H. T. Butler,
R.P.O.
Fish and Wildlife Branch,
1600 - 3rd Avenue,
PRINCE GEORGE, B.C.

G. A. Smythe,
Conservation Officer,
Fish and Wildlife Branch,
4506 Lakelse Ave.,
TERRACE, B.C.

February 12, 1969. 42-021

FISHERIES:

CUTTHROAT FISHERY - LAKELSE RIVER - 1968

LAKELSE RIVER: Some parallels can be drawn from the information gathered over the past four years to the paper written by Bilton & Shepard, covering the cutthroat trout fishery on the Lakelse Lakerand River from 1950 to 1954.

They hold that there are two definite groups of cutthroat in Lakelse. One is the stream spawner who moves into the small creeks feeding the Lake. The other group is that portion of the fish that move down the outlet stream, the Lakelse River, to spawn. I agree with this movement of spawning fish except for the fact that they specify eight streams are used by group one. There are beside these main streams several small spring fed tributaries that act as spawning streams. Very little angling pressure is exerted on these streams during March, April and May.

Group 2, the River fish, are fished quite extensively during the same period March, April, and May. The heaviest fishing occurred in the section from Herman Creek to the Kitimat railway bridge. During this period 70% of the anglers use fly fishing tackle. The remainder are split between bait and spinning. It is interesting to note that there is so much fly fishing done in a region where heavier gear is highly predominate. It is also interesting to note that 90% of the total fish are taken by flies of the minnow immitation type. From creel checks it has been noted that very few sexually mature fish have shown up. This is contrary to the Bilton and Shepard report. The majority of fish have been in the 8 to 12 inch class with a high predominance of 9 and 10 inch fish. Age classifications were not made. One in five creeled trout were Dolly Varden.

During this three month period taking casual creel census figures plus visual estimates, it is estimated that there is an average of 700 hours fished per month for the period March to June. Heaviest pressure being placed on during late April and early May. In June the fishing on the river dwindles. There is little doubt that this is due to the end of the movement of fry and the increase in insect activity on the Lake.

During the period from May 24th through June, the fishery moves to the weed-beds on the west side of the Lake. Trolling becomes to equal terms with flies and as June progresses and July comes, trolling with spinner and worm becomes the chief means of fishing. During the remainder of the season bait fishing at stream mouths takes over the position formerly held by the fly fisherman. Strong hatches of May flies during May and June appear to be the reason for the concentration of fish in the weedy sections of the Lake.

Most of the persons who fish this area are locals, and one tends to meet the same people day after day. Weather has a strong effect on pressure. 1968 proved to

continued.....

H. T. Butler,
R.P.O.,
Prince George, B.C.

continued.....

be very wet and I would estimate less than 400 hours were put in on the Lake last year.

One point not covered by Bilton and Shepard is the ice fishing that takes place in February. Fishing is done pretty well all over the Lake with the heaviest pressures being put on the River exit area, and the entrance of Clearwater Creek. The catch consists of a very high percentage of ripe fish. At present we have such a small number of people using this method that there is little or no problem. We must be sure to keep an eye on this fishery however, as it could affect the balance of the Lake if too many spawners are removed.

Before leaving this system, it should be noted that there is a good secondary fishery in the March, April, May period for Rocky Mountain whitefish. Whitefish are in the upper reaches of the River all during the fry movement period. They are often caught and killed by people who think them to be coarse fish, i.e. Peamouth Chub. It should also be noted that excellent fishing for both trout, Dolly Varden, Cutthroat, may be had throughout the length of the River during the fry movement period. There is very little angling done for these fish in the centre section of the River at any time of the year. Bait fishing takes a fairly heavy, but numerically undetermined, number of fish in the lower mile of the River during June, July, August. These fish are usually caught by people after salmon.

G. A. Smythe,
Conservation Officer.

GAS:kj

cc: M. Pinsent,
Prince George.
G. D. Taylor,
Victoria.

File in Lakelse Lk. & survey file

Environment Canada / Environnement Canada

Fisheries and Marine / Pêches et sciences de la mer

T.P.C. MEETING

RECEIVED
MAY 6 1974
REGIONAL DISTRICT OF KITIMAT-STIKINE

JUN 7 1974
SMITHERS
FISH & WILDLIFE BRANCH

PLEASE READ AND INITIAL

1			7		MKW
2			8		DB
3			9		
4			10		
5			11		
6			12		

May 1, 1974

Your file / Votre référence

Our file / Notre référence
31-2-L2

Mr. John Pousette,
Administrator-Treasurer,
Regional District of Kitimat-Stikine,
12-4644 Lazelle Avenue,
Terrace, B.C.

Dear Mr. Pousette:

Attached for your information is a copy of a report on the Lakelse Lake studies which were conducted over the last year.

The report warrants some comment pertinent to the question of enrichment of Lakelse Lake and the need for controlling that enrichment. Several things are obvious from our limited efforts. It is clear that nutrient input from the streams flowing into the lake is very low as is the input from permanent and seasonal residences and businesses. By comparison, the nutrient loading attributable to the huge number of people using the lake in the summer months for recreational purposