

Gilfilian Engineering, Inc.

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COUNCIL MEMORANDUM NO. 90-80

TO: Wasilla City Council

FROM: Bob Gilfilian, P.E.
City Engineer *Bob Gilfilian*

DATE: November 8, 1990

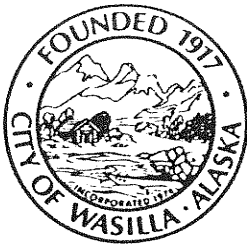
SUBJECT: Lake Lucille Water Budget

This memo is to request Council to authorize use of the funds that were previously approved in Ordinance Serial No. 90-28 (copy is attached). The original intent of the funds was to match a Local Water Quality Planning Grant from the Alaska Department of Environmental Conservation (ADEC) for the purpose of conducting a water budget study of Lake Lucille. Unfortunately, the State did not have sufficient funds to cover all of the requests which included the City of Wasilla.

Attached is a copy of the original proposal (RFGP #2) dated August 8, 1990 that was submitted to ADEC. Subsequent to the submittal of the proposal, the City had an assessment of lake rehabilitation techniques for Lake Lucille prepared by Mr. Joe Eilers of E&S Environmental Chemistry, Inc. A copy of Mr. Eilers' September 10, 1990 report is attached for your review. Please note that on page 6, second paragraph of his report, Mr Eilers stated that it is critical a water budget be prepared on the lake in order to plan for the installation of the replacement outlet structure.

In consideration of the scheduling of the submission of a grant application to EPA under their Clean Lakes Program, it is essential that work begin on establishing the lake's water budget as soon as possible. I have reviewed the budget that was presented in the proposal (RFGP #2) and believe a considerable amount of preliminary information on the water budget could be obtained with the amount of funding approved under Ord. Serial No. 90-28. During the Council meeting of November 14, 1990 I will be available to address the specifics on the scope of work to be done. Also, I will speak on procedures for requesting Clean Lakes Grant Funding from the US EPA.

*approved 11/14/90
use appropriations from Ord 90-28*



CITY OF WASILLA

290 E. HERNING AVE.
WASILLA, ALASKA 99687
PHONE: (907) 373-9050
FAX: (907) 373-0788

Requested By: Administration
Prepared By: Municipal Services

ORDINANCE SERIAL NO. 90-28

AN ORDINANCE OF THE CITY OF WASILLA, ALASKA AMENDING THE FY-91 BUDGET BY APPROPRIATING FUNDS TO THE CAPITAL IMPROVEMENT FUND.

BE IT ORDAINED AND ENACTED BY THE CITY OF WASILLA, ALASKA AS FOLLOWS:

SECTION I. Classification. This is a non-code ordinance.

SECTION II. Purpose. To appropriate additional funds to the FY-91 Budget to continue the Lake Lucille Study

SECTION III. Appropriation. Funds are appropriated to the following fund.

<u>CAPITAL IMPROVEMENT FUND</u>	
Lake Lucille Study	\$19,200.00

SECTION IV. Source of Funds.

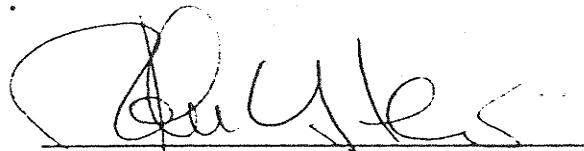
MG #4/86-313	\$ 9,600.00
Clean Water Grant	\$ 9,600.00

SECTION V. Effective Date. This ordinance becomes effective upon adoption by the Wasilla City Council.

Introduction: 08/13/90


Public Hearing: 08/27/90

ADOPTED by the Council of the City of Wasilla on this 10th day of September, 1990.

