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PROPOSAL FOR LAKE ASSESSMENT

TO

PELICAN RIVER WATERSHED DISTRICT

HOGEN

BY

INSTRUMENTAL RESEARCH, INC

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PURPOSE

The visual condition of a lake is the parameter most likely to be the trigger concern by the property owners. By the time this happens, the lake system is usually already carrying an excessive nutrient load and the cost for reducing this load has typically been high.

The approach of Instrumental Research, Inc. is to identify problem areas in the watershed, and approach the solution of these in a manner which is cost effective and where possible, profitable. Work in the lake for the purpose of improving the water quality should be the last phase of a program, since the condition of the lake is a product of its watershed.

There are a large number of lakes in the state of Minnesota where the natural process of eutrophication has progressed to a late trophic stage. This trophic state or condition of rapid aging can be reversed, but the costs for designing and implementing a program are high. The costs for testing and carrying out a reclamation program can be offset in the long run by developing a profit base nutrient reduction program. The reclamation of the lake must be done in the proper sequence.

The first stage in correcting the problem of excessive nutrient loading is to assess the current condition of the lake through physical, chemical, and analytical processes. The data collected is then used to identify the problems and establish the background for corrective solutions. A cost to benefit analysis can be done at the end of this stage. In many cases a profit can be projected from the proper harvesting of the unwanted nutrients.

Instrumental Research, Inc. has four experimental phase programs in place this summer to establish the profitability of harvesting unwanted nutrients from lake watersheds. Three of these are in the form of aquatic cash crops, and the fourth is a new chemical control for phosphorus. All of these are planned to go into full production next year.

The second stage in the program involves the reduction of the nutrient loading from the watershed. In most cases the heaviest nutrient load is found in the surface runoff and the majority can be reclaimed at this point. The goal in this phase should be to reduce the available surface water nutrient load at the highest loading points to offset the uncontrollable loading from dispersed sources. This reduction should involve the implementation of one or more

nutrient reduction systems to bring the total loading to a mesotrophic or midrange level. Currently available methods involve sedimentation through the use of stormwater holding ponds. This is a partial solution to the problem, but does not address the soluablized nutrients in the runoff water.

The sediments in a eutrophic lake will continue to recycle their nutrients to the free water for a long time after the watershed loading has been reduced. The period of reclaimation is then determined by the flushing rate of the lake by the watershed. This time period is measured in years, and for a landlocked lake can be a very long. Where the hydrology and topography of the area adjacent to the lake are conducive to design, this process can be accelerated considerably. This can be accomplished by removing the recycling nutrients from the hypolemnitic water, the volume beneath the thermocline, and returning the water to the lake. This then constitutes the third phase in the program.

DATA COLLECTION

Field Collected

1. Secchi Disc Readings: used to compare the field visit data to that collected by residents throughout the summer months.

2. Temperature Profiles: for the determination of the thermocline position and thus the volume of the hypolimnion in the lake.
3. Conductivity at the surface, thermocline, and bottom: to determine the nutrient cycling through the season.
4. Dissolved Oxygen Profiles: to determine the biological oxygen demand through the season.

Laboratory Analysis

1. Chlorophyll-a at two meters, the thermocline, and the bottom: establish the photosynthetic biomass of the lake.
2. Algae determination and cell count at two meters, the thermocline, and the bottom: to correlate the biomass to chlorophyll-a.
3. Total Suspended Solids at two meter, thermocline, and the bottom: includes bacterial biomass as well as the algae in suspension.
4. Total Kjeldahl Nitrogen at two meters and the bottom: gives organic nitrogen concentrations by subtracting ammonia.
5. Nitrate at two meters and the bottom: establish NO3 nitrogen concentrations.

6. Nitrite at two meters and the bottom: establish NO_2 nitrogen concentrations.
7. Ammonia at two meters and the bottom: establish NH_3 nitrogen levels.
8. Total Phosphorus at two meters and the bottom: determine the phosphorus load in the lake through the summer.
9. Ortho Phosphorus at two meters and the bottom: establish the levels of available phosphorus for biomass production.
10. Total Alkalinity: establish the carbonate and bicarbonate alkalinities for each lake.
11. EDTA Hardness: establish the calcium and magnesium levels in the lakes.

The water sample volume collected must be sufficient to allow all tests to be done from the same container to reduce the possibility of sampling errors. A four liter sample from each station and position will be required to cover all of the tests.

Water quality studies completed in past years have addressed the condition of the waters coming into the lakes from the watershed. The primary concern was for discharge to the lakes facilitated through an input-output study. Very little emphasis has been placed on the condition of the lakes. The lake sampling carried out for these studies excluded the test for chlorophyll-a, which is an important parameter in the lake data analysis. The extrapolation of the chlorophyll-a to zero establishes the natural background turbidity in each lake and will allow future sampling to be restricted to phosphorus, nitrogen, and secchi disc readings. These parameters can then be fitted to the curves established for this season for the purpose of monitoring future changes in the lakes.

For these reasons the testing proposed for this summer program will require all the listed parameters to facilitate the calibration of the system.

The lake sampling dates should be the end of May, early July, mid August, and the end of September. Four sampling times are needed to establish the zero chlorophyll-a levels for each lake. This parameter eliminates much of the data scatter in the least squares fits and allows a direct plot of chlorophyll-a (biomass estimation) over time.

