UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

MAR 23 1993

Reply to
Attn of: WD-139

MEMORANDUM

SUBJECT: Recommendation for TMDL Approvals

Liberty Lake - Waterbody Segment No. WA-57-9010

TMDL Parameters: Total Phosphorus, Total Nitrogen

FROM: Rob Pedersen, Environmental Engineer
Environmental Characterization Program

TO: File

- **WA-57-9010 is not on Washington's §303(d) list, nor is it on the water quality limited list. It was, however, a federal Clean Lakes project.**
- TMDLs submitted 25 August 1992
- TMDL package completed 16 March 1993
  - EPA Approval Checklist
  - Document 1: Transmittal letter
  - Document 2: TMDL document
  - Document 3: Michael Kennedy Consulting Engineers. 1985. "Liberty Lake Restoration Project - Completion Report." Report to Liberty Lake Sewer District, Liberty Lake, WA.

    Breithaupt, S., D. Lamb, W. Funk and B.C. Moore. 1986. "Extended Post-Restoration Evaluation of Liberty Lake, WA. - Final Report." Report to Liberty Lake Sewer District, Liberty Lake, WA.

    Michael Kennedy Consulting Engineers. 1988. Water Quality Summary Report for Summer 1987 Monitoring of Liberty Lake Washington. Report to Liberty Lake Sewer District, Liberty Lake, WA.

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- Document 4: Implementation documentation, for the Liberty Lake Sewer District. Actions summarized in above documents. Summary of resolutions passed by the district (63-83, 48-85 and 40-89) found in:

  Liberty Lake Sewer District. No date. "'Restoring Liberty Lake' A Record of Achievement, The First 16 Years 1973-1989". Liberty Lake Sewer District #1.

Transmittal letter - Complete (see Document 1)

- States that TMDLs have been established in accordance with Section 303(d)(1) of the Clean Water Act.

- **Review note: meets requirements.**

Problem Assessment - Complete (see Document 2 and 3)

- Liberty Lake falls under "Lake Class" in Washington state's standards. Protected uses include: domestic water supply, primary contact recreation and wildlife habitat. Liberty Lake is near the Spokane River in northeast Washington. Lake surface elevation is approximately 2050 feet above sea level. The lake is 282 hectares in size and has a mean depth of 5.5 meters. Hills rise about 2000 vertical feet on three sides of the this glacier origin lake and have been popular for residential development. Shallow, permeable soils in the watershed are rapidly drained over bedrock to the lake. The watershed is over the Spokane-Rathdrum Prairie Sole Source Aquifer.

- By the mid 1960s, Liberty Lake exhibited symptoms of eutrophication and the lake was becoming less and less usable. Throughout the late 1960s and into the 1970s, large masses of decaying algae and plant fragments were deposited on the lake's beaches. In 1968 the Liberty Lake Property Owner's Association requested water quality analyses. Results from early monitoring showed high nutrient levels, high chlorophyll a and poor clarity. In 1973 the Liberty Lake Sewer District was formed. Sewering of the drainage basin began and a lake monitoring/restoration plan was developed. Monitoring begun in the late 1970s, continued along with restoration efforts, through 1985; some monitoring continues today.

- Numerous sources were identified as contributors to nutrient enrichment of the lake. The primary inlet stream flowed through (especially at high flow times) a marshy area adjacent to the lake. The marsh was an

unusually high nutrient source, perhaps because of its use as a manure spoils site in past years. Unsewered homes contaminated groundwater due to the unfavorable soils and geology of the area; sewered areas had significant exfiltration. Stormwater runoff was also a major contributor. Lake sediments were found to be rich in nutrients and the luxuriant growth of aquatic plants and algae recycled nutrients in the lake.

- **Review notes: Problem assessment provides background information and thoroughly documents lake restoration techniques. Several measures of eutrophication conditions are presented and discussed.**

TMDL document - Complete (see Document 2)

- Documents 3 and 4, along with other citations in Document 2 deal with planning, restoration and management of Liberty Lake. TMDLs were not the purpose of these activities.

