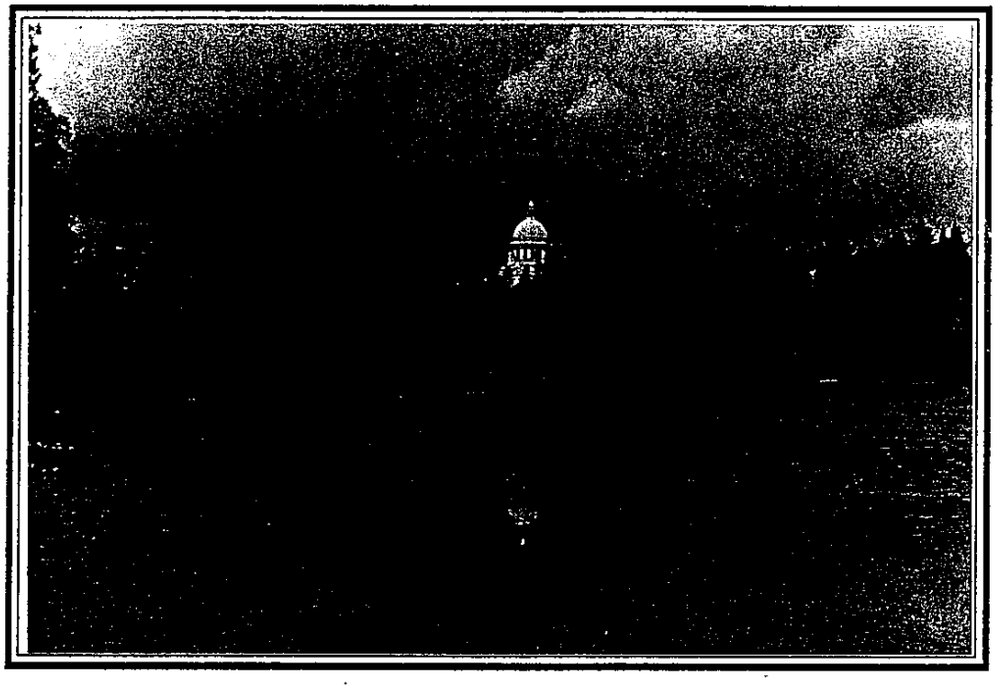
Washington State
Department of General Administration

# NORTH BASIN SHORELINE EROSION CONTROL STUDY



# CAPITOL LAKE

NOVEMBER 1990

ENTRANCO ENGINEERS, INC.

# *CAPITOL LAKE*

## NORTH BASIN SHORELINE EROSION CONTROL STUDY

Prepared for

Department of General Administration
State of Washington

Prepared by

ENTRANCO ENGINEERS, INC.

in association with

Lee & Associates
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November 1990

# EXECUTIVE SUMMARY

## Purpose and Need

The purpose of this report is to summarize the present shoreline erosion conditions of the north basin of Capitol Lake and to recommend conceptual repair actions and preliminary costs for planning purposes.

Since the formation of the north basin of Capitol Lake in 1952, the shoreline area has been armored with rock and concrete riprap in most places. Loss of shoreline areas at Marathon Park and shoreline road deterioration along Powerhouse Road and the Deschutes Parkway were issues associated with shoreline erosion conditions. The Department of General Administration decided to evaluate the status of shoreline erosion conditions due to these issues.

This report is one of three reports prepared for the Department of General Administration by Entranco Engineers, Inc. for the Capitol Lake Wetland Feasibility Study contract. A second report evaluates the feasibility of establishing a freshwater wetland in the south and middle basins of Capitol Lake. A third report provides an overview of the effects of watershed nonpoint pollution on Capitol Lake water quality and potential solutions. Work outlined in this report is separate from consideration of the wetland feasibility or nonpoint pollution reports.

## Study Approach

The project included a total condition survey of the entire 8,130 foot circumference of the north basin shoreline. The survey occurred during a July 5 and 6, 1990 lake drawdown and a follow-up survey on August 28 during full lake level summer conditions. Erosion problems occur more in summer when water levels are higher (e.g. 6.48 feet MSL). Fourteen shoreline zones, starting at Marathon Park and proceeding counter-clockwise, were identified for photographic documentation, analysis, and development of repair recommendations.

## Alternatives Considered

A literature review of shoreline erosion techniques was conducted to identify repair alternatives. Seven shoreline repair concepts, ranging from placement of riprap to the bioengineering technique of brush layering, were considered in more detail. Unit costs for these concepts ranged from $33 to $150 per linear foot.

## Recommended Shoreline Erosion Control Plan

Thirty-four percent (about 2,750 feet) of the entire 8,130 feet of shoreline was identified for repair at a planning-level total cost of about $302,000.

As part of this total cost, shoreline at Marathon Park and the inlet to the north basin (about 800 feet of shoreline) was designated as high priority for repair at a cost of about $114,000.

As part of this total cost, the Capitol Lake Park area (about 950 feet of shoreline) was designated as medium priority for repair at a cost of about $65,000. Repair recommendations in this area were defined in light of the City of Olympia's plans for park renovation.

The reader is referred to table 3, page 9 for a breakdown of costs for each shoreline zone.

Preliminary regulatory permit implications of this work were defined through contact with the Army Corps of Engineers - Seattle District. The beach restoration proposed for Marathon Park and Capitol Lake Park would require an individual 404 permit which could take from eight months to three years for processing.

Remaining shoreline repairs may be authorized under the nationwide permit process applied to each remaining zone of the shoreline. This could take from two to three months for processing. These zones include repair work at the railroad trestle, Powerhouse Road, south of Capitol Lake Park, north shore parking lot, and at the tide gate.

# ACKNOWLEDGEMENTS

This North Basin Shoreline Erosion Control Study was funded by the State of Washington Department of General Administration as part of their on-going management of Capitol facilities. The study was completed at the direction of the State of Washington Department of General Administration under the supervision of Nick Cockrell and Bob Arndt, and the technical assistance of Cliff Ikerd and Dave Lohrengel, Division of Capitol Management.

The development of study objectives, scope of work and reviews of draft reports was greatly enhanced by the cooperative efforts of the members of the Wetland Technical Advisory Committee:

| | |
|---|---|
| Nick Cockrell | Washington Department of General Administration |
| Bob Arndt | Washington Department of General Administration |
| Randy Acker | House of Representatives |
| Bill Robinson | House of Representatives |
| Allen Moore | Washington Department of Ecology |
| Brian Benson | Washington Department of Fisheries |
| Jeff Skriletz | Washington Department of Wildlife |
| Jeff Dickison | Squaxin Island Tribe |
| Gregg Grunenfelder | Thurston County |
| Rick Nelson | Thurston County Conservation District |
| Leonard Smith | City of Tumwater |
| Joanne Richter | City of Olympia |

The consultant team for the study was comprised of the following firms and individuals:

| | |
|---|---|
| Entranco Engineers, Inc. | Lee & Associates |
| Dale Anderson | Jim Brennan |
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| Jory Oppenheimer | |
| Gretchen Johnson | Terra Associates |
| Stacie Martella | Bill Bailey |

The following special advisors also provided assistance with technical analyses and reviews of draft reports:

| | |
|---|---|
| Richard Horner, Ph.D. | University of Washington |
| Alyn Duxbury, Ph.D. | University of Washington |
| Steven Chapra, Ph.D. | University of Colorado |
| John Orsborn, Ph.D. | Washington State University |

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**CONTENTS** Page

## FIGURES



## TABLES

# CAPITOL LAKE
# NORTH BASIN SHORELINE EROSION CONTROL STUDY

## INTRODUCTION

The objectives of this report are to identify existing shoreline erosion conditions at the north basin of Capitol Lake, to identify shoreline stabilization techniques appropriate to these conditions, to provide a recommendation for repair of eroded shoreline areas, and to discuss environmental impacts and environmental permit implications.

The scope of these recommendations is conceptual; preliminary costs are provided for planning purposes.

In general most of the shoreline is stable, showing no signs of substantial erosion. Much of the basin shore has been constructed with riprap which is providing adequate protection against erosion in most locations. Specific shoreline areas are identified in this report (figure 1), and recommendations are made for each.

## Factors Affecting Shoreline Erosion

### Existing Lake Shoreline Conditions

Based on observations after the July 5 and 6 1990 drawdown, the near-shore lake bottom in the north basin of Capitol Lake appears to be mostly fine sand overlying somewhat clayey silts with shell fragments. The sand often is only a few inches thick. It is much thicker at the east side near Capitol Lake Park, probably because this area was reclaimed with several feet of sand dredge spoil. Near the railroad bridge, pit-run gravel was used for the embankment and the abutment fills and the near-shore lake bottom in this area is noticeably coarser.

The lake-bottom sands are all very loose. The silts generally are soft. Typical shear strengths probably are in the range of one to two hundred pounds per square foot.

To protect the erodible shoreline, riprap has been placed around much of the north, west, and south shores. Despite the presence of riprap, shoreline erosion is occurring at various locations representing about 34 percent of total shoreline length.

### Erosion Forces

The erosion observed most likely is caused by waves breaking against the shoreline. Fine sands from behind and beneath the riprap are washed out through the spaces among the pieces of riprap. Eventually, the riprap subsides and is overtopped by the waves, which increases the rate of erosion. In areas with little or no riprap, such as along Power Plant Road (southeast shoreline), the waves have eroded fine sand from beneath grasses and other vegetation that are not deeply rooted. Where cattails and other aquatic vegetation are present around the shore, the shoreline appears to be more stable.

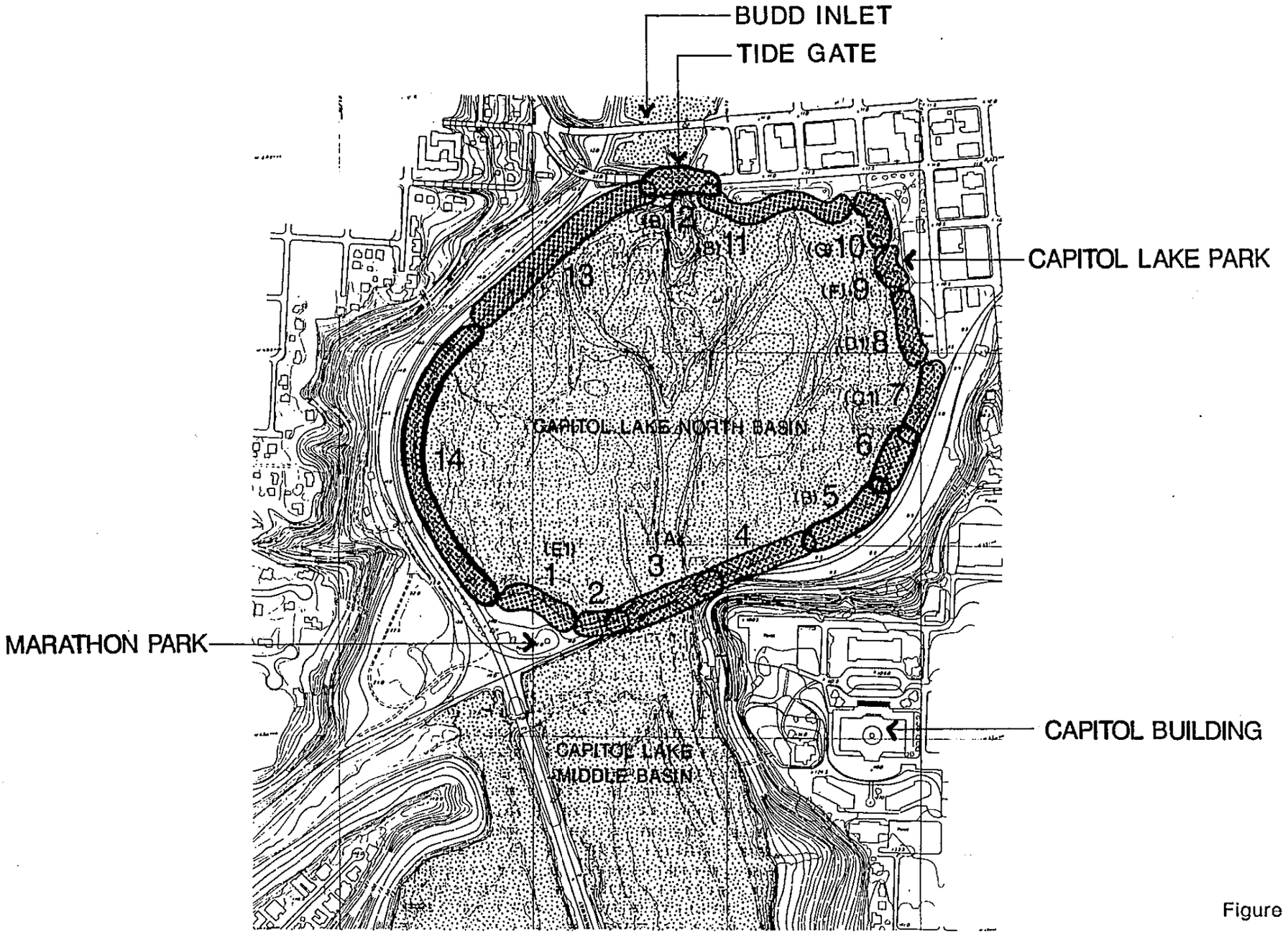


Figure 1

CAPITOL LAKE SHORELINE ZONE MAP

An unprotected shoreline will be eroded by waves that break near the shoreline. However, if littoral currents do not carry the shoreline debris away, the waves will use the material to build a protective beach. The steepness of the beach will depend on the height of normal waves and on the grain size of the material available for beach construction. Eventually, the beach will protect the shoreline from further erosion by the normal waves. However, storm waves will remain capable of destroying the beach and eroding the shoreline.

When the shoreline material is fine sand, which is the case at Marathon Park, the final beach will be flat, often sloping less than five percent. Waves will break on the beach, or at a plunge point where the beach steepens at the off-shore edge of the beach. At Marathon Park normal waves running up and down the beach will shift material back and forth, but there will be little or no net loss of beach material. The shoreline will retreat until the normal waves no longer reach it, or until vegetation takes root and secures the shoreline against the residual wave action.

Where the shoreline material is not uniformly graded, the waves will sort the debris eroded from the shoreline. Gravel particles will form "pavement" or "shingle" on the upper beach. Smaller particles will be carried to deeper water further down the beach. The stable beach in this case will tend to be concave rather than flat. Beach construction of this type is occurring along much of the east shoreline.

This shoreline erosion will continue until the waves build stable beaches. In the meantime, the shoreline will continue to retreat. The process can be arrested by increasing the erosion resistance of the shoreline. This can be accomplished with adequate riprap, placement of gravel, or with suitable vegetation. If the shoreline is hardened, erosion of the lake bottom near the shoreline may increase. Consequently, corrective measures, whether using riprap, gravel, or vegetation, should consider stabilizing both the shoreline and the adjacent lake bottom.

In comparison to Marathon Park, most of the north basin shoreline is steeper and the shoreline has been hardened by placement of riprap.

## Wave Characteristics

The height and frequency of shallow water waves depend on wind velocity, fetch, water depth, and the bottom roughness.

Winds in the Puget lowlands are intense only rarely. Olympia and vicinity are quite well protected by the Coast Range from the strong south and southwest winds accompanying many of the Pacific storms during the fall and winter. Winds which reach hurricane force along the coast, only 45 miles away, will reach only 50 or 55 mph in gusts in this vicinity. Some damage to utility lines occurs every fall and winter from trees and limbs broken or felled by the wind, but damage rarely occurs to dwellings or buildings. The prevailing wind in Olympia is southerly during most of the year, but during the fair weather in the summer the wind is gentle and from the north to east. (Wind data from the Olympia Airport is presented in table 1.)

For the short fetch at the north basin, 28-mph winds would be expected to produce waves only about one foot high, measured crest to trough. Wave periods should be in the range of three to five seconds.

Table 1
Wind Information

| | Mean Speed (mph) | Prevailing Direction through 1963 |
|---|---|---|
| January | 7.1 | SSW |
| February | 7.1 | SSW |
| March | 7.4 | SSW |
| April | 7.4 | SW |
| May | 6.9 | SW |
| June | 6.7 | SSW |
| July | 6.2 | SW |
| August | 5.9 | SW |
| September | 5.7 | SW |
| October | 5.8 | SSW |
| November | 6.8 | SW |
| December | 7.2 | SSW |
| Year | 6.7 | SSW |

Source: Olympia Airport. Latitude 46°58'N. Longitude: 122°54' W. Elevation: Ft. Grnd., 195 Baro, 196 Time Zone: Pacific. WBAN: 24227
Note: Recorded over 37 years, although individual months may be missing.

Winds on the order of 50 mph might raise waves on the north basin about two feet high. Winds of this magnitude should occur only briefly, with a probable return period of several years. The Uniform Building Code predicts that sustained winds in the range of 80 to 90 mph might occur in the Puget lowlands, but with an annual probability of only about two percent. Winds of that intensity would raise waves about four feet high on the north basin.

As wind-driven waves approach shore, they steepen and break, but normally not before their height becomes less than about eight tenths of the water depth. Thus, most waves, even those from most storms, should reach the shore or break within a few feet of the shore, depending on the near-shore water depth.

## Effects of Water Level Change Flooding

Small changes in lake level for seasonal management and partial or total drawdown for maintenance purposes are common practice for Capitol Lake. Summer season lake levels are maintained high (elevation 6.43 msl) for recreational and fish uses. Summer field observation on August 28, 1990 showed a lake level very close to the top of existing riprap. As noted earlier, wave overtopping of riprap is a common cause of shoreline erosion in Capitol Lake since the profile of the wave zone is affected with fluctuating water levels.

Typical winter lake levels are maintained at 5.43 feet msl for additional flood control protection in anticipation of higher Deschutes River flows. Prior to flood events, the lake may even be drawn down to the maximum low water level of -7.7 feet msl.

Lake levels historically have been drawn down to allow salt water flushing of the lake for control of excessive algae and aquatic macrophyte growth, and to facilitate re-

pair activities. This practice has been limited in recent years due to concerns over downstream water quality impacts—specifically dissolved oxygen impacts to Budd Inlet.

The practice of complete or partial drawdown can be a significant contributor to shoreline erosion. Drawdown conditions result in rapid dewatering of shoreline soils: soil erosion occurs as the retreating water moves through the shoreline profile. In addition, during drawdown, the lateral stability of steep shoreline areas (e.g. just east of the north basin inlet) is much less because there is no lake water to provide lateral support to the slope. The angle of repose of shoreline material is different when underwater compared to above water. There was evidence of rills forming as rivulets of water flowed out of the shore during the July 5 and 6 drawdown.

### Vegetation as Shoreline Stabilization

In addition to the rock riprap placement, the shoreline vegetation has a stabilizing affect on the shoreline at Capitol Lake. The roots of vegetation lock soil particles in place and reduce the impact of wave erosion. The foliage of vegetation also protects the shoreline by reducing the impact of waves.

There are generally two vegetation systems that help reduce erosion at Capitol Lake. One is the aquatic or marsh vegetation which stabilizes the shore by reducing the wave forces. The practice of saltwater flushing to eliminate aquatic weeds has the potential for increasing shoreline erosion by removing them as a wave barrier. The other system is the marginal and terrestrial vegetation which armors the shore. Observations during the July drawdown showed lawn maintenance staff actually cutting this shoreline vegetation (e.g. cattails) along Powerhouse Road—a practice which could increase shoreline erosion.

Grass and lawns are probably the least effective vegetation in stabilizing the shore. The greatest loss of shorelines occurs where lawn is found. This is due to the shallow root depth and the inability of grass to withstand the forces of waves which may overtop shoreline riprap protection.

## Related Planning Issues

### Community Use

The recreational uses of the shoreline areas have an impact on erosion. Areas with heavy shoreline use can become severely eroded if the use is not accommodated in the design of the shoreline. In addition, the type of shoreline stabilization employed should relate to the appropriate uses and activities.

### Seismic Hazards

The Capitol Lake area has experienced earthquakes which can have a significant impact on shoreline activity. Since most of the shoreline areas are fill placed on a former estuary mudflat, the potential for slippage during earthquakes is high. The Deschutes Parkway road surface has experienced cracking and vertical shifting in recent years. In the event of a future earthquake, those areas showing cracks are likely places for failure. Shoreline stabilization in this area is unlikely to mitigate this situation.

Wildlife and Fisheries Habitat

The character of shoreline development can have a substantial impact on habitat value. Vegetation and beach configuration provide food, cover, and reproduction resources for fish and wildlife. Special attention should be given to rearing habitat for juvenile salmon in Capitol Lake by employing erosion control techniques that enhance habitat values and functions.

Another shoreline wildlife issue is use of Marathon Park grassed areas by waterfowl. The waterfowl, although a valued resource, create an aesthetic and water quality problem with their droppings. Bacteriological monitoring conducted during the drawdown revealed higher fecal coliform concentration in the nearshore Marathon Park areas than offshore areas. Waterfowl are one suspected source of this contamination.

Solutions to this problem are not easy and have been the topic of much public debate. The U.S. Department of Agriculture, Animal Damage Control (ADC) recommends developing a trapping-relocation program as the first step in effectively controlling Canada geese. ADC has trapped and relocated 450 geese from western Washington in 1990, and plans to trap and relocate 5,000 geese from Snohomish, Pierce, and King Counties in 1991. Additional measures to control geese populations and discourage goose congregation in Capitol Lake include:

- Posting signs prohibiting all feeding of waterfowl; and
- landscaping along the Marathon Park shoreline to reduce available habitat. The landscape approach is addressed in this report as part of the shoreline restoration for Marathon Park.

Aesthetics

The visual quality of Capitol Lake is an important resource for the state capitol grounds, and for the City of Olympia. Shoreline enhancement should be provided to enhance the experience of strolling or driving around the lake, and to relate the vista to and from the capitol grounds. Much of the existing shoreline is steep and stabilized with riprap which gives a "hardened" visual experience. The existing natural areas (e.g. the cattail marsh along Powerhouse Road) should be preserved to balance the visual experience.

Shoreline enhancement should also relate to the character of Marathon Park and Capitol Lake Park and provide continuity around the lake.

There are a variety of shoreline zones around Capitol Lake. For the purpose of this report shoreline zones were identified based on shoreline material, structure, slope, and vegetation. Fourteen shoreline zones, starting at Marathon Park and proceeding counter-clockwise, were identified for photographic documentation (figure 1 and Appendix B).

## Study Approach

The project included a total condition survey of the entire 8,130 foot circumference of the north basin shoreline. The survey occurred during a July 5 and 6, 1990 lake drawdown and a follow-up survey on August 28 during full lake level summer conditions.. The survey team included the Entranco project manager, a structural and geotechnical engineer, and a landscape architect. Photos were taken during the field observations (Appendix B). Several of these are referred to in the Existing Conditions Priorities for Corrections/Recommendations section.

The Consultant team met four times both to identify erosion problems in the field and to cooperatively develop erosion control strategies: (1) prior to the drawdown field survey, (2) during the drawdown field survey, (3) immediately after the drawdown survey, and (4) during the full lake level survey, to develop a consensus on the shoreline conditions, priority for correction, and to recommend repairs based on the status of the fourteen shoreline zones.

Thirty-four percent of the shoreline (about 2,800 feet) was identified for repair. Shoreline at Marathon Park and the inlet to the north basin (about 800 feet) was designated as high priority for repair. The Capitol Lake Park area (about 950 feet of shoreline) was designated as medium priority for repair. Repair recommendations in this area were defined in light of the City of Olympia's plans for park renovation.

# ALTERNATIVES CONSIDERED

## Erosion Control Methods

Various erosion control measures have been applied to lake shorelines. (U.S. Army COE 1981; McComas, et al. 1986). These control strategies can be divided into two methods: structural (built), and non-structural (for example, regulations and bioengineering techniques). An effective strategy is to combine structural and non-structural methods. One of the better structural solutions for shoreline erosion protection is a sloping concreted wall (Illinois University 1981; Hayashi 1985). Other types of control structures include vertical concrete walls, horizontal timbers, and steel docks. Riprap along the shoreline remains one of the most effective and commonly used control methods available (New York State Dept. of Environmental Conservation 1981; Siegel 1982; Klessig and Jones 1986). Another type of control structure is revetments—connected large blocks of rock or timber (Collinson and Jansen 1985). Comprehensive design manuals for structural shoreline protection methods are available (U.S. Army COE, CERC 1984).

Once these shoreline erosion control structural control methods are in place, it is important that monitoring and maintenance plans be developed (U.S. Army COE, CERC 1975).

Another approach for control techniques includes the category of non-structural methods, such as zoning regulations that result in a reduction of erosion from land (Hayashi 1985). The field of bioengineering, in which live plants and plant parts are used as building material for erosion control, has recently expanded as a cost effective way to maintain lake shorelines. Examples of bioengineering methods include tree and brush mats revetments, planting of shoreline vegetation, and log cribs (U.S. Forest Service, undated; University of Michigan 1990). Paying close attention to the optimal timing of plantings and the types of plants used is critical for bioengineering applica-

tions. It is important that native plants particular to a region be used. In addition to low cost, the use of native plants can also benefit wildlife habitat (Juelson 1980).

### Estimated Shoreline Enhancement Costs

Costs were developed for comparison of alternative erosion control methods. Unit costs do not include incidental costs that may be desirable for all treatments, such as timber headers, filling to reclaim land lost to erosion, restoration of disturbed areas, habitat plantings, etc.

Unit costs are based on a 200 foot shoreline length, and are stated in linear feet of shoreline treatment. Typical sections for each type of shoreline are shown in Concepts A through G (Appendix A) to document assumptions made.

Table 2
**Shoreline Enhancement Costs by Type**

| Erosion Control Method | Estimated Cost per Linear Foot | Concept |
|---|---|---|
| Maximum riprap revetment | $97.00 | A |
| Minimum riprap revetment | $58.00 | B |
| Brush layering | $33.55 | C-1 |
| Brush layer with jute & filter fabric | $116.00 | D-2 |
| Perched gravel beach | $150.00 | E-1 |
| Minimal gravel beach | $70.00 | F |
| Retaining wall stabilization | $58.00 | G |

## EXISTING CONDITIONS / PRIORITIES FOR CORRECTIONS / RECOMMENDATIONS

A summary of the following recommendations is provided in table 3. the different erosion control concepts are graphically presented in Appendix A.

### Zone 1 - Marathon Park

*Existing Condition*. The shoreline is characterized by an eroded grass or shrub bed upland, riprap sloped at approximately 3:1 to 4:1 dropping to a flat sand/mud bottom at a depth of about 10 feet (photo 1, Appendix B). The riprap adjacent to the eroded shoreline has been buried and shifted downslope and therefore is partially failing. Waves have overtopped riprap and eroded lawn (photos 2, 3, and 4). Over time the waveshave continued to erode the shore by undercutting lawn resulting in a loss of approximately 30 to 40 feet of shoreline.

