APPLICATION FOR FUNDING

UNDER THE CLEAN LAKES PROGRAM

Administered by

Oregon Department of Environmental Quality

PHASE I FEASIBILITY STUDY

SMITH AND BYBEE LAKES FLOW AUGMENTATION

submitted by

METRO

PLANNING DEPARTMENT

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SUMMARY

Historically, the hydrology of Smith and Bybee Lakes and associated wetlands was dynamic, determined principally by the Columbia River water levels. Recent development activities in the watershed has resulted in isolating the lakes from any significant water source for much of the year. Augmentation of water flow to the lakes area has been identified as restoration goal. Though other water sources may be available, the Columbia River is the outstanding water source in the area. This proposal outlines a study to determine the feasibility of establishing a direct connection to the Columbia River and to assess the potential impacts of the proposed project.

BACKGROUND

Smith and Bybee Lakes and associated wetlands are remnants of formerly extensive lakes, sloughs, and marshes of the lower Columbia River bottomlands. The lakes are hydrologically connected, collectively having a surface area of over a thousand acres. The lakes are an important fishery in the Portland metropolitan area, as well as providing habitat for migratory and resident birds.

As part of the 2000-acre Smith and Bybee Lakes Management Area, the lakes are managed by the Metropolitan Service District (Metro). Interagency coordination and public participation, and on-going management is coordinated by a management committee composed of resource agencies, environmental groups, landowners, and neighborhood associations. The goals for managing the lakes as stated in the Natural Resources Management Plan for Smith and Bybee Lakes are to:

(1) maintain and enhance the lakes, to the extent possible, in a manner faithful to their original condition:
(2) provide and maintain habitat diversity: and,
(3) encourage educational and passive recreational use of the lakes area.

Considerable biological and water quality data has been collected in the lakes' area. The most recent extensive study (Fishman's Environmental Studies of Smith and Bybee Lakes) was completed in 1987 (attached). In this study, water quality problems identified included high nutrient levels and increasing aquatic macrophyte development. Nutrient concentrations indicate the lakes are often hypereutrophic. Aquatic macrophytes cover nearly 85% of Smith Lake, deterring boat access, and are increasing in Bybee Lake. Both in this study and in the Management Plan, a recommendation for lake restoration was made to examine the feasibility of augmenting water flow to the lakes, particularly from the Columbia River. A flow augmentation feasibility study has been recommended by the Smith and Bybee Lakes Technical Advisory Committee and the Lakes Management Committee.

LAKE DESCRIPTION

Smith and Bybee Lakes are located within the city limits of Portland, in Multnomah County, Oregon, adjacent to the confluence of the Willamette and Columbia Rivers. Lake data given below assumes the surface water elevation of the lakes is at 10.4 feet AMSL, which is the elevation of the fixed weir at the east end of North Slough. Smith and Bybee Lakes are directly connected over the normal surface water levels observed. Although they are distinct basins, they can be treated as one water body for most management decisions.

Physical Characteristics

	Smith & Bybee Lakes	Smith Lake	Bybee Lake
Surface Area	~~1050~~ ac	725 ac	325 ac
Drainage Area	approx. 1600 ac	----	----
Volume	3860 ac-ft	2660 ac-ft	1200 ac-ft
Maximum Depth	-----	6.7 ft	7.6 ft
Trophic Status	-----	Eutrophic	Eutrophic

Hydrology

The lakes and associated wetlands have been historically manipulated for development and waterfowl management purposes. By 1980, the entire north side of the lakes area had been filled for industrial development. The historic direct link from the lakes to the Columbia River was eliminated by this development. The more indirect link to the Willamette and Columbia Rivers through the Columbia Slough was restricted by the 1983 construction of a water level control structure at the east end of the North Slough. This structure not only restricted flow exchange between the lakes and the slough, but also maintained the lakes at a static level year-round. This dramatically increased the retention time of the lakes and changed the vegetation types in the lakes and wetlands (see attached Management Plan and Environmental Studies Summary Report).

The lakes have been essentially isolated from influences of the slough and rivers much of each year. However, when the lakes' level or the slough/river levels exceed 10.4 feet AMSL, there is a direct connection between the North Slough and the lakes. This usually occurs during the Willamette River freshet in winter months and during the Columbia River freshet in late spring.

Based on the attached Environmental Studies Report and recently-collected data, the major components of the water budget are precipitation and evaporation. Surface runoff inflow and groundwater flux are relatively minor in the water budget.

WATERSHED DESCRIPTION

Smith and Bybee Lakes drainage basin encompasses approximately 1600 acres in the northwest Portland area. Most of watershed is comprised of the adjacent wetlands and uplands, with two stormwater discharges from nearby industrial developments. The adjacent uplands are mostly within the Management Area, are relatively undisturbed, heavily vegetated, with low slopes. The stormwater discharges receive passive treatment prior to discharge to the lakes.

The St. Johns Landfill, located within the Management Area and immediately adjacent to Smith Lake, is no longer active and is proceeding through an extensive closure process. There are two surface water discharges from the closed landfill that indirectly enter Smith Lake that appear to have insignificant impact on water quality of the lake.

The largest population center nearest the lakes is Portland, having an estimated population of 453,000 as of July 1, 1991. The four-county metropolitan area that is accessible to the lakes includes approximately 1.4 million people.

BENEFICIAL USES

Current uses of the lakes include boating, fishing, and birdwatching. The warm-water fishery offers popular angling for largemouth bass, crappie, and bluegills. Juvenile salmon have been found in the lakes during years of high flows in the Columbia and Willamette Rivers, indicating the use of the lakes as refugia for salmon migrating downriver. Current boating access is limited to two locations, where boats must be hand-carried.

The lakes area is important to a variety of waterfowl, songbirds, and raptors in the metropolitan region. The lakes serve as a principal feeding area for Great Blue Herons form nearby rookeries. Migratory waterfowl and raptors are frequent users of the lakes area. The substantial wildlife use of the area attracts wildlife observers in the urban environment.

A master recreation plan was recently adopted for managing Smith and Bybee Lakes area for wildlife habitat protection and enhancement while providing for passive recreational opportunities. The plan outlines the development of boat access, trails around the lakes, and an interpretive center.

Public Benefits Anticipated from Restoration

With insufficient fresh water flow entering the lakes, increasing nutrient levels, persistent algal blooms, and increasing aquatic macrophyte coverage, the current lake uses as described above will be adversely affected or impaired. The restoration of water flow to and from the Columbia River will improve the hydrodynamics and water quality of the lakes. The connection to the Columbia River has potential for restoring habitat to migrating juvenile salmon.

RESTORATION FEASIBILITY SCOPE OF WORK

Task 1: Management/Coordination

Management of the project includes ensuring that all tasks and products will be completed as scheduled. Coordination between agencies and affected parties will be facilitated through the existing Smith and Bybee Lakes Technical Advisory Committee. Agency participation in this committee include Port of Portland, Oregon Division of State Lands, Oregon Department of Water Resources, Oregon Department of Fish and Wildlife, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Army Corps of Engineers.

Task 2: Determine Preferred Option

Information currently available indicates direct connection to the Columbia River is preferred. However, in this task, the rationale for selecting this option will be updated and outlined.

To augment water flow to the lakes other than directly from the Columbia River, three alternatives exist:

1. ground water from on-site wells;
2. flow from the Columbia Slough; and,
3. pumping from Columbia River through existing Port of Portland dredge lines.

Augmenting lake water with ground water appears to have potential for improving water quality in the lakes. However, preliminary work conducted by Sweet-Edwards/EMCON, Inc. indicates high installation and operation costs associated with the necessary water yield rates. Also, the effect of pumping from the sand/gravel aquifer may have on the potential movement of leachate from the landfill is unknown at this time. Additional information on aquifer characteristics is needed.

Water quality in the Columbia Slough is currently designated water quality limited by Oregon Department of Environmental Quality. Combined sewer overflows from City of Portland sewer discharges into the slough and possible leaching from the St. Johns landfill into the slough results in undesirable water quality for flow augmentation to the lakes. Pumping Columbia River water through existing or modified dredge lines owned by Port of Portland may be feasible, but is probably cost prohibitive and currently restricted until the Port is able to obtain water rights for diverting water from the Columbia River.

Connecting the Columbia River directly with the lakes has been under consideration as a management option. The most obvious route of directly connecting the lakes to the Columbia River is between the northeastern corner of Smith Lake going north to the North Portland Harbor of the Columbia River, a distance of approximately 2000 feet. This option appears

desirable given the following reasons:

1. Columbia River offers a practically unlimited, long-term source of water quantity;
2. re-connecting will restore the lakes closer to former natural conditions;
3. opening to the river will provide greater access for migrating juvenile salmonids seeking refuge, as surveys have indicated;
4. the water quality appears to be preferable in comparison to the alternatives;
5. the water level gradient between the river and lakes will eliminate potential pumping costs for much of the year;
6. with the existing outflow structure from the lakes to North Slough, having inflow directly from the river will promote flushing of the water quality-degraded North Slough; and,
7. analogous nearby lake systems, Vancouver Lake and Sturgeon Lake, have established direct connections to the Columbia River as restoration techniques.