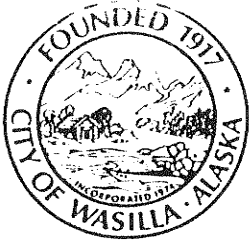


JOHN C. STEIN, Mayor

ATTEST:



ERLING P. NELSON, CMC
City Clerk



CITY OF WASILLA

290 E. HERNING AVE.
WASILLA, ALASKA 99687
PHONE: (907) 373-9050
FAX: (907) 373-0788

August 8, 1990

Alaska Department of Environmental Conservation
Water Quality Management Section
P. O. Box 0
Juneau, Alaska 99811-1800

Attention: Mr. George Franklet

Re: Local Water Quality Planning Grant

Dear Mr. Franklet:

Forwarded herewith is the project description for determining the Lake Lucille Water Budget. The data that we expect to acquire through the planning grant funds is necessary to future work that will address lake restoration under Section 314 of the Clean Water Act as amended by the Water Quality Act of 1987.

The City of Wasilla will be the prime contractor for the project and the City's contract engineering firm, Gilfilian Engineering, Inc., will be the sub-contractor and perform the actual data collection. The City of Wasilla will contribute 50% of the total project costs (\$19,200) and respectfully requests that project grant funds in a matching amount of \$9,600 be awarded.

Sincerely,

John C. Stein
Mayor, City of Wasilla

JCS/sbh

GRANT PROPOSAL
FOR
LOCAL WATER QUALITY PLANNING
RFGP #2

A Proposal Submitted to the
Alaska Department Environmental Conservation
Division of Environmental Quality
Water Quality Management Section

August 8, 1990

PROJECT DESCRIPTION

PROJECT NAME: Lake Lucille Water Budget
City of Wasilla, Alaska

PROJECT OBJECTIVE:

Determine the water budget for Lake Lucille by measuring the water flow into and out of the lake. The water budget includes measurements of the surface and groundwater inputs and changes in lake level.

The water budget of Lake Lucille is currently unknown, and is essential for determining the annual nutrient, organic matter, and sediment loads to the lake and establishing the assimilation capacity of the lake.

In order to make sound recommendations for restoring or improving the lake's water quality, the water budget of the lake must be determined with a reasonable degree of accuracy. Water inflow to the lake is from ground water, and no defined stream enters the lake. However, an undetermined amount of inflow results from the discharge of partially treated storm water at two (2) locations on the lake that are connected to the Parks Highway drainage system. The lake is drained by Lucille Creek located on the western end of the lake. Water outflows by ground water at the west end of the lake may be a significant factor. The water budget should provide a means to evaluate the significance of the outflow and inflow sources.

PROJECT BACKGROUND:

Lake Lucille is a 146.3 hectometers urban lake located in the City of Wasilla. In June, 1989 the City of Wasilla received a grant under ADEC's Local Water Quality Planning Program (RFGP #1) for the purpose of conducting a one year water quality study of Lake Lucille. The final report on the findings of the study has been completed and is being made available for distribution.

As found in earlier studies, the 1989-90 water quality study noted the lake continues to be adversely affected by nuisance growths of submerged aquatic plants and severe depletion of dissolved oxygen during the ice covered winter months. These water quality problems have persisted over the years and appears not to have improved as a result of the elimination of on-site septic tank systems on the lots surrounding the lake, by connection to a municipal STEP sewer system.

However, storm water from the major drainage systems serving the Parks Highway has continued to discharge to the lake at two locations along the northern shoreline. The environmental impact on the lake resulting from the storm water discharges may be significant with respect to the lake's total inflow. Determining the lake's water budget should provide a means to evaluate this source of inflow with respect to groundwater inflow.

PROJECT TASKS AND OUTPUTS:

The water budget will be determined by measuring the water flow into and out of the lake by the following methods:

- A stilling well will be installed with a continuous water level recording device located near the outlet of the lake. The outlet discharge flow will be measured with a current meter and correlated to the water levels recorded in the stilling well.
- Twelve (12) ground water piezometers will be installed in sets of 2 at strategic locations around the lake. The piezometer will consist of steel cased sand point wells. Each set of 2 piezometers will be placed approximately 100-feet and 200-feet from the edge of the lake at 6 different locations. A benchmark survey will be made to establish vertical control elevations between the wells. The elevations of the ground water will be measured on a monthly basis in relationship to the lake level. The piezometers will be used to define the ground water basin about the lake.
- The City of Wasilla meteorological station located at City Hall will be used to collect precipitation data. This data is continuously recorded and averaged on an hourly basis.