The use of four sampling periods will require the assistance of residents on each of the lakes in the watershed. The secchi disc readings are to be used to follow the rates of algal biomass growth and reduction through the season. These secchi disc readings will need to be taken on each lake at two day intervals throughout the season. Readings need to be taken between 10 AM and 3 PM on the day chosen beginning in May and continuing through October, or November if possible. Without the secchi disc readings from each lake tested, there will not be sufficient data on the lakes to do an analysis. This is an important part of the program.

During the second year, the lakes in the watershed should be core sampled to determine the changes in the makeup and rate of current sedimentation in the lake systems. Instrumental Research, Inc. has designed a four foot piston core sampler

for the specific purpose of collecting lake sediment cores. The collected cores would be dated and analyzed for nutrient concentrations at selected stages. This data gives the rate of aging and sedimentation of each of the lakes in the watershed district. The best time of the year for collecting the cores is in the winter, as the ice gives a stable platform from which to work.

The analysis work on each core will probably be done at thirteen positions in the core with five of these to be taken from fifty years ago to present. The parameters tested will be:

total solids to determine the density of the sediment,

chemical oxygen demand to determine the carbon content,

total phosphorus,

total kjeldahl nitrogen.

The dating process will be done on the entire core using a chemical analysis since the stratigraphy of these sediments is seldom obvious.

For the purpose of facilitating the data collection during the summer months, we would greatly appreciate the use of privately owned watercraft on each of the lakes. Where this is not possible we will use a canoe for sample collection.

The stream sampling should be done at least two times this summer. Once for a normal flow condition and again for a one-half inch rain. Twelve sampling bottles and the retaining straps will be supplied by Instrumental Research, Inc. at a cost of $138.00.

The Detroit Lakes Wastewater Lab samples are to be total suspended solids, ortho phosphorus, and total phosphorus. We have deleted the 5 day BOD, the nonfilterable total kjeldahl nitrogen, the nonfilterable total phosphorus, the sulfate, and sulfide from the lake testing regimen. These were deleted but may be needed in the event that any of the lakes under test prove to be very eutrophic during the season.

Test	May	July	August	September
TSS	6.	14.	14.	14.
Ortho[PO4]	6.	10.	10.	10.
Total[PO4]	6.	10.	10.	10.

COSTS PER LAKE FOR WATER SAMPLING

Sampling Period	May	July
Lake Sallie	$173.91	$343.02
Big Detroit Lake	$173.91	$343.02
Little Detroit Lake	$173.91	$173.91
Big Floyd Lake	$173.91	$173.91
Little Floyd Lake	$173.91	$343.02
Lake Melissa	$173.91	$343.02
Sub Total	$1,043.46	$1,719.90
Sampling Period	August	September
Lake Sallie	$343.02	$343.02
Big Detroit Lake	$343.02	$343.02
Little Detroit Lake	$173.91	$173.91
Big Floyd Lake	$173.91	$173.91
Little Floyd Lake	$343.02	$343.02
Lake Melissa	$343.02	$343.02
Subtotal	$1,719.90	$1,719.90
Total Data collection and water chemistry		$6,203.16
Mileage @ $0.30/mile		$828.00
Accommodations 2 nights/trip		$476.00
Salaries for 2 persons		$5,454.00
Secchi Discs 12 ea		$283.48
Data Analysis and Report		$2,400.00
Total		$15,361.16

COSTS FOR CORE SAMPLING

Based on Six Lakes

Item	Price/core	Price/6 cores
Sub coring	$320.00	$1,920.00
Dating	$457.14	$2,742.84
Percent solids	$91.00	$546.00
Chemical oxygen demand	$292.50	$1,755.00
Total kjeldahl nitrogen	$377.00	$2,262.00
Total phosphorus	$136.50	$819.00
Sub total	$1,674.14	$10,044.84
Mileage		$148.50
Accommodations		$136.00
Salaries (2 persons)		$1,440.00
Report		$1,600.00
Total		$13,369.34

	All Chem by I.R.,Inc.	TSS, o(PO4), t(PO4) by D.L. Chem Lab
Lake Sampling	$15,361.16	$14,558.48
Core Sampling	$13,369.34	$13,369.34
Total	$28,730.50	$27,927.82

TESTING PRICES

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Algae determinations and population counts	$30.91
Chlorophyll-a	$12.00
Total Suspended Solids	$7.31
Total Solids (suspended and soluable)	$6.77
Biological Oxygen Demand (5 day BOD)	$18.10
Chemical Oxygen Demand (COD)	$22.50
Dissolved Oxygen (fresh samples)	$2.20
(fixed samples)	$7.85
pH	$2.00
Total Coliform Bacteria	$13.20
Fecal Coliform Bacteria	$13.20
Fecal Strep Bacteria	$13.20
Oil & Grease	$10.00
Phenol	$22.00
Conductivity	$7.34
Total Alkalinity	$7.15
Total Acidity	$7.15
EDTA Hardness	$7.87
Ammonia	$8.13
Chloride	$6.75
Nitrate	$7.44
Nitrite	$6.00

Nitrogen- total kjeldahl	$29.00
Nitrogen- kjeldahl, non filterable	$31.20
Phosphorus- ortho	$7.60
Phosphorus- non filterable	$9.60
Phosphorus- total	$10.50
Sulfate	$5.90
Sulfide	$6.15
Sulfite	$6.80
Arsenic	$9.85
Calcium	$7.15
Iron	$11.00
Magnesium	$11.00
Mercury	$33.00
Potassium	$15.00
Zinc	$27.50