## Table 3
## Summary of Capitol Lake North Basin Erosion Repair Recommendations

| Shoreline Zone[a] | Shoreline Length (ft.) | Description | Photo Refs. | Priority for Repair | Concept for Repair | Preliminary Cost/Foot 1990 Dollars | Shoreline Length (ft.) | Preliminary Cost |
|---|---|---|---|---|---|---|---|---|
| 1 | 650 | Marathon Park | 1-5 | High | Perched Beach | $150 | 400 | $75,000[b] |
| 2 | 230 | West of Trestle | 6 | Low | None | | 0 | 0 |
| 3 | 400 | Railroad Trestle | 7-11 | High | Maximum Riprap | $97 | 400 | 38,800 |
| 4 | 450 | East of Trestle | 12-14 | Low | None | | 0 | 0 |
| 5 | 650 | Powerhouse Rd. (south) | 15-17 | Medium | Minimal Riprap | $58 | 650 | 37,700 |
| 6 | 600 | Powerhouse Rd. (north) | 18 | Low | None | | 0 | 0 |
| 7 | 200 | South of Capitol Lake Park | 19 | Medium | Brush Layering | $34 | 200 | 6,800 |
| 8 | 400 | Cap. Lake Park Lot | 20 | Medium | Minimal beach | $70 | 400 | 28,600 |
| 9 | 450 | Cap. Lake Park Dock | 21-22 | Medium | Minimal beach | $70 | 450 | 31,500 |
| 10 | 300 | Abandoned Swim Beach | 23-24 | Medium | Riprap at Wall | $58 | 100 | 5,800 |
| 11 | 950 | North Shore Park Lot | 25-27 | Medium | Minor Riprap/ Vegetation | $58 | 95[c] | 5,510 |
| 12 | 200 | Tide Gate | 28-29 | Medium | Minor Riprap | $58 | 50[d] | 2,900 |
| 13 | 1,200 | Tide Gate & NW Shore | 30 | Low | None | | 0 | 0 |
| 14 | 1,450 | West Shore | 31-34 | Low | None | | 0 | 0 |
| Totals | 8,130 | | | | | | 2,745 | $232,010 |

[a] Keyed to figure 1.
[b] $15,000 added for landscaping after beach construction.
[c] Assumes 10% of total length for spot repairs.
[d] Minor replacement of riprap on east wing wall.
[e] Assumes no soils borings or special investigations.

| Preliminary Costs: | |
|---|---|
| Construction | $232,010 |
| 15% Contingency[e] | 34,802 |
| 15% Administrative & Design | 34,802 |
| Total | $301,613 |

*Priority*. This zone has been assigned a high priority due to the loss of lawn and shoreline along the park. As discussed earlier, this area also presents a concern about water quality due to the high concentration of waterfowl which forage there (photo 5).

*Recommendation*. Develop a perched gravel beach (Concept E-1) to reclaim park area lost to erosion. The toe of gravel beach should be locked in with riprap placed below normal low water to lessen the slope and avoid the need for large amounts of gravel. The beach needs to be reestablished by placement of landscape gravel (7 8 inch & or 1-1 2 inch minus drain rock is preferred).

The beach design (figure 2, Concept E-1) should provide enough beach to allow adequate wave run up. The underwater riprap will be tied into structurally sound sections of existing riprap. The proper beach length will prevent waves from reaching lawn areas. Lakeside vegetation (figure 2) will be planted on the upper portion of the beach to supplement gravel and to limit the movement of waterfowl onto the shoreline.

The reestablishment of the beach in this way will improve its use for viewing and small boat access; it would not be designed to provide swimming use due to water quality concerns. The border between the beach and the lawn will be separated with a pressure-treated lumber staked into the ground. New grass sod and overseeding will be needed in shoreline areas.

Construction access to the Marathon Park beach will need careful planning to minimize impacts to the park and facilitate equipment movement.

In addition to the landscape measures to limit waterfowl access to grass areas, it is recommended that park signage be added to educate the public on the need to stop feeding waterfowl for water quality, aesthetic, and wildlife protection reasons.

### Zone 2 - Riprap Shore East of Marathon Park, West of Channel

*Existing Condition*. Stable vegetated riprap with trail between top of riprap and railroad tracks (photo 6). Riprap slopes at approximately 3:1, slope below riprap is gentle.

*Priority*. This has been assigned a low priority; there are some isolated areas of use erosion and no major problems.

*Recommendation*. Monitor riprap and maintain vegetative cover.

### Zone 3 - Railroad Trestle

*Existing Condition*. Light riprap is present on shoreline areas on each side of the north basin inlet channel (photos 7 and 8). There exists a railroad bridge with a concrete abutment pile cap (photo 10). There is also a wood pile supported pedestrian bridge (photo 11).

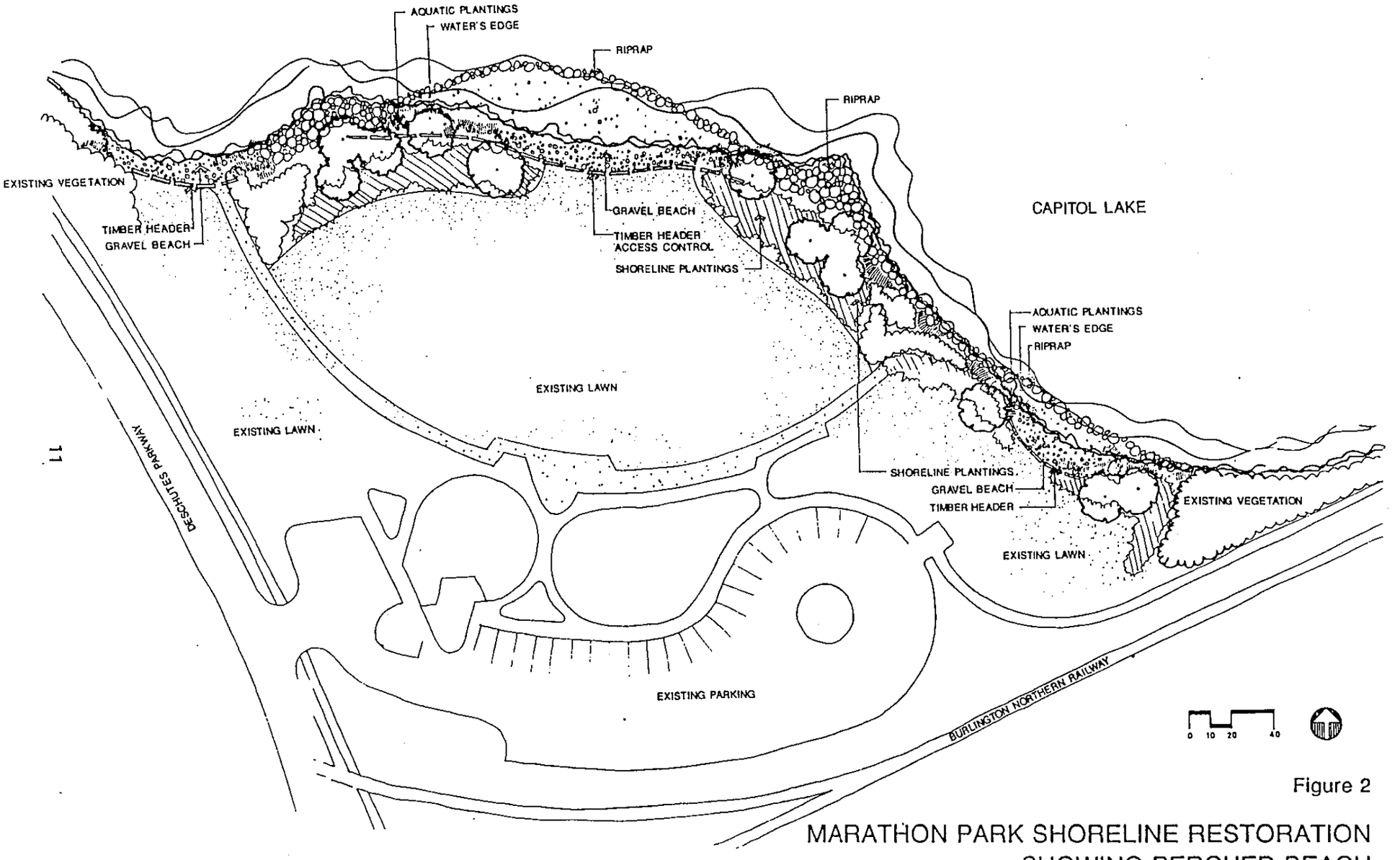


Figure 2

MARATHON PARK SHORELINE RESTORATION
SHOWING PERCHED BEACH
ZONE 1

*Priority*. This zone has been rated as a high priority due to concern over the fill slope instability of the embankment on the east side of the trestle on the north basin side—downstream (photo 7). Embankment cracks were observed and the soil was unstable near the water's edge (photo 9). It is important to note this instability occurred after rapid drawdown of the lake. These slopes are probably only marginally stable with the lake at normal levels. The current through the railroad trestle was directed into the east bridge pier during drawdown observations on July 5, 1990. This deserves further investigation as described below.

*Recommendation*. Heavy riprap placed at the toe of the present slopes on both sides of the channel and extending east, would probably be adequate to correct any problems that may be present.

Because of the river currents in this area during lake drawdown, scour may be occurring, especially adjacent to the east bridge pier. If the piers are pile-supported, they likely are in no danger. We recommend sounding the lake bottom near the piers. Any scour holes that are deeper than the existing bottom grade should be backfilled with rock spalls and capped with riprap.

During times of normal lake levels and normal river flows, the velocities in the vicinity of the railroad trestle are much less than under drawdown conditions. In view of these higher drawdown velocities there is a need to obtain additional information from Burlington Northern Railroad regarding settling problems and maintenance history in reference to erosion control measures in this zone.

## Zone 4 - East of Trestle - Vegetated Riprap

Existing Conditions. Shoreline consists of fill placed at the toe of a steep hillside in the 1930s. The shoreline has a stable vegetated riprap which shows no clear sign of recent movement (photo 12). Upland of this section of shoreline is a steep slope (photo 13). Some areas on the lake side of the tracks show evidence of being affected by upland soil slides/slope failure (photo 14).

*Priority*. This has been assigned a low priority since there are no observed shoreline problems. Upland areas appear prone to further instability, which could affect the lake shore.

*Recommendation*. Monitor riprap for signs of failure.

## Zone 5 - Level Vegetated Shore along Powerhouse Road

*Existing Condition*. The vegetated shoreline slopes gently (2 to 5 percent) toward the water adjacent to Powerhouse Road. The upland portion is field grass meadow. The shore edge consists of aquatic vegetation with some exposed soil. The beach slopes gently and is mostly gravel. Beach material gets finer moving toward deeper water.

Field observations of ponded water also suggest that upslope water drainage does not have a good outlet in this zone.

*Priority*. This area has been assigned a medium priority due to erosion. Waves have undercut vegetated meadow areas and the erosion is slowly cutting back the shore (photo 15).

There is some evidence that small slumps (photo 16) extending nearly to the pavement on Power Plant Road have occurred in this area. The road condition at the present time appears satisfactory (photo 17). Future repairs may be necessary.

*Recommendation*. Although two concepts (riprap and minimal beach) were considered here, the recommendation is placement of minimum riprap against the toe of the beach slope (Concept B). At this time, only spot areas need repair.

The basis for this recommendation is to minimize the capital and maintenance costs until the ultimate shoreline use for this area can be determined. A minimal gravel beach would be a temporary repair. In addition, lawn maintenance staff in this area should avoid cutting shoreline vegetation, in order to lessen erosion potential.

Since this is one of few more natural shoreline areas, it is important to maintain a natural beach profile.

This area of shoreline provided the best example of the effects of high summer lake levels resulting in overtopping of existing riprap. An operational recommendation is to consider dropping the summer lake level about 0.5 to 1 foot to minimize this impact. There would be some trade-off in exposing riprap which may not be as visually pleasing.

## Zone 6 - Natural Shoreline at East Side of Lake, North Powerhouse Road

*Existing Condition*. The natural shoreline is in good condition (photo 18). The upland portion consists of lush native vegetation. The shoreline edge is well established marsh vegetation.

*Priority*. This low priority area is a good example of shoreline vegetation protection against erosion problems.

*Recommendation*. Save and protect the natural shoreline. Recreate this shoreline condition in other parts of the lake. Natural shoreline creates excellent fish and wildlife habitat. This segment of the shore also provides relief from intensive riprap edge on other shoreline areas.

## Zone 7 - Sloped Vegetated Shoreline South of Capitol Lake Park

*Existing Condition*. The slope is vegetated with field grass, and slopes at about 3:1 to the lake edge (photo 19). A gravel beach then slopes at about 5:1 or less.

*Priority*. This area has been rated medium priority with only minimal wave undercutting of the grass slope. The erosion process seems slow, although the access road is within 20 to 30 feet of shore.

*Recommendation*. Provide the bioengineered shoreline using brush layering (Concept C-1) to slow shore erosion.

## Zone 8 - Shoreline Adjacent to Capitol Lake Park Parking Lot

*Existing Condition*. The existing gravel beach is at about a 3:1 slope. A temporary crushed rock dike has been placed at the edge of the parking lot to limit flooding. The gravel beach slope levels off on a mud bottom (photo 20). This area is within the Capitol Lake Park; plans are underway for the redesign of the park by the City of Olympia. The landscape architect firm of Jones & Jones is preparing the master plan.

*Priority*. This area has been rated as a medium priority due to the flooding potential at this low spot and some erosion of crushed rock dike material.

*Recommendation*. Develop a minimal gravel beach as a temporary shoreline erosion control measure. The intent of this treatment is to reduce erosion and help restore its use as an interim (i.e. 3 to 5 year) measure until park redevelopment occurs.

The Jones & Jones park plan depicts this area as having a lake wall under a decked walkway at the shoreline edge. This wall and walk is to be located outside the existing shoreline. Fill behind the wall will be developed to provide wet soil conditions at or just above lake level for aquatic plantings.

## Zone 9 - Capitol Lake Park, Dock Area

*Existing Condition*. This area has substantial erosion of firmly compacted till fill. The eroded soil face at the shoreline ranges from one to two feet (photos 21 and 22). Beach-building presently is underway using both older till-like areal fills and more recent loose gravel fills. There is an existing floating dock and small boat house near the point. The concrete walkway between the house and dock has deteriorated and is undermined. The upland planting is predominantly lawn. The Jones & Jones plan shows the water walk in this area that will connect with the "Lake Fair Circle"—a pile supported concrete platform to be located near the existing point.