The above water budget components will be measured over a one (1) year period of time. At the conclusion of the 12 months of monitoring work, a final report will be prepared that will summarize the findings and provide a description of the lake's water budget.

It is anticipated the water budget will be used for future work to address lake restoration under Section 314 of the Clean Water Act, as amended by the Water Quality Act of 1987.

PROJECT SCHEDULE:

In lieu of a project flow chart, the following section describes the schedule for completion of project tasks and outputs:

TASK	DATE
Contract Start Date	September 24, 1990 (Per RFP)
Install Piezometers and Stilling Well Recorder	October 1990
Perform Vertical Control Survey And Outlet Discharge Measurements	By October 31, 1990
Collect Monthly Piezometer Elevations, Water Level Measurements from the Stilling Well Recorder and Precipitation Data	November 1990 thru October 1991
Final Report	Completed on or before December 31, 1991

PROJECT BUDGET:

I. Installation of Piezometers and Stilling Well Recorder

A. Personnel

1. Project Manager	2 Mandays @ \$480/MD	\$ 960.00
2. Field Technician	3 Mandays @ \$360/MD	\$1,080.00

B. Equipment and Supplies

1. Piezometers	12 @ \$350/each	\$4,200.00
2. Stilling Well Recorder		\$2,500.00

II. Vertical Control Survey and Stream Flow Measurement

A. Personnel

1. Project Manager	2 Mandays @ \$480/MD	\$ 960.00
2. Field Technician	2 Mandays @ \$360/MD	\$ 720.00

III. Monthly Data Collection (12 Months)

A. Personnel

1. Field Technician	12 Mandays @ \$360/MD	\$4,320.00
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IV. Project Coordination and Final Report Preparation

A. Personnel

1. Principal	2 Mandays @ \$760/MD	\$1,520.00
2. Project Manager	4 Mandays @ \$480/MD	\$1,920.00
3. Technician	2 Mandays @ \$360/MD	\$ 720.00
4. Secretary	1 Manday @ \$200/MD	\$ 200.00

B. Supplies

1. Report Copies and Material		\$ 100.00
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TOTAL PROPOSAL BUDGET

\$19,200.00
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CITY HALL -
Mayor John Stein

RECEIVED

SEP 12 1990

City of Wasilla, Alaska

A Review and Assessment of
Water Quality and Rehabilitation
Techniques for Lake Lucille,
(Wasilla, Alaska)

J.M. Eilers

E&S Environmental Chemistry, Inc.
P.O. Box 609
Corvallis, OR 97339

September 10, 1990

E&S Report 90-13
Through Work Order WO-8912
to Gilfilian Engineering, Inc.

INTRODUCTION

Lake Lucille is a 362 acre lake located in the Matanuska-Susitna Valley adjacent to Wasilla, AK. The lake is a shallow (mean depth = 5 1/2 ft), elongate (1.5 miles long) system oriented parallel with the prevailing northeasterly winds. Nearly all of the lake bottom is covered by macrophyte growth during the open water period, excluding the shallow (< 3 ft) zone impacted by ice formation. The abundant macrophyte growth contributes to considerable oxygen consumption, resulting in virtual elimination of oxygen in the water column during winter. These anaerobic conditions during the winter result in generation of hydrogen sulfide (H₂S) odors that are particularly evident near the lake outlet to Lucille Creek. Several studies have been conducted to assess the water quality in Lake Lucille and to examine possible rehabilitation approaches. The purpose of this report is to review the existing data on Lake Lucille and to recommend a course of action for improving the water quality.

WATER QUALITY AND RELEVANT DATA

Available reports containing data on Lake Lucille were reviewed for this report (Table 1). The data from these studies are generally consistent in reporting the following findings on Lake Lucille:

- low winter-time dissolved oxygen measurements dating back to 1960 (however, anaerobic conditions reported only in last two years)
- low concentrations of phosphorus (probably attributable to rapid utilization by aquatic macrophytes and/or marl formation)
- moderately high values of transparency and low concentrations of chlorophyll (indicating low phytoplankton biomass)
- extensive macrophyte coverage of the lake bottom was comprised largely of Chara, Potamogeton praelongus, P. pectinatus, and Myriophyllum exalbescens.