- In Document 2, Ecology presents TMDLs for total phosphorus (TP) and total nitrogen (TN) "...based on estimated loads achieved after implementation of various restorations activities to the lake that achieved levels of aesthetic enjoyment acceptable to the lake user community". These were based on nutrient budgets developed for the restoration project (p. 144, document 3). Load allocations (LA) in kg/yr are:

Source	TP	TN
surf.w.tribs.	243	2378
precipitation	98	1668
groundwater	28	234
internal loading	157	-
reserve	3	-
total	**529**	**4280**
	(1.45 kg/d)	(11.7 kg/d)

- **Review note: TMDL document clearly identifies the load capacities for TP at 529 kg/yr and for TN at 4280 kg/yr to Liberty Lake. References the supporting technical documents which give pollutant levels before, during and after restoration activities.**

Supporting Studies - Complete (see Document 3)

- Summary of activities at Liberty Lake, from Document 3:
  1973 Liberty Lake Sewer District formed
  Sewering of drainage basin
  Develop lake restoration plan

1976 Sewer facility plan developed
Sewer bond issue passed
1979 Wastewater collection system completed
Lake restoration plan included:
-dike work at marsh, 1979, 1980-81, 1985;
-dredging, 1980-81;
-alum application, 1974, 1980-81;
-stormwater management plan, 1981.
1981 Stormwater management plan implemented
1983 Pre-restoration and concurrent-restoration monitoring
1984-85 Post-restoration monitoring
To date: continued monitoring and maintenance (e.g. of marsh dike system, sewer systems)

- Summary of restoration techniques:

Diversion of flood flows around marsh at south end of lake. Continued repair and maintenance as needed.

Data from 1978-79 showed the marsh was the highest source of TP. Of all, this action had the greatest effect on reducing TP loads to the lake. Total TP loading was reduced by 47 kg/yr (or from 7 percent to 1 percent of total TP budget by 1987). TN was not accurately quantified; but about 4 percent decrease in the total TN budget was claimed. Results from sewering were expected to reduce the overall effectiveness seen from marsh diking.

Dredging. About 50 acres (20.2 ha) in two sections of the most nutrient rich sediment areas.

TP release rate dropped from 60-80 to 6 $mg/m^2/d$ at near anaerobic conditions. There was about a 25 percent decrease in total aquatic plant biomass. Relative to cost, this action was of minimal effectiveness. Less than 1 percent decrease in the total TP budget was attributable to dredging.

Application of alum.

Applied as an interim measure in 1974 before long term actions were implemented. Substantial decrease in the massive algal blooms was observed and Secchi disk depth increased. Primary purpose of later application was to enhance dredging effectiveness.

Sewering success.

Groundwater nutrients were reduced by 95 percent (177 kg TP/yr) or 34 percent of overall TP budget.

Stormwater management.

In 1975, TP contributions were 47 percent and TN 16 percent of total. After implementation, these contributions were significantly reduced.

- Results; some before and after comparisons: Conclusions from the 1974-79 nutrient budget -- eutrophic; from mid 1980s -- meso-eutrophic, overall TP loading was reduced by over a third. Spring 1981 nutrient concentrations were down to: 8-22 ug/l TP, 0.48 mg/l (less than detection) TN. Some comparisons from just 1983 to 1986:

Date	Secchi (m)	TP (kg/yr)	-(ug/l)	Chl a (ug/l)
1983	1.9	483	31	19
1986	4.2	196	13	4

- Results from the 1987 survey showed good conditions even though the lake was at its lowest level (less dilution) in 40 years. Nutrient levels stabilized at relatively low levels. Secchi disk depths were the same or better than 1983-1985. Macrophyte density was maintained; an increase was expected due to low lake levels and greater light penetration.

- **Review notes: Detailed limnological reports document restoration processes. Based on annual Trophic State Indices, significant improvement in the lake's trophic state was documented. In 1984, water clarity was claimed to be the best observed in 10 years. However, it should be noted that the lake is not oligotrophic and relatively minor shifts in nutrient and plant/algal dynamics could be problematic.**

Public participation - Complete (see Documents 4a, 4c)

- The Liberty Lake Sewer District formed in 1973. The District holds public meetings and works with the Property Owners' Association to manage the lake to maintain a water quality acceptable to the lake users. An Environmental Impact Statement was prepared for the restoration project which included all the public notice and hearing requirements specified under WAC 197-535 of the State Environmental Policy Act.

- **Review notes: Adequate public involvement.**

Enforceability - Complete (see Document 2)

- Responsibility for "quality uses" of lake falls on the district. Enforcement authority through the district and the city (resolutions).

- **Review notes: Local infrastructure provides close surveillance of lake's aesthetics; monitoring not based**

on Ecology's TMDLs. Pertinent city resolutions and enforcement capability by the District. EIS not submitted for file.

TMDL effectiveness plan - Complete (see Documents 2, 3 and 4)

- Besides continued lake monitoring, the district has some management powers. Also the city of Liberty Lake has several environment oriented resolutions such as: Resolution 48-85 - watershed stormwater management guidelines to protect the lake from detrimental activities in the watershed.