*Priority*. A medium priority has been assigned to this area due to undercutting of shoreline.

*Recommendation*. The shoreline erosion can be arrested temporarily, prior to the anticipated park reconstruction, by building a minimal gravel beach using rock spalls or coarse gravel, and sand. Some regrading of the shoreline edge and revegetation of upland areas is recommended. This placement of gravel fill of appropriate size would serve as an interim solution to limit wave impact on the shoreline.

Gravel beach material may later be used in implementing the Jones & Jones plan.

## Zone 10 - Capitol Lake Swimming Beach

*Existing Condition*. This portion of the shoreline consists of a sandy swimming beach (photo 23) and a concrete lake wall. The area will be filled as part of the Jones & Jones plan.

*Priority*. A medium priority has been assigned to this area, because there is some evidence of erosion at the base of the concrete lake wall (photo 24). Much of the wall's footing is now exposed.

*Recommendation*. The undermined wall footing at the northeast corner of the basin can be protected from further erosion by placing rock spalls at the toe of the wall (see Concept G, Appendix A). The rock spalls should be placed on a slope of about 4:1, beginning from a depth about two feet at the face of the wall.

## Zone 11 - Riprap Shore From Capitol Lake Park To Tide Gate

*Existing Condition*. The riprap is generally quite stable (photos 25 and 26). A path follows the top of the riprap. There is very little vegetation established on the riprap. Upland vegetation above the riprap is predominantly lawn. Some areas have eroded from waves overtopping the riprap and exposing landscape drains (photo 27).

*Priority*. This area has been rated an overall medium priority, due to its low priority from a structural perspective and high priority from a shoreline erosion aesthetics perspective. Waves have overtopped the riprap, causing minor isolated erosion of the lawn area on top of the riprap. Also the lack of vegetation limits habitat on the riprap.

*Recommendation*. Increase the height of the riprap in areas where wave over topping has been a problem. Provide vegetation that will green riprap in time and will be less prone to erosion than lawn. This vegetation would also improve habitat potential while increasing visual diversity. Cracks in the parking lot should be sealed to prevent drainage from further eroding the shoreline. In particular areas where the path has been eroded, consider moving the path upland.

This area of the shoreline provided the best example of the effects of high summer lake levels allowing overtopping of existing riprap. An operational recommendation is to consider dropping the summer lake level about 0.5 to 1 foot to minimize this impact. There would be some trade-off in exposing riprap which may not be as visually pleasing.

## Zone 12 - Tide Gate

*Existing Condition*. Drawdown water levels on June 5 and 6 did not expose the entire wing walls (photos 28 and 29); only the middle and top of the structure was exposed. All areas except the east side of the east wing wall appeared to have stable vegetated riprap. Although the east wing wall appeared stable, some placement of riprap was recommended by the Washington State Department of General Administration (GA).

*Priority*. This area has been rated medium because of the uncertainty of underwater conditions and the east wing wall observations by GA.

*Recommendation*. Since water levels on June 5 and 6 did not expose the entire wing wall, we suggest that depth soundings be made to reveal scour along the wing walls, if any.

## Zone 13 - Vegetated Riprap West of Tide Gate

*Existing Condition*. The shoreline is defined by a stable vegetated riprap (photo 30) with an approximate 4:1 slope. A gravel slope starts at the toe of the riprap and drops to a flat muddy bottom. Slopes are generally steeper toward the tide gate.

*Priority*. This area has been rated as low priority because the riprap is stable, and no erosion is evident.

*Recommendation*. Monitor the riprap condition for deterioration.

### Zone 14 - Vegetated Riprap West Shore

*Existing Condition*. This vegetated riprap shoreline is less steep than the riprap to the north (photos 31 and 32). As with the riprap to the north, the shoreline is stable.

*Priority*. This has been rated low priority because these areas appear generally to be stabilized by a combination of vegetation and riprap. Any erosion occurring likely is at a slow, tolerable rate.

It should be noted that this area suffered earthquake damage in 1965. The soil conditions prone to earthquake failure have not changed. Roadway cracks (photos 33 and 34) are evidence of instability. These areas off the western shoreline (and the east shore along Powerhouse Road) are likely to be damaged in future significant earthquakes.

*Recommendation*. No further action except roadway crack repair.

### Regulatory Permit Implications

Preliminary consultation on regulatory permit implications of Capitol Lake work was held in early October 1990 with the U.S. Army Corps of Engineers - Seattle District. A summary of that meeting is located in Appendix D.

There are two general approaches to obtaining regulatory approval for the recommendations for the north basin of Capitol Lake. The first approach is the individual permit process addressing Section 404 which is a more complex and lengthy review process (it was noted in the meeting that this could take from eight months to three years for processing).

The second approach is the Nationwide permit process which may be applied to each zone of the shoreline. A separate Nationwide permit for each zone could be processed; these separate permits could be "piggy-backed" for review at one time (it was noted in the meeting that this could take from two months to three months for processing).

Under this second approach, it was also noted that the Nationwide permit does not authorize beach restoration as proposed for Marathon Park and Capitol Lake Park (zones 1,8,and 9). This means that an individual permit would be probable for these shoreline zones.

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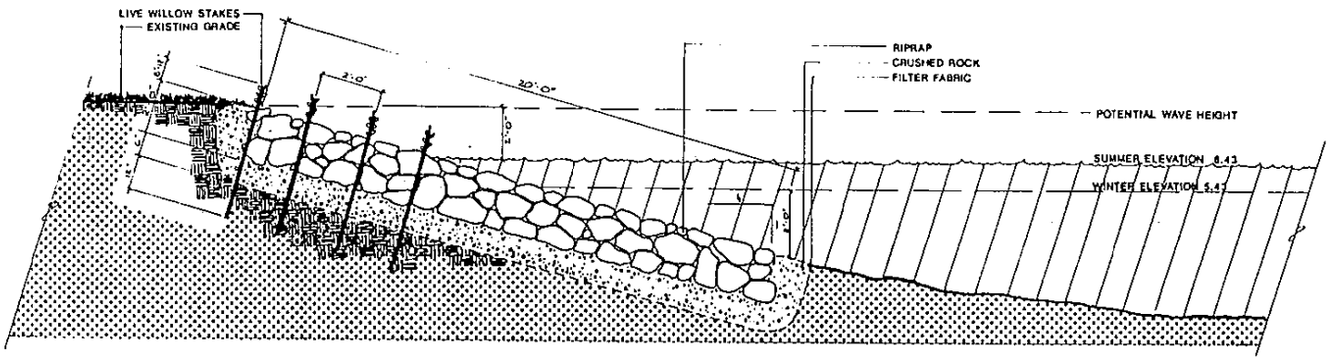
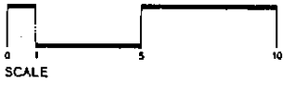
# APPENDIX A