Table 1. Water quality related studies on Lake Lucille.

Reference	Sampling Dates	Nature of Data	Findings/Notes
Mat-Su Test Lab 1982	October 13, 1982	4 stations, Nutrients	Further study recommended
ADEC 1983	1960-1983	D.O., major and minor chemical parameters	Summarized available data data through 1983
Woods 1985a	Summer 1984	Nutrients, chlorophyll, macrophyte biomass	Harvesting macrophytes will not resolve D.O. depletion
ADEC 1986	September 4-7, 1984	D.O., major and minor chemical parameters	Sampling related to discharge from storm sewers
ADEC 1990	September 1988 May 1989	Metals, Hydrocarbons	Characterization of discharge from storm sewer
Gilfilian Engr. 1990	June 1989- Feb. 1990	6 stations, nutrients, D.O.	Water budget required on Lake Lucille

- the presence of spring discharge into the littoral zone of the lake (particularly along the northeast littoral zone)

Although Lake Lucille would not be considered an eutrophic lake using the traditional parameters of phosphorus, Secchi disk transparency, or chlorophyll (Carlson 1977), the extensive macrophyte growths and dissolved oxygen depletion are indicative of a highly productive lake (Canfield et al. 1983).

It appears to me that the lake historically had relatively little winter-time dissolved oxygen which is typical of other natural, shallow lakes in the area (Woods 1985b). However, the water quality has probably deteriorated as a function of (1) increased delivery of nutrients from sewage and storm water discharge, and (2) artificial maintenance of a stable lake stage. The problem of increased nutrient delivery to the lake has been partially remedied by connecting lake shore homes to a municipal sewer system. However, nutrients will continue to be delivered to the lake from the abandoned septic fields and from the recently installed highway storm drains. The existence of stormwater drainage from the highways is not in the long-term best interest of the lake. By maintaining the lake stage at what is probably an artificially higher level than natural, more of the shallow areas of the lake have become available as habitat for macrophyte beds. Historically, lake levels periodically fluctuated probably occasionally freezing a portion of the macrophytes in the shallow waters. Under present conditions, freezing of the sediments only occurs at depths less than 3 feet.

REVIEW OF TREATMENT OPTIONS

Various alternatives have been proposed or discussed to improve the water quality conditions in Lake Lucille including macrophyte harvesting (Woods 1985a), winter drawdown coupled with dredging (Woods 1985a), herbicide treatment of aquatic macrophytes, and hypolimnetic aeration. Macrophyte harvesting was evaluated by Woods (1985a) who concluded that internal phosphorus

cycling would be sufficient to maintain high levels of productivity. I agree with Woods that macrophyte harvesting alone will probably not be sufficient to result in an adequate improvement in the lake. Treatment of the lake with herbicides will yield immediate results, but will require annual applications and may exacerbate the depletion of dissolved oxygen by providing abundant material for decay during the winter. Hypolimnetic aeration is totally inappropriate for Lake Lucille; only a small percentage of the lake bottom is in the hypolimnion and the epilimnion also becomes anaerobic.

One of the most promising alternatives for treating Lake Lucille is to use the winter drawdown technique. This consists of artificially lowering the lake level to some predetermined level in the fall and maintaining the low level until the following spring. This exposes the shallow areas of the lake to freezing temperatures which kills the aquatic macrophytes. The aquatic macrophytes will eventually regrow; however, the drawdown technique can be repeated whenever needed.

