory. Mostly cedar milling. A water tower was located next to the two-story wood frame structure.

9. Mill complex (1870): A series of mills and factories were located here. The building complex included the Kendall sawmill, Esterly Mill, Pressey chair factory. These businesses were located in a large multistory wood frame structure.

10. Lincoln Flour Mill (1864): Owned and operated by Clanrick Crosby. A six-story wood structure, water-powered four-stone grist mill with a capacity of 50 bushels per day. Grain was grown locally and sold locally and exported.

11. Puget Sound Milling Company (1847): Corporation established to build and maintain a sawmill. The corporation consisted of Michael Simmons, Supt. F. Shaw, E. Sylvester, J. Ferguson, A. Rabbeson, G. Jones, A. Carnifes, and J. Kindred. A. Rabbeson was the manager and operator of the first sawmill on Puget Sound owned by Americans. The machinery for the mill was purchased from the Hudson's Bay Co., Vancouver, Washington. The mill produced much of the lumber used in local construction or exported to other ports on the West Coast. The mill was sold to C. Crosby and Gray in 1849. The foundation pilings are still visible.

12. Simmons Mill (1846-1847): The log structure was located at the base of the falls and on the west bank of the Deschutes River. The structure had granite stones and was water powered. The grain came from the surrounding farms and was not bolted. The mill was sold to Crosby and Gray in 1849.

13. Horton Pipe Factory (1868): This single-story wood structure was built on pilings over the water and produced wood water pipes. The wood poles were drilled, the drills being power by water.

14. Washington Waterpipe Manufacture and Water Co. (1870): Issac Burlingame bought the Horton Pipe Factory and continued to produce water pipe until 1880 when the facility was converted to a sawmill.

15. Olympia Light and Power Co. (1905): The second powerplant was constructed at the base of the falls. The cement and stone block structure was removed in 1952. The plant had a metal penstock that ran upriver to the dam at the upper falls. The powerplant produced up to 45,000 kilowatts of power used by the Olympia-Tumwater trolley car system and residences and businesses of the area.

16. Biles and Carter Tannery (1860): A series of wood frame buildings and several small out-buildings were used in the tannery.

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