Potential problems associated with using Columbia River water are:

1. the high sediment load carried in the river may result in an increase in sediment load to the lakes;
2. the nutrient levels in the river water at certain times of year may be undesirable for introducing into the lakes;
3. the potential physical, legal, and permit obstacles of creating either an open channel or closed conduit between Smith Lake and the river is unknown.

Task 3: Model Hydrodynamics of River/Lake Linkage

A modification of an existing two-dimensional, unsteady, hydrodynamic and water quality numerical model, CE-QUAL-W2, has been developed for the lower Columbia Slough that includes the lakes. This model will be used to evaluate the feasibility of utilizing gravity flow from the Columbia and the potential water quality impacts of introducing Columbia River water. Sub-tasks include:

(i) development of flow algorithm with new discharge structure;
(ii) review of water level fluctuations in the Columbia River and Columbia Slough;
(iii) hydraulic model development for various design configurations for the channel connecting Columbia River and the lakes;
(iv) determine optimal operational strategy for weir level for discharge and intake structures, with consideration of seasonal effects; and,
(v) simplified analysis of the effect on ground water recharge to the lakes as a result of changing water levels in the lakes.

Task 4: Evaluate Water Quality Impacts of Linkage

Existing and newly-acquired water quality monitoring data will be entered into the water quality model that will be used to evaluate the potential impact of connecting the lakes directly to the

Columbia River. Available water quality data on the Columbia River will be compiled from the on-going Lower Columbia River Bi-State Study. Columbia Slough water quality data, with additional Columbia River monitoring data, will be acquired from current City of Portland Columbia Slough studies.

Lakes' water quality will be evaluated using limited historical data (i.e. quarterly sampling at two locations) and recently-expanded monitoring results. Since 1980, water locations were sampled and tested for following parameters: pH, alkalinity, hardness, conductivity, BOD, COD, Cl, and NH_3. Beginning in August, 1992, parameters for which lake sampling at two lake stations occurred are listed in Table 1.

TABLE 1
Smith and Bybee Lakes and Slough
Water Quality Parameters

Basics	Nutrients
Water Temperature	NH_3-N
Secchi Disk *	NO_2+NO_3-N
Dissolved Oxygen	Total Kjeldahl Nitrogen
Electrical Conductivity	Total Phosphorus
pH	Dissolved Ortho-Phosphorus
Redox Potential	
	Biological
Solids	Fecal Coliform Bacteria *
Total Solids *	Enterococci Bacteria *
Total Suspended Solids *	Chlorophyll *a*

* Parameters will be added in February, 1993

In 1993, sampling frequency at two lake stations and one North Slough station will be bi-monthly in December-March, once in April and November, and twice-monthly May-September.

The water quality model will be used to evaluate the effect of introducing Columbia River water into the lakes, focusing, at a minimum, on nutrients and suspended sediments. Modeling sub-tasks will include:

(i) literature of sediment loadings in the Columbia system;
(ii) model simulation analyzing suspended sediment transport into the lakes;
(iii) evaluation of potential designs of a sedimentation basin within the channel from the Columbia River to Smith/Bybee, if necessary;

(iv) model the lake system for phosphorus;
(v) calibrate the model with available data (Temp., DO, nutrients, chl-*a*);
(vi) analyze the effect of low phosphorus water from the Columbia on phosphorus and chlorophyll levels in the lakes.

Task 5: Evaluate Habitat Impacts

Due to the lakes proximity to the St. Johns Landfill and the hydrologic connection with the Columbia Slough, there is potential for the presence of toxins in the lakes system. Earlier sediment and water column studies do not indicate toxins are of a concern within the lakes. However, the proximity of the landfill and stormwater discharges into the lakes will continue to pose potential for sources of toxins. Sediment monitoring for toxins is a cost-effective means for evaluating impacts of water quality changes that may result from these potential sources. A change in sediment quality is an indicator of long-term changes in water quality.