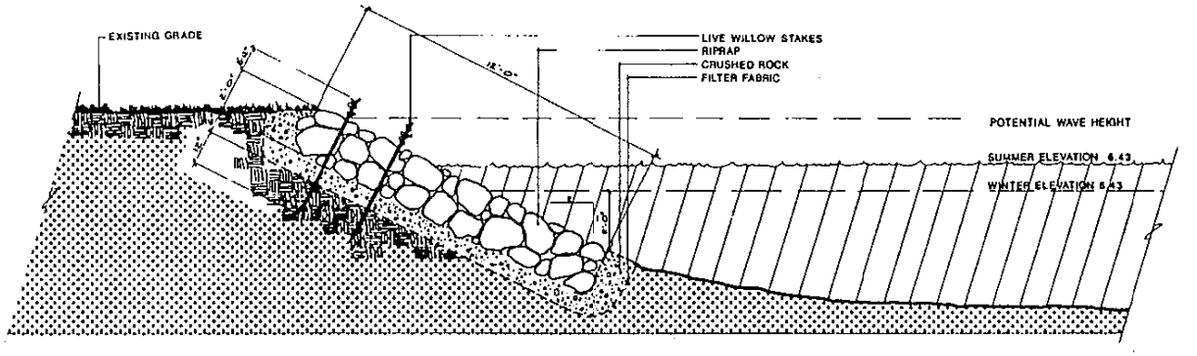
## SHORELINE EROSION CONTROL CONCEPTS



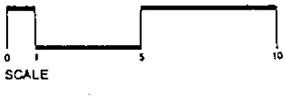

MAXIMUM RIPRAP WITH LIVE STAKES



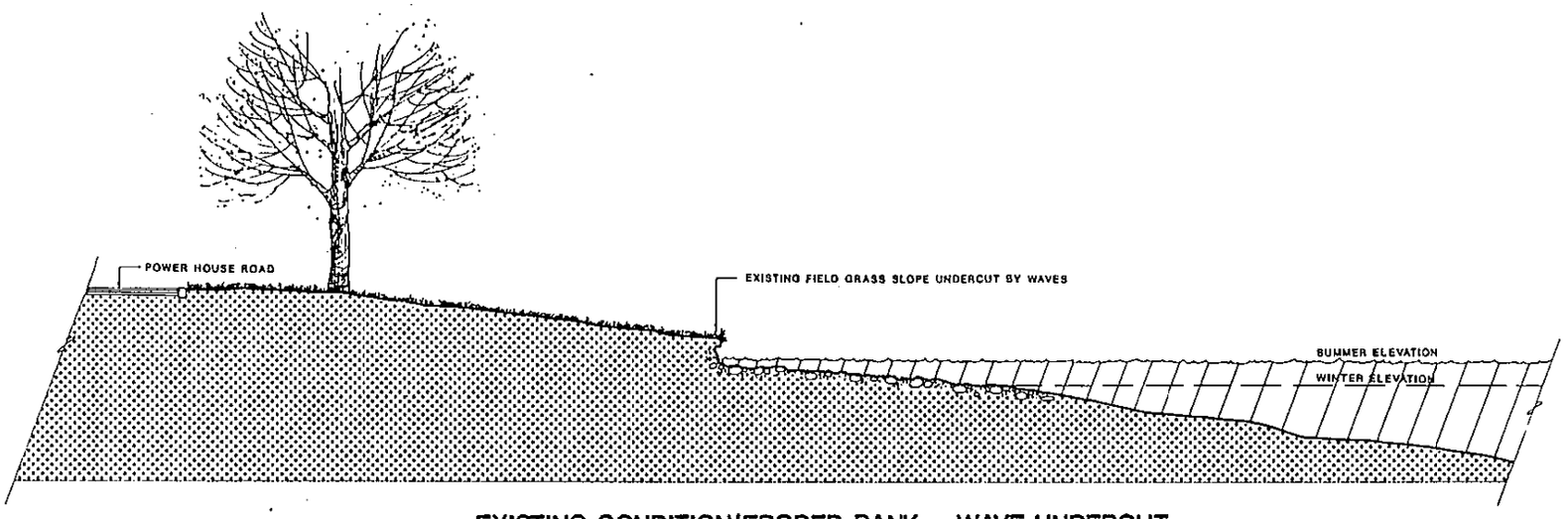

# CONCEPT A



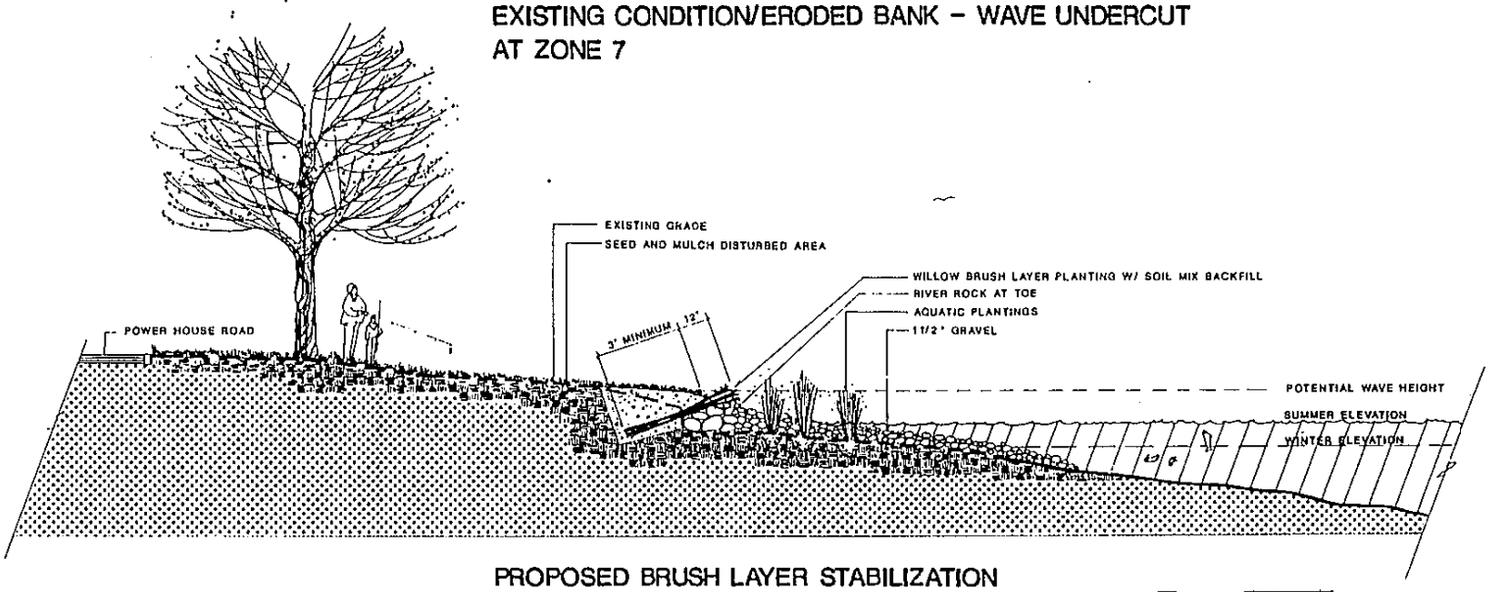

MINIMUM RIPRAP WITH LIVE STAKES




# CONCEPT B




EXISTING CONDITION/ERODED BANK – WAVE UNDERCUT
AT ZONE 7

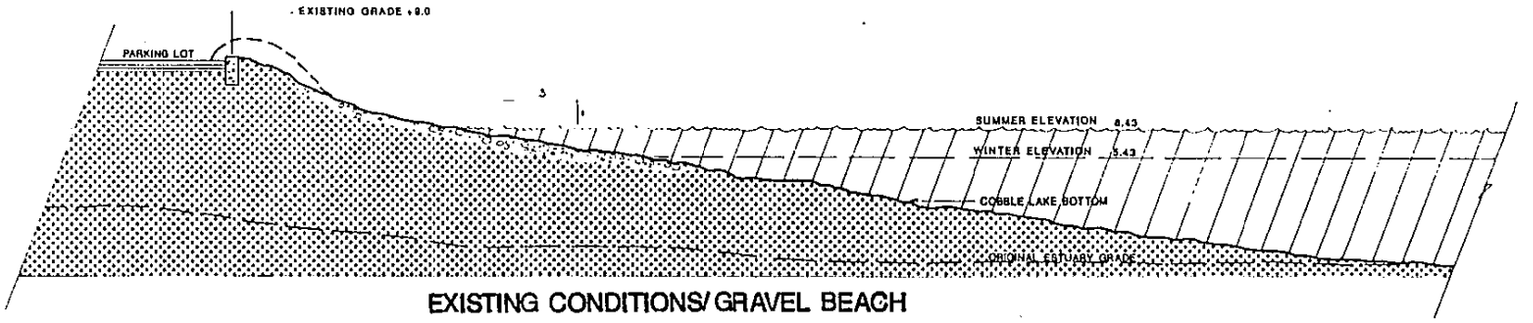



PROPOSED BRUSH LAYER STABILIZATION

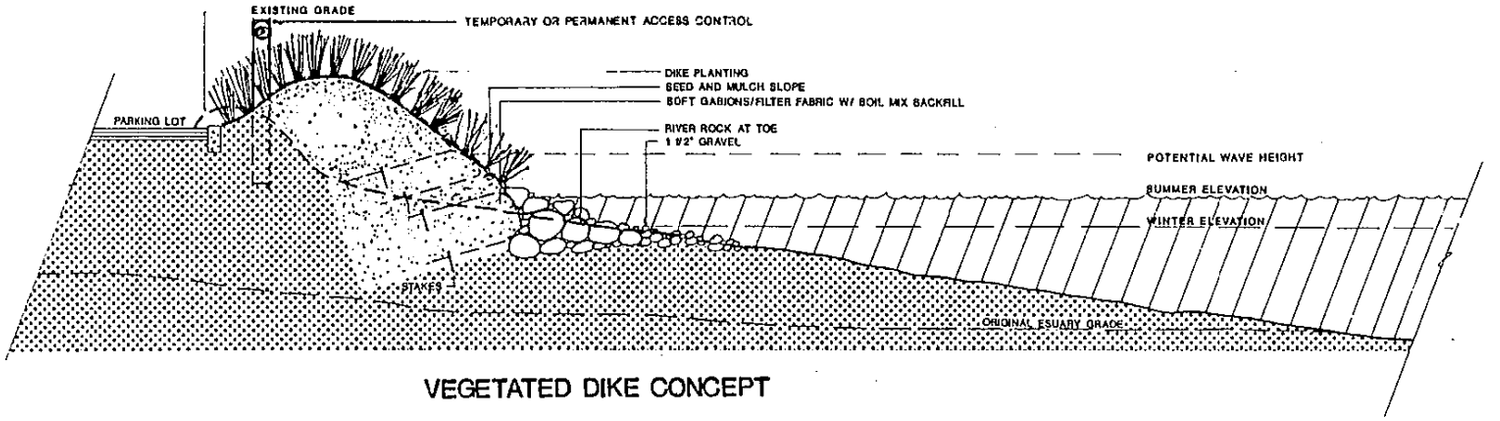
MINIMAL TREATMENT

SCALE

CONCEPT C-1



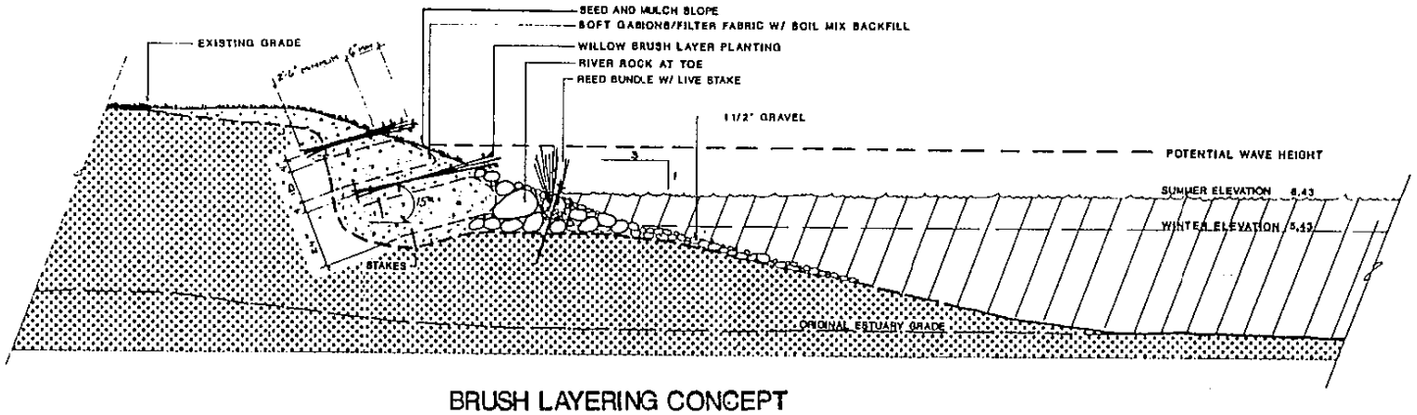

EXISTING CONDITIONS/ GRAVEL BEACH
AT CAPITOL LAKE PARK



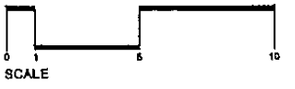

VEGETATED DIKE CONCEPT


CONCEPT D-1

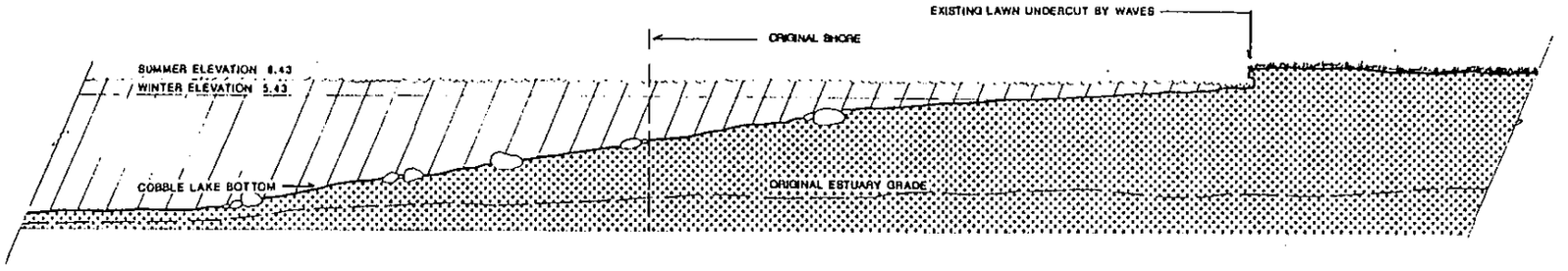
A.4



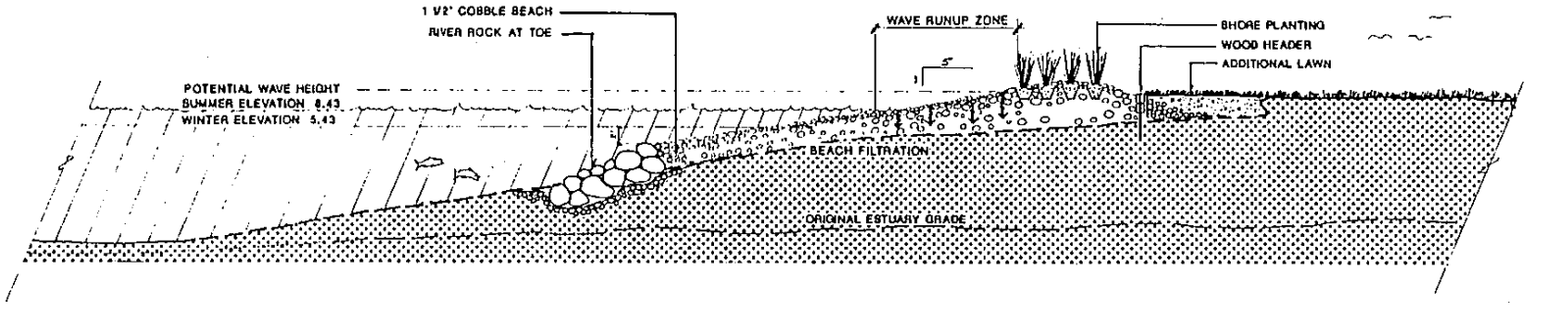

BRUSH LAYERING CONCEPT




# CONCEPT D-2




**MARATHON PARK EXISTING CONDITION AT ZONE 1**

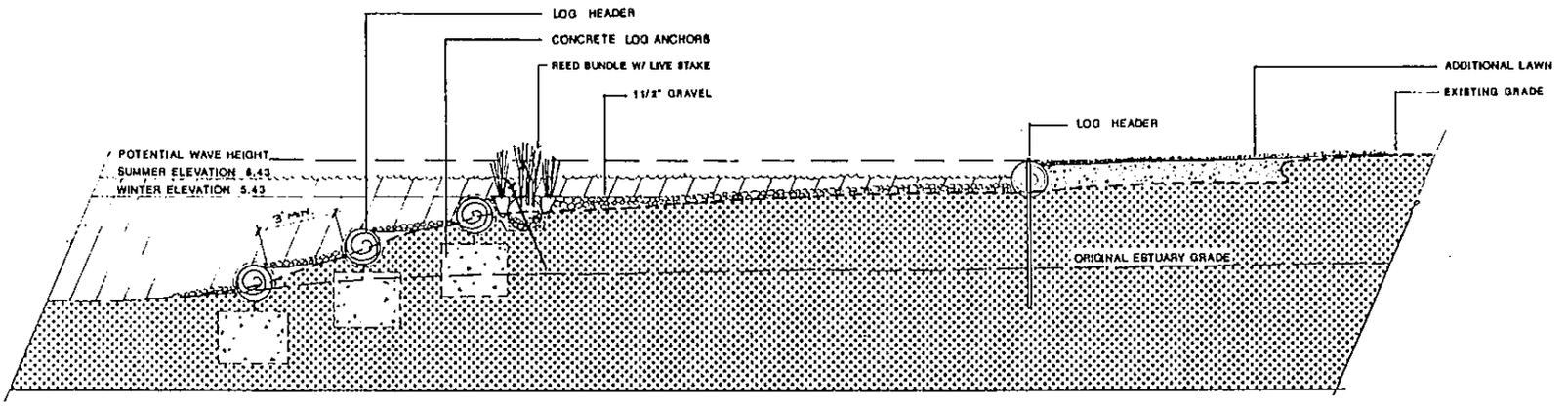