- **Review notes: Adequate conditions. It's up to the lake users to maintain water quality. Ecology's TMDLs for TP and TN are probably less stringent than what the district will strive for.**

Additional Information

- From Document 3. Four long term factors which together have the potential to hold the lake at a trophic level near that of the mid 1980s: 1) installation of marsh flushing controls; 2) dredging removal of about 15,000 kg of phosphorus from the system; 3) construction of wastewater collection and treatment systems; 4) implementation and enforcement of the watershed management guidelines.

- From the 1988 report. Recommendation that the Liberty Lake Sewer District continue to monitor the lake during the summer algal growing season. In addition to chemical, physical and biological parameters, monitoring of the lake surface elevation should be performed on a regular basis. These monitoring efforts will allow the District to keep track of usual and unusual changes as each season progresses and to play an active role in controlling nutrient availability through lake volume (level) manipulation.

- **Review notes: EPA recommends following the suggestions in the 1988 report. Although nutrient loading was greatly reduced and inlake concentrations of nutrients are relatively low, traditional limnological measures hint that the lake is borderline on problem conditions. Given that current loading is substantially below Ecology's TMDLs, the TMDLs do not leave much, if any flexibility relative to perceived user requirements.**

Recommendation, approve TMDLs.

ERP, 03/17/93

TOTAL MAXIMUM DAILY LOAD

Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Developed pursuant to 40 CFR 130.7 and the Federal Clean Water Act

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WATERBODY SEGMENT: WA-57-9010

Liberty Lake

(outlet at TRS 50N-45E-22)

TMDL PARAMETER:

Total Phosphorus

RECEIVING SYSTEM INFORMATION:

Basin: Middle Spokane
Counties: Spokane

APPLICABLE RULES:

WAC 173-201-045(5)(viii)
Liberty Lake Sewer District Resolutions 63-83, 48-85 and 40-89.

SOURCES COVERED BY THIS TMDL:

Allocation Type	Source Description
LA	Liberty Lake Surface Water Tributaries
LA	Precipitation
LA	Groundwater
LA	Internal Loading

TMDL:

A loading capacity for total phosphorus of 1.45 kilograms p per day (529 kg p/year) to Liberty Lake has been established. The LA for surface water tributaries is set at 243 kg-P/yr; for precipitation is set at 98 kg-P/yr; for groundwater is set at 28 kg-P/yr; and for internal loading is set at 157 kg-P/yr. These LA's have been set based on estimated loads achieved after implementation of various restoration activities to the lake that achieved levels of aesthetic enjoyment acceptable to the lake user community.

Technical Documents:

Washington Department of Ecology. 1979. Environmental Impact Statement - Liberty Lake Restoration Project.

Michael Kennedy Consulting Engineers. 1979. Liberty Lkae Restoration Plan. Report to Liberty Lake Sewer District, Liberty Lake, WA.

Michael Kennedy Consulting Engineers. 1985. Liberty Lake Restoration Project - Completion Report. Report to Liberty Lake Sewer District, Liberty Lake, WA.

Breithaupt, S. Lamb, D., Funk, W., and B.C. Moore. 1986. Extended Post-Restoration Evaluation of Liberty Lake, WA.- Final Report. Report to Liberty Lake Sewer District, Liberty Lake, WA.

Public Participation:

In 1973, the Liberty Lake Sewer District was formed due to pressure from the lake user community concerned with the lake's accelerating eutrophication problem. The District holds public meetings and works with the Property Owners' Association to manage the lake to maintain a water quality acceptable to the lake users. An Environmental Impact Statement was prepared for the restoration project which included all the public notice and hearing requirements specified under WAC 197-535 of the State Environmental Policy Act.

Implementation:

After the Liberty Lake Sewer District was formed from concerned lake users in 1973, the District identified two actions needed for lake improvement; sewering the lake drainage basin and lake restoration work. In 1976, a sewer facilities plan was prepared and a sewer bond issue was passed. In 1979, the wastewater collection system was completed and the lake restoration plan was published from the finding of a Phase I project.

The restoration plan included dredging nutrient rich sediments from the lake, application of a alum, improving existing storm water diversion structures, and the preparation of a storm water management plan. The restoration plan was implemented in 1981 and the lake monitored through 1983. A post-restortaion analysis showed that nutrient loads in 1984 and 1985 were well below the TMDL goal resulting in oligiotrophic conditions.

Monitoring:

Monitoring of numerous quality constituents was conducted during and after the lake restoration effort. Currently, monthly samples for total phosphorus are collected at two stations by Washington State University under contract from Liberty Lake Sewer District.