A total of four sediment stations will be sampled in summer in Smith and Bybee Lakes and two stations in the North Slough for the parameters listed in Table 2 below. Data on toxins in the sediments of Columbia Slough will be obtained from City of Portland's comprehensive Columbia Slough Sediment Analysis and Remediation Project. Data on toxins in the Columbia River will be derived from sources listed in Sources of Biological, Chemical, and Physical Information for the Lower Columbia River (1990) by Robert McConnell.

TABLE 2
Smith and Bybee Lakes
Sediment Parameters

Copper	PAH's (lake sediments only)
Lead	Pesticides listed in RCRA Method 8080/NPDES Method 608
Zinc	Total organic carbon
Cadmium	
Chromium	
Arsenic	Biological
Mercury	Macroinvertbrates

An improvement in water quality of the lakes resulting from the proposed project may yield an increase in water clarity. This could result in an increase in aquatic macrophyte growth, particularly submergent species. Using the 1992 aquatic macrophyte survey results conducted by Metro and a results from a similar survey planned for 1993, a baseline condition will be established for assessing the effects on macrophyte growth of changes in

water quality. Changes in water clarity and nutrients predicted by the water quality model will be used to evaluate the impact on aquatic macrophytes in the lakes.

Establishing a channel connecting Smith/Bybee Lakes with the Columbia River would most likely allow the movement of juvenile salmon in and out of the lakes, unless the connection was designed to exclude this movement. The movement of juvenile salmon into the lakes during their migration downriver was observed in 1986 when juvenile chinook salmon entered the lakes during high water levels of the February freshet. Data indicates that the lakes and Columbia Slough are heavily utilized by juvenile salmon during the spring. Abundant zooplankton provide food and warmer temperatures favor rapid growth of these young fish. A study of nearby Vancouver Lake, WA, supports the conclusion that Smith and Bybee Lakes provide a good rearing environment for juvenile salmon during spring and early summer; food is abundant and predation is minimal.

Management of water levels through control of the structure connecting the lakes to the river and the existing control structure on North Slough will consider the release of juvenile salmon from the lakes during June as a priority. A management strategy will be developed that will address this task. The Smith and Bybee Lakes Technical Advisory Committee, which includes representation from National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Oregon Fish and Wildlife Service, will review all proposals for flow augmentation and water level management of the lakes.

Task 6: Analyze Physical Barriers to Linkage

With results from modeling exercises described in Task 3, the most feasible design and route will be determined. The physical barriers or opportunities of the preferred rout will be examined. The preferred type of connection, whether open channel or closed conduit, will be selected based on site factors, such as potentially contaminated soils, proximity to pollution releases, location of existing structures, and total linear distances. Issues regarding land acquisition, either in-fee or easement rights, will be investigated. Consideration will be given to potential problems associated with using Columbia River water listed above. Design considerations, such as screening and pre-settlement basins, will be evaluated.

Task 7: Estimate Costs of Linkage

The construction, operation, and maintenance costs associated with the preferred option will be estimated.

Task 8: Report Findings

Information and products developed from the tasks listed above will be incorporated into a final report. A preliminary implementation plan will be recommended.

ESTIMATED COSTS FOR PHASE I SMITH/BYBEE LAKES FEASIBILITY STUDY

Task	Clean Lakes Contribution	Metro Contribution	TOTAL
Management/Coordination	$ 2,000	$ 3,000	$ 5,000
Determine Option	1,000	1,000	2,000
Hydrodynamic Modeling	6,000	500	6,500
Water Quality - Sampling	10,000	2,000	12,000
- WQ Modeling	8,000	1,000	9,000
Habitat Impacts - Sediment	4,000	2,000	6,000
- Macrophytes	-	3,000	3,000
- Salmonids	-	3,000	3,000
Analyze Barriers	3,000	1,500	4,500
Cost Estimate	4,000	2,000	6,000
Report Findings	1,000	1,000	2,000
TOTAL	$ 39,000	$ 20,000	$ 59,000

Metro is requesting $39,000 from the Clean Lakes Fund to fund portions of this project. The remaining local matching funds will come from the Smith and Bybee Lakes Trust Fund managed by Metro.

Schedule

Management/Coordination	March 93 - January 94
Determine Option	March 93 - April 93
Hydrodynamic Modeling	March 93 - August 93
Water Quality Impacts	March 93 - October 93
Habitat Impacts	April 93 - November 93
Analyze Barriers	June 93 - December 93
Cost Estimates	Nov. 93 - January 93
Report	Dec. 93 - January 94