**MARATHON PARK PERCHED BEACH AT ZONE 1**

SCALE

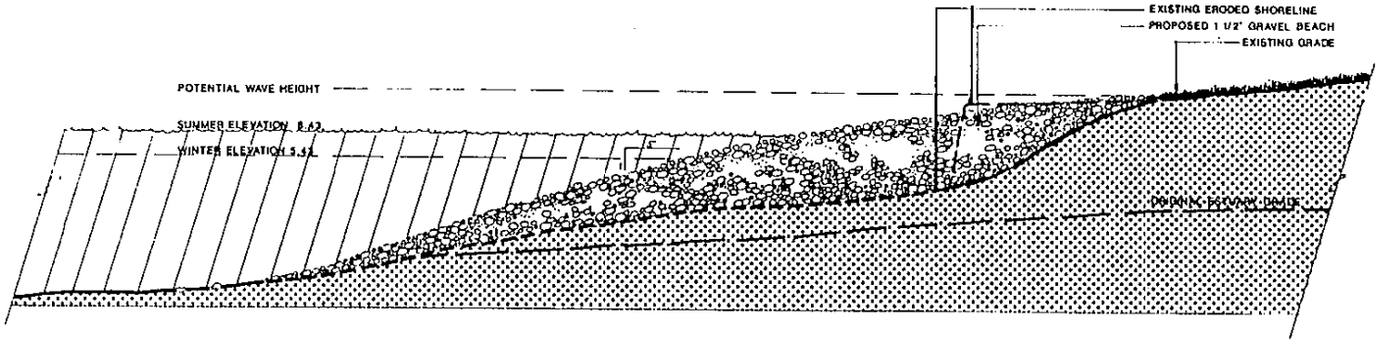
# CONCEPT E-1

A.6



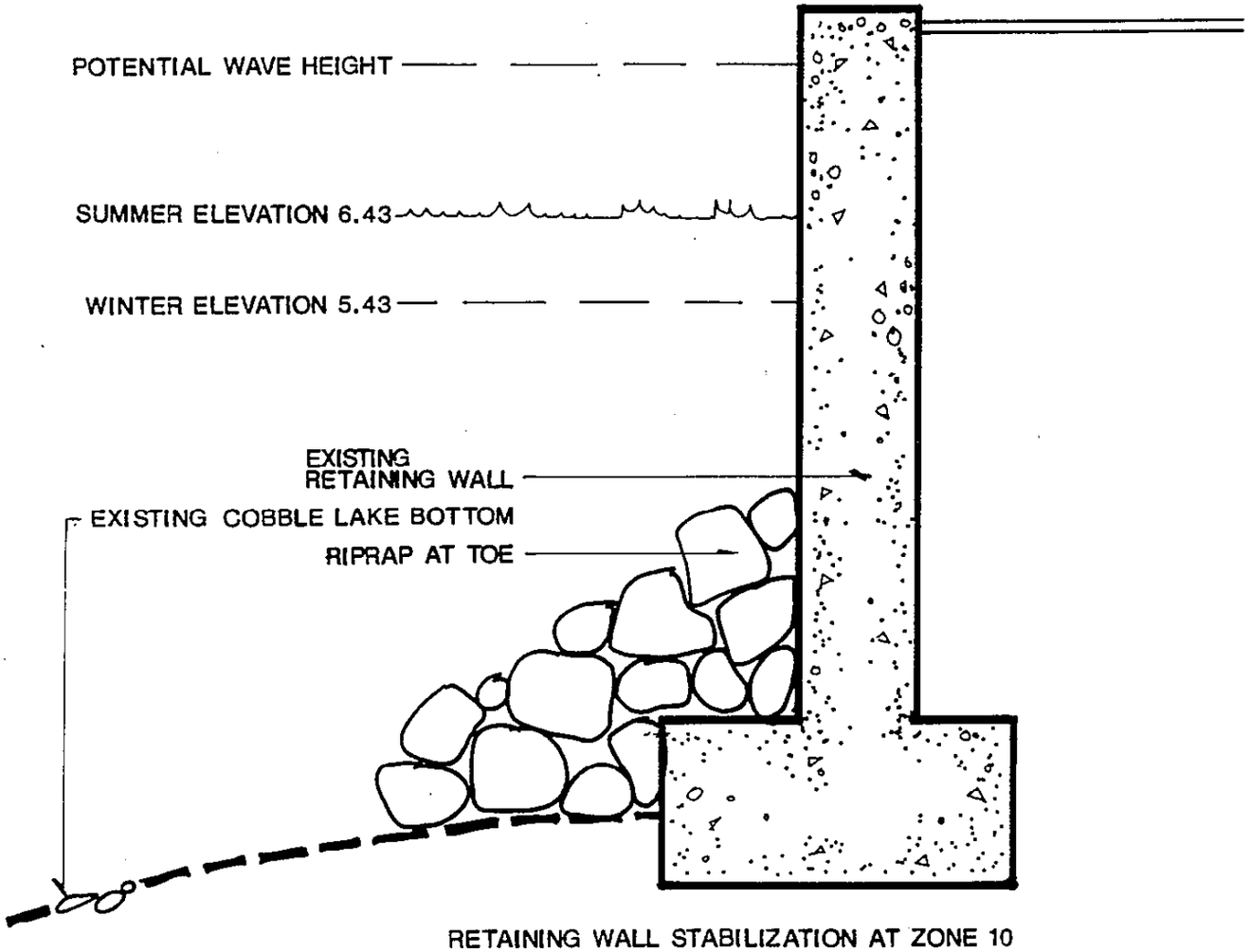

MARATHON PARK
PERCHED BEACH WITH LOG TOE


CONCEPT E-2




MINIMUM GRAVEL BEACH


# CONCEPT F




RETAINING WALL STABILIZATION AT ZONE 10

# WALL AT CAPITOL LAKE
# CONCEPT G

APPENDIX B

**PHOTOGRAPHS**

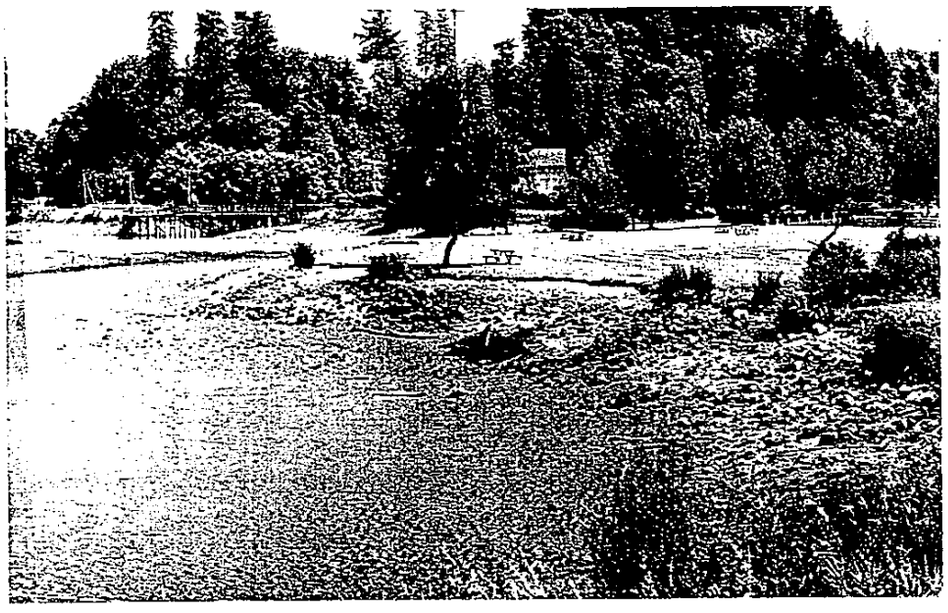


Photo 1
Zone 1

Marathon Park
shoreline

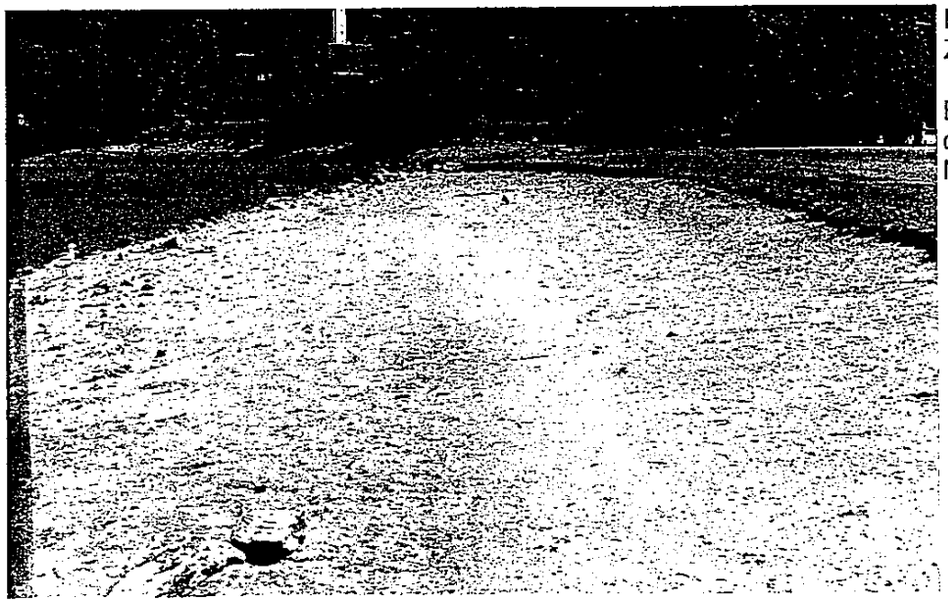


Photo 2
Zone 1

Beach erosion/
dispersed riprap at
Marathon Park

Photo 3
Zone 1

Beach erosion at
Marathon Park

Photo 4
Zone 1

East side of
Marathon Park

Photo 5
Zone 1

Waterfowl/dispersed
riprap at Marathon
Park

Photo 6
Zone 2

East of Marathon Park

Photo 7
Zone 3

Unstable shoreline during drawdown, east of north basin inlet

Photo 8
Zone 3

Shoreline at west side of pedestrian walkway

Photo 9
Zone 3
Cracks in slope during drawdown at shoreline east of north basin inlet