Winter drawdown is relatively inexpensive, doesn't require the use of chemicals, and can be repeated when desired. The temporary eradication of the macrophytes in the littoral (shallow) zone means that there is less biomass available to decompose in the winter. With less material decaying, there should be more oxygen available in the water column. Formation of hydrogen sulfide should be prevented, so long as the dissolved oxygen concentrations are maintained above 1 or 2 mg/L. A potential negative affect of eliminating some of the macrophytes is that more phosphorus may be available for growth of phytoplankton or filamentous algae. The data are insufficient to determine if this would occur. However, if phosphorus concentrations are being controlled by marl formation, excess algae production will not be a problem.

A SUGGESTED APPROACH

My recommendation for improving the water quality in Lake Lucille is to use the winter drawdown technique. This could be accomplished in conjunction with replacement of the existing

outlet control structure to Lucille Creek which apparently is required because of the structure's deteriorating condition. Removal of the outlet structure will cause the lake level to be lowered by about 1 1/2 feet. This would be sufficient to expose about 15% of the existing lake area. To achieve a more complete drawdown will require that a channel be dredged from the lake outlet eastward towards the lake center (Figure 1). The dredged channel would permit a drawdown of about 3 feet which would expose about 25% of the lake area. A deeper drawdown to about 5 or 6 feet below the current lake stage would expose about 50% of the lake area, but would require that a pump be used to move water from the lake basin the Lucille Creek. The replacement outlet control structure should have removable or adjustable gates to allow easy drawdown in future years. If desired, the lake could be deepened in selective areas by dredging.

The winter drawdown technique has worked well in other cold climates (e.g. Wisconsin), but there is some uncertainty if it will work well for the species of plants present in Lake Lucille. The drawdown would also require approval permits from the State of Alaska because of the potential impacts downstream from Lake Lucille. Another major uncertainty is the rate at which Lake Lucille would refill. It is critical that a hydrologic (water) budget be prepared for the lake by accurately measuring the inputs and losses of water to and from the lake.

In terms of obtaining supplemental funds to assist with this project, grant money may be available in 1990/1991 from EPA through the Clean Lakes Program (Sec. 314 funds). The Clean Lakes Program uses a phased approach:

Phase I: diagnostic and feasibility study

designed to evaluate the lake problems and evaluate options for rehabilitation
(30% local or state cost-share requirement)

Phase II: implementation

actual implementation of structural or other lake rehabilitation techniques (50%
local or state cost-share requirements)

LEGEND...