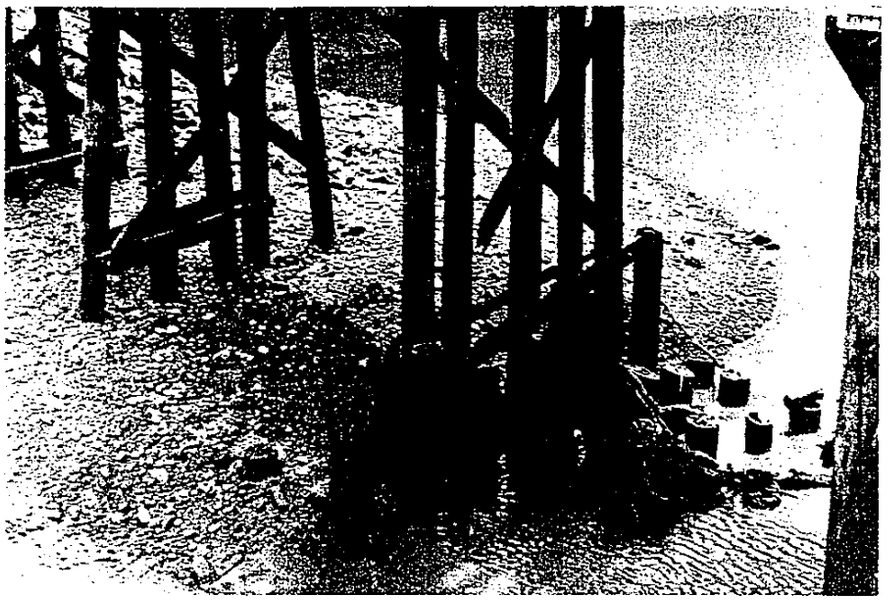


Photo 10
Zone 3

Railroad trestle at north basin inlet

Photo 11
Zone 3

Pedestrian walkway supports at north basin inlet

Photo 12
Zone 4

East of north basin inlet

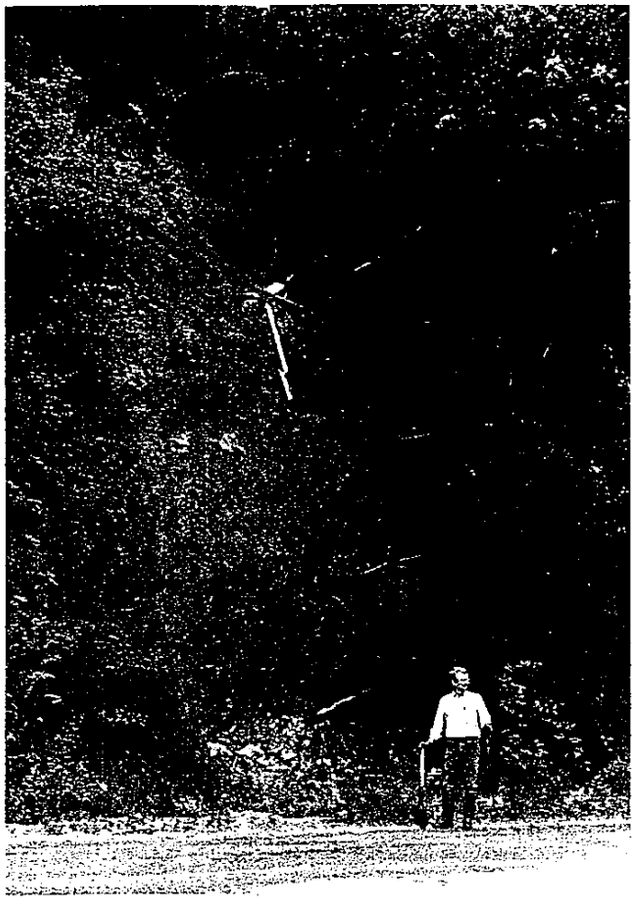


Photo 13
Zone 4

Upland slide area, east of north basin inlet

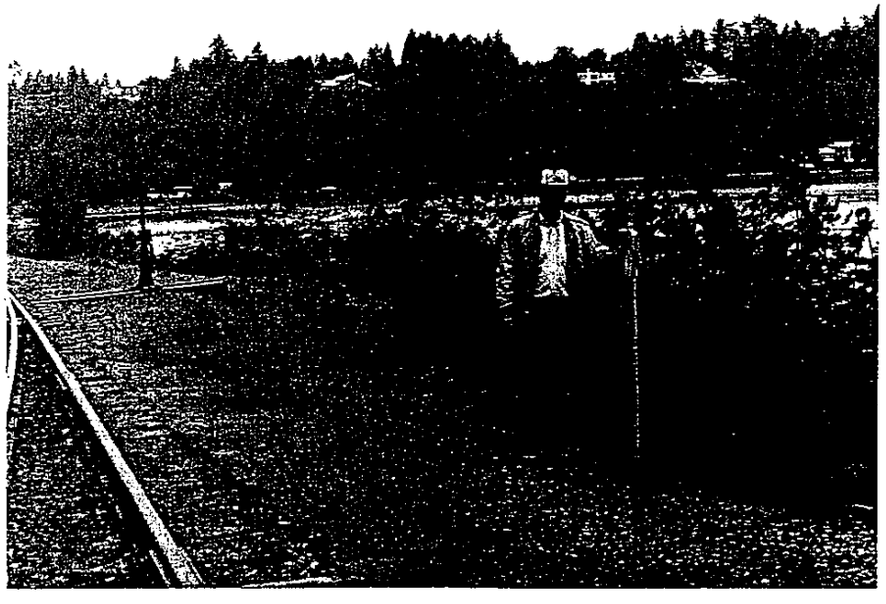


Photo 14
Zone 4

Railroad tracks adjacent to photo 13 slide area

Photo 15
Zone 5

Shoreline along Powerhouse Road

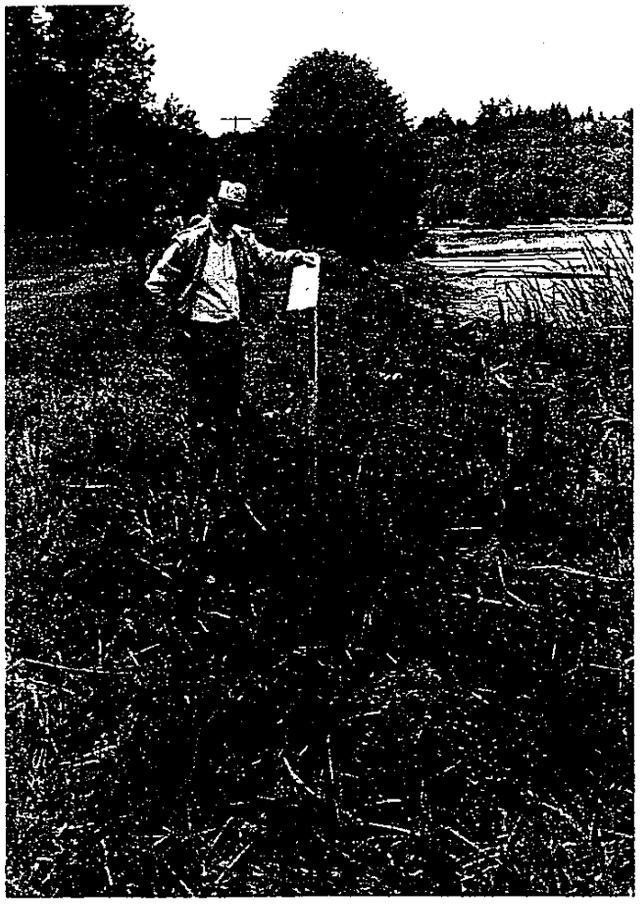


Photo 16
Zone 5

Areas of shoreline soil movement along Powerhouse Road

Photo 17
Zone 5

Road potholes,
poor drainage along
Powerhouse Road

Photo 18
Zone 6

Natural shoreline,
North Powerhouse
Road

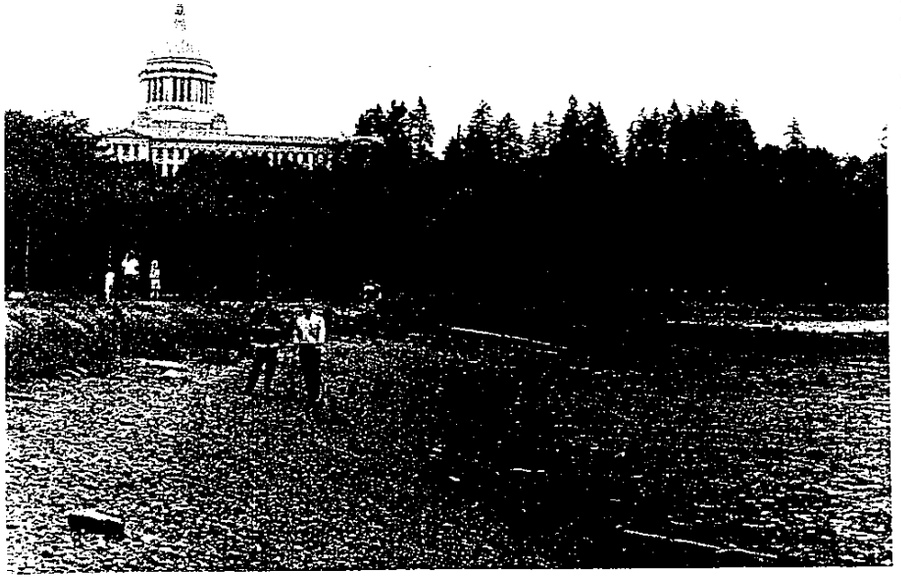


Photo 19
Zone 7

Shoreline erosion
south of parking lot

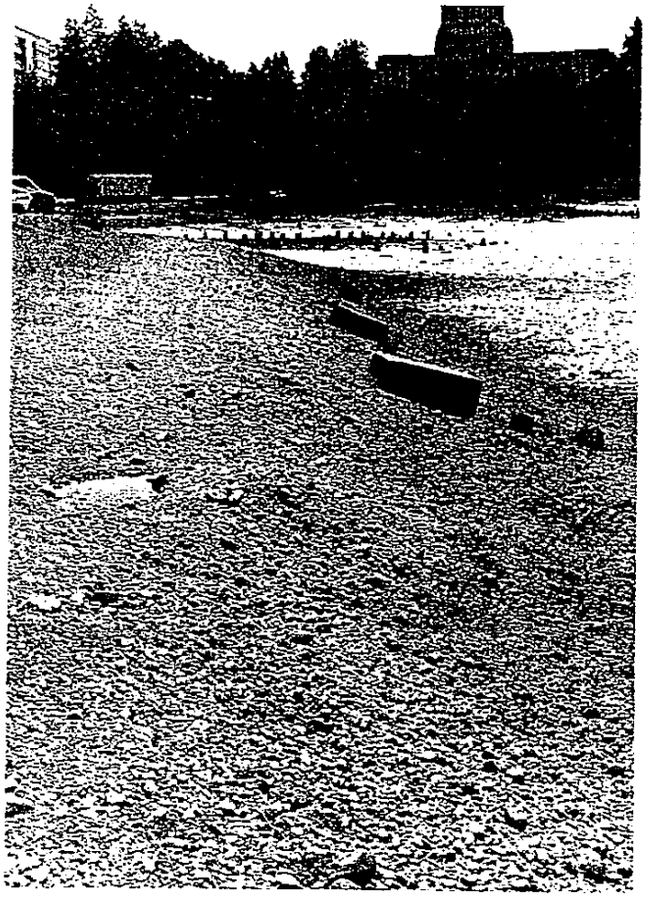


Photo 20
Zone 8

Shoreline adjacent to parking lot at Capitol Lake Park, south view

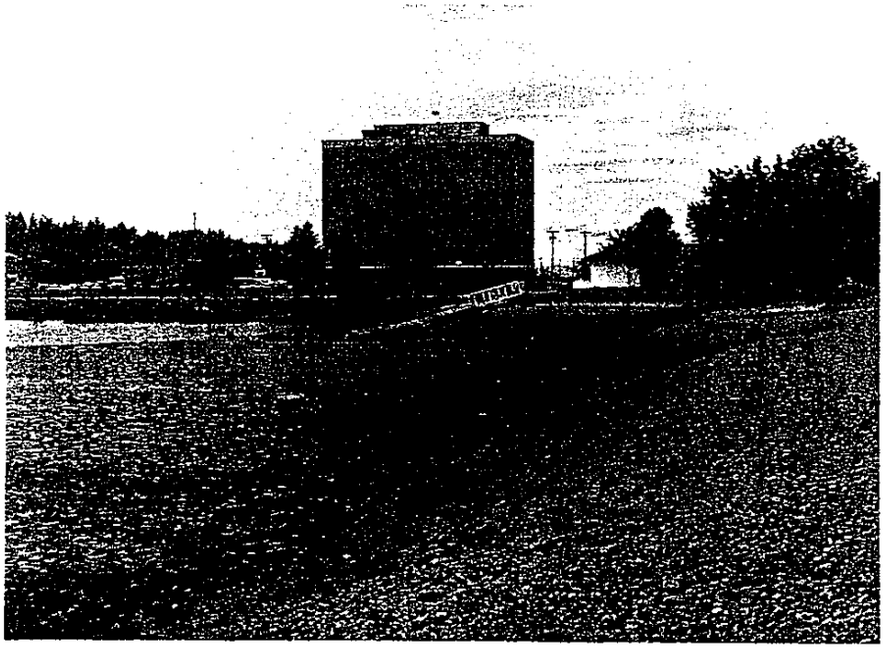


Photo 21
Zone 8

Shoreline of Capitol Lake Park, north view

Photo 22
Zone 9

Shoreline dropoff at
Capitol Lake Park

Photo 23
Zone 10

Swimming beach at
Capitol Lake Park

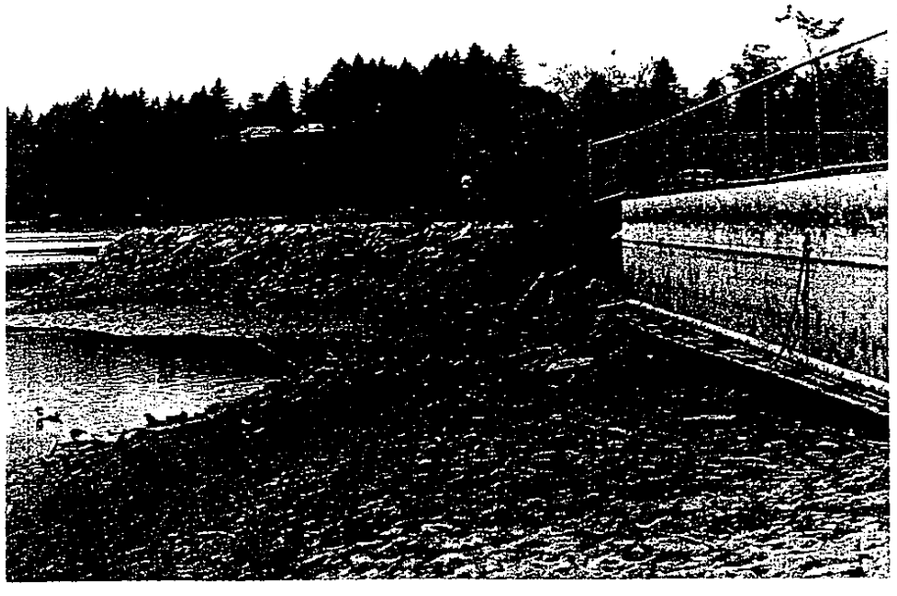


Photo 24
Zone 10

Retaining wall needing
riprap

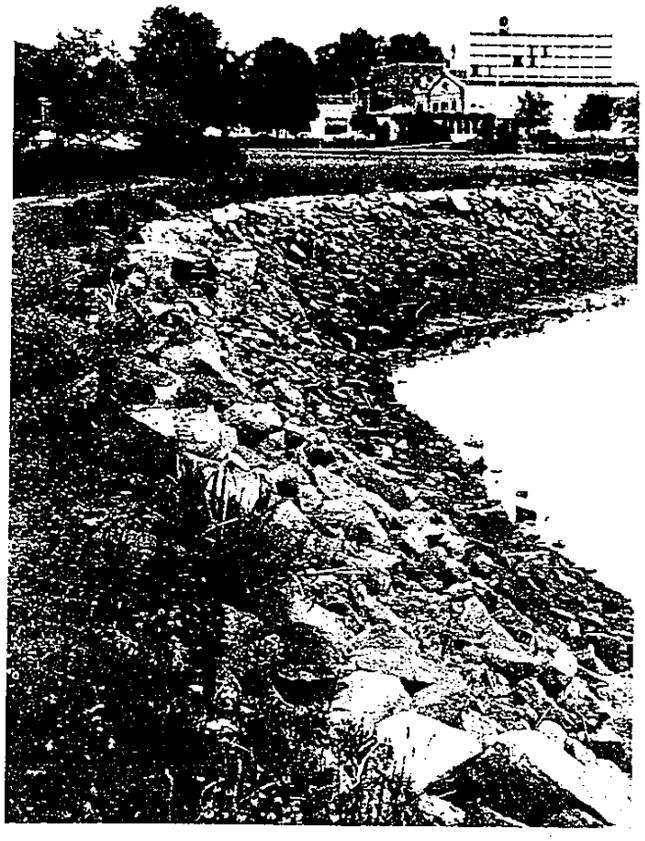


Photo 25
Zone 11

Shoreline adjacent
to north parking lot,
east view

Photo 26
Zone 11

Shoreline adjacent
to north parking lot,
west view

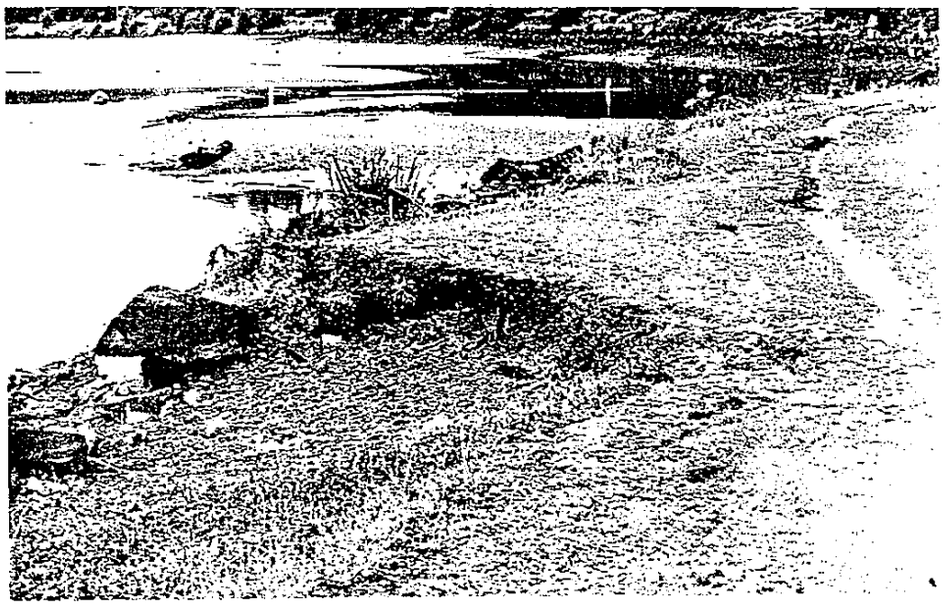


Photo 27
Zone 11

Shoreline erosion near path and north parking lot

Photo 28
Zone 12

East wing wall of tide gate at drawdown

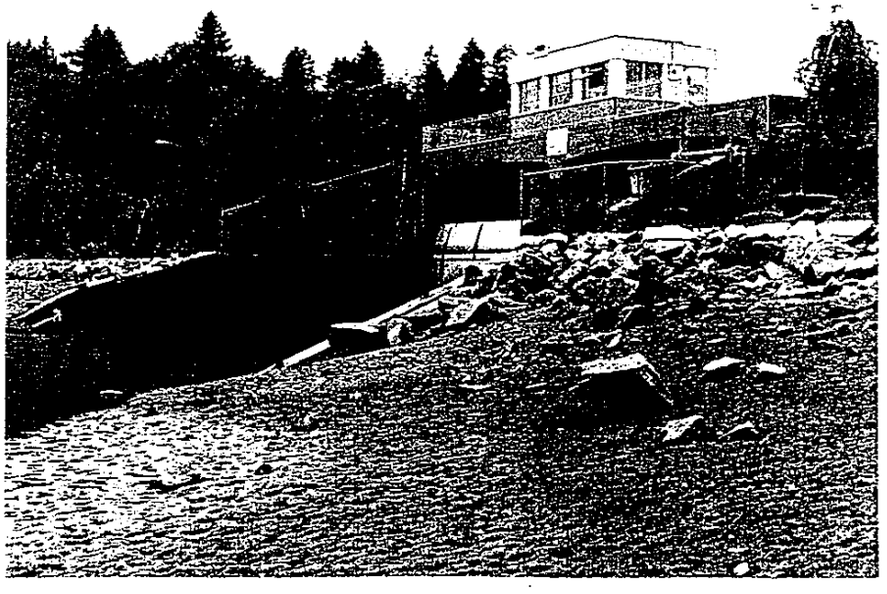


Photo 29
Zone 12

East approach to tide gate

Photo 30
Zone 13

Heavy riprap west of tide gate

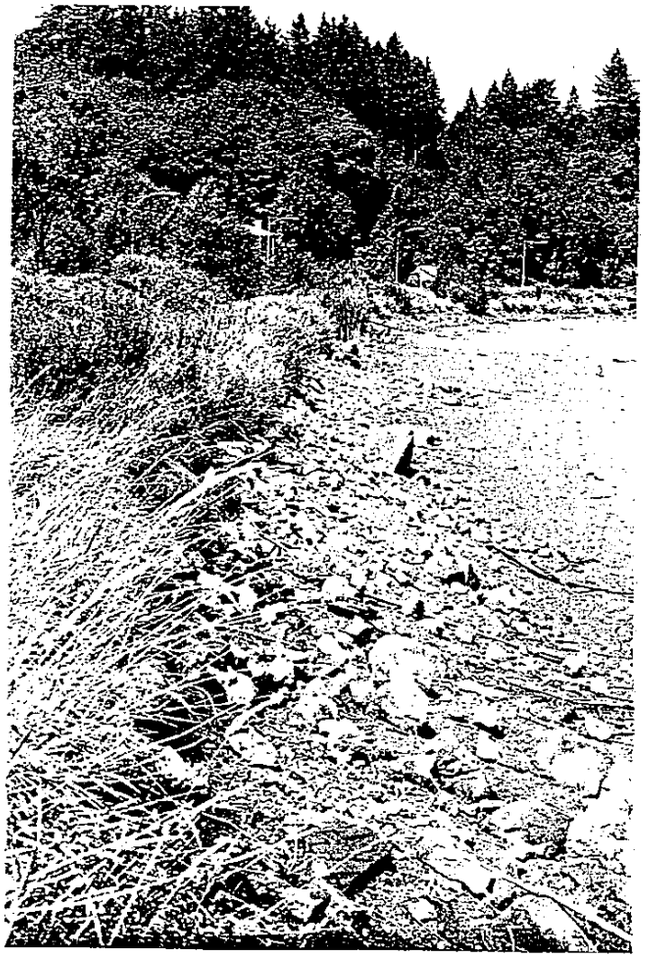


Photo 31
Zone 14

Shoreline along
Deschutes Parkway

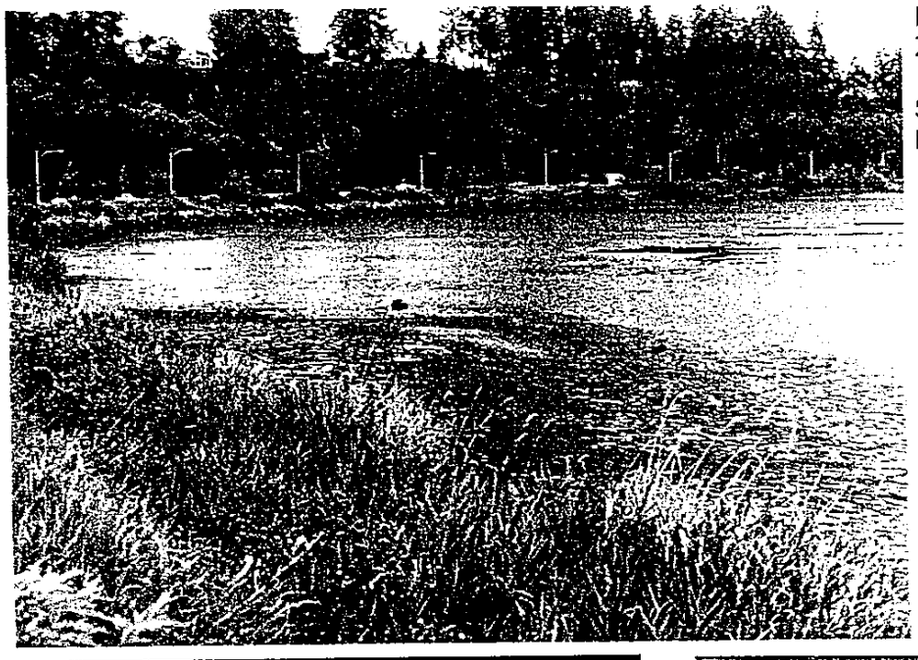


Photo 32
Zone 14

Shoreline along
Deschutes Parkway

Photo 33
Zone 14

Road cracks on Deschutes Parkway

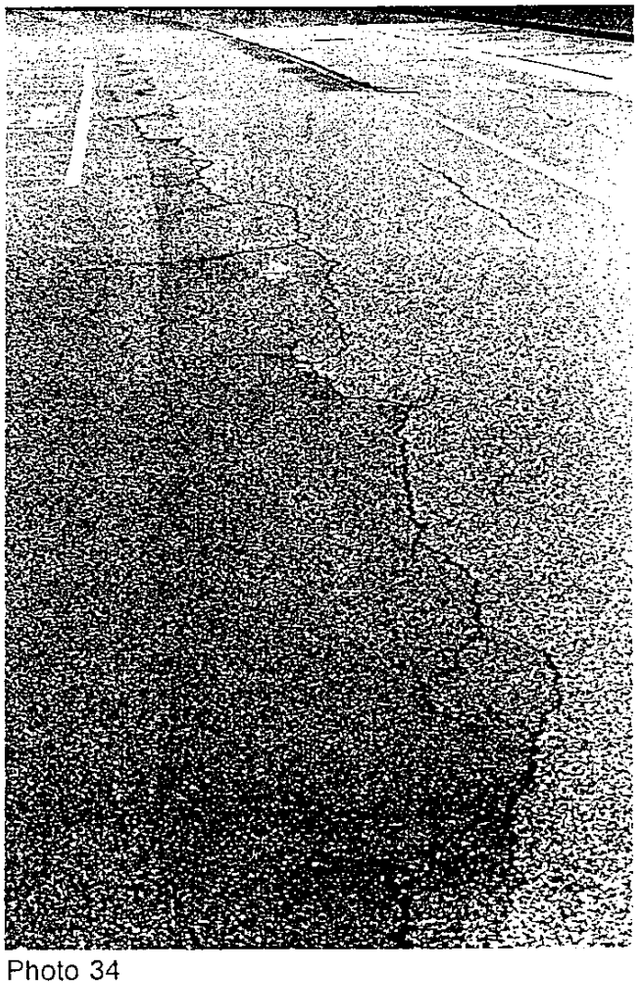


Photo 34
Zone 14

Road cracks on Deschutes Parkway

APPENDIX C

# PRELIMINARY PLANT LIST

# CAPITOL LAKE
# PRELIMINARY PLANT LIST

Note: The following plant list is a menu from which the desired plant species can be selected for shoreline protection implementation.

| | | |
|---|---|---|
| **DECIDUOUS TREES** | | |
| | Alnus rubra | Red Alder |
| | Betula | Birch |
| | Populus trichocarpa | Black Cottonwood |
| **LARGE SHRUBS** | | |
| | Betula glandulosa | Bog Birch |
| | Cornus stolonifera | Red-Osier Dogwood |
| | Physocarpus capitatus | Pacific Ninebark |
| | Salix scouleriana | Scoulers Willow |
| | Salix sitchensis | Sitka Willow |
| | Salix eleagnos | |
| | Salix | Siberian Willow |
| | Spirea douglassii | Hardhack |
| **SMALL SHRUBS** | | |
| | Gaultheria shallon | Salal |
| | Rosa Rugosa | Ramanas Rose |
| | Salix purpurea nana | Dwarf Blue Arctic Willow |
| | Vaccinium ovatum | Evergreen Huckleberry |
| **AQUATIC HERBS** | | |
| (Emergent Plants) | | |
| | Epilobium angustifolium | Fireweed |
| | Iris pseudacorus | Yellow Iris |
| | Typha angustifolia | Narrow-Leaved Cattail |
| | Typha latifolia | Cattail |
| | Veronica scutellata | Marsh Speedwell |
| **NON AQUATIC HERBS** | | |
| | Aster subspicatus | Douglas Aster |
| | Filipendula palmata | Spiraea Filipendula |
| **GRASSES/SEDGES/RUSHES** | | |
| | Alopecurus | Foxtail |
| | Butomus umbellatus | Flowering Rush |
| | Carex obnupta | Slough Sedge |
| | Deschampsia caespitosa | Tufted Hairgrass |
| | Eleocharis | Spike-Rush |
| | Juncus effusus | Soft Rush |
| | Scirpus acutus | Hardstem Bulrush |
| | spp. | European Beach Grass |
| **NON FLOWERING PLANTS** | | |
| | Athyrium filix-femina | Lady Fern |
| | Polystichum munitum | Sword Fern |

APPENDIX D

# MINUTES OF MEETING FOR CONSULTATION WITH THE ARMY CORPS OF ENGINEERS ON REGULATORY IMPLICATIONS

# APPENDIX D
## Minutes of Meeting

October 4, 1990

**Army Corps of Engineers Meeting for the Capitol Lake Project**
**Preliminary Guidance on ACOE regulatory issues**

**Attending:**

Muffy Walker - Army Corps of Engineers - Seattle District
Dale Anderson - Entranco Engineers, Inc.
Glenn Grette - Jones & Stokes
Todd Tressler - B-twleve Associates

**Agenda :**

Discussion of Wetland Feasibility Concepts:
- Concept I River Delta Freshwater Wetlands
- Concept II Diked Freshwater Wetlands
- Concept III Estuary Salt-tolerant Wetlands

Regulatory Implications of Each Concept
- ACOE Permits
- Other Possible Permits Contacts
- Possible Permit Schedules
- Special Requirements

Discussion of North Basin Shoreline Repair Recommendation
- Comments by Zones and Shoreline Treatment

Regulatory Implications for the Recommendation
- ACOE Permits
- Other Possible Permits Contacts
- Possible Permit Schedules
- Special Requirements

Recommended Follow-Up

**Results:**

Note: The preliminary consultation is intended as a planning guide and does not reflect future regulatory policy decisions of the Army Corps of Engineers.

<u>As Related to Wetland Feasibility Study</u>

*Concept I* - There is no need for permits to terminate dredging. If the saltwater barrier is constructed, an ACOE individual permit is probable. This permit would probably have to address Sections 10 and 404. The Section 404 need assumes that the salt-

water barrier would place more than 10 cubic yards of fill in the lake or associated wetlands.

The Coast Guard would likely have jurisdiction over the saltwater barrier since it would be placed in a navigable water.

Other applicable regulations will probably include: hydraulic project approval; shoreline management; DNR tidelands; WDOE Dam Safety; 401 triggered -EPA Water Quality Certification; WDOE Variance from State Water Quality Standards.

*Concept II* - Same as Concept I. In addition, the in-water disposal of dredge material would likely trigger the Puget Sound Dredged Material Disposal requirements for sediment testing.

The general concensus on this concept is that it may not be a feasible alternative because obtaining permits would be very difficult due to in-water disposal of dredged material on existing vegetated and non-vegetated wetlands.

*Concept III* - Similar to Concept I - except their would be no saltwater barrier and potential Sections 10 and 404 targeted individual permit. Note: Since this meeting, further alternative work has identified the need for a saltwater barrier at the Percival Creek outlet into Capitol Lake and shoreline erosion stabilization along the north basin and the west side of the middle basin. Regulatory review would be required for these changes. The outlet work to Percival Creek would be similar to Concept I; the shoreline erosion control work would be similar to that decribed below for the north basin.

<u>As Related to North Basin Shoreline Erosion Control Study</u>

There are two general approaches for obtaining regulatory approval for the recommendations for the north basin of Capitol Lake as noted in the North Basin Shoreline Erosion Control Study. The first approach is the individual permit process which is a more complex and lengthy review process (it was noted in the meeting that this could take from 8 months to 3 years for processing).

The second approach is the nationwide permit process which may be applied to each zone of the shoreline. These shoreline zones are identified in the study. A separate nationwide permit for each zone could be processed; these separate permits could be "piggy-backed" for review at one time (it was noted in the meeting that this could take from 2 months to 3 months for processing). Each nationwide permit request could be considered as repair, rehabilitation, or replacement of past fill or stucture as outlined in nationwide permit #3 or as bank stabilization activities to prevent erosion (nationwide permit #13) if the zone is less than 500 feet in length and meets several other requirements.

Under this second approach, it was also noted that nationwide permit #3 does not authorize beach restoration. This recommendation was included for Marathon Park and Capitol Lake Park in the study. This means that an individual permit would be probable for these shoreline zones.