- I STORM WATER OUTFALL
- O SAMPLING LOCATIONS

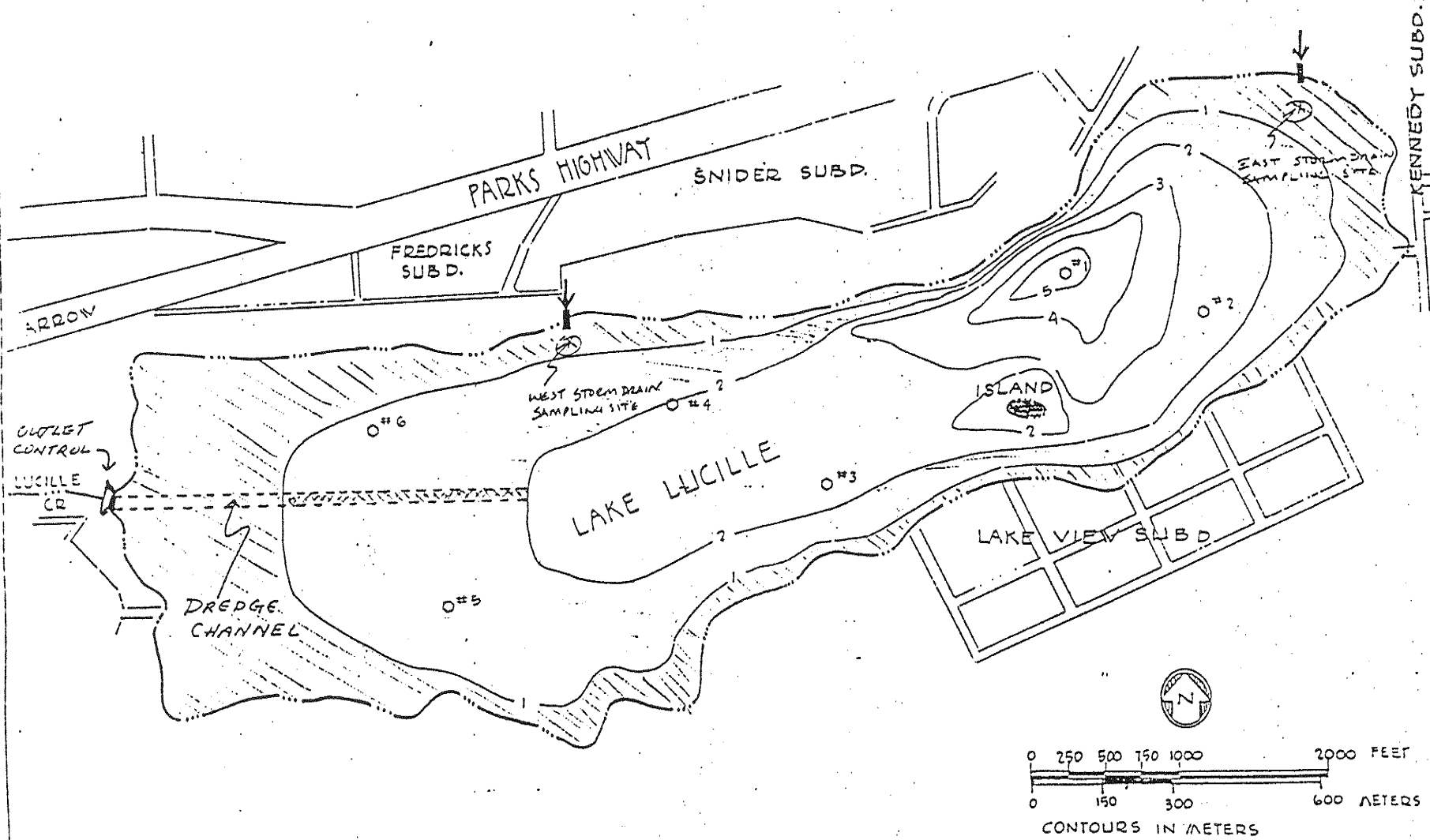


FIGURE 1. LAKE LUCILLE

Galligan Engineering, Inc.
 P.O. Box 871868
 Wasilla, Alaska 99687



Phase III: long-term monitoring

designed to evaluate the effectiveness of the project.

Phase I is required by EPA, although in the case of Lake Lucille, one could apply for an abbreviated diagnostic/feasibility study because of the previous research and monitoring conducted on the lake (based on personal communication with the EPA Region X Clean Lakes Coordinator). It may be possible to apply for funds under Phase I to install a new outlet control structure during which time the lake would only be drawn down only 1 1/2 feet. We could then monitor the lake to determine how effective the technique would be under a more radical drawdown which could be done by dredging the drawdown channel under a Phase II grant. This phased approach would also allow us to measure how quickly the lake would refill under a more radical drawdown.

To achieve funding from EPA, a proposal would need to be prepared this fall. The proposal would be submitted to the State (DEC) which would (hopefully) submit the proposal to EPA - Region X around January. EPA grant funds are typically released in late spring to Clean Lake projects. Meanwhile, it would also be useful if interested citizens would begin forming a lake management district. A lake management district is a legal unit of government that could submit the proposal and contract any work under the restoration program. I will forward information on forming a lake management district to the City of Wasilla.

SUMMARY

Lake Lucille is a naturally productive lake that has water quality problems (low dissolved oxygen in winter) that probably resulted from two activities: (1) increased fertilization from human development, and (2) installation of a fixed stage outlet control structure. I recommend removing the present control structure and replacing it with a structure with removable gates. This will allow a periodic drawdown of the lake in the winter to kill macrophytes in the shallow areas. The extent

of drawdown can be increased by dredging a channel towards the center of the lake or by pumping from the lake to Lucille Creek. Grant funds may be available through EPA's Clean Lakes Program to finance a major portion (50 to 70%) of the lake rehabilitation effort.

LITERATURE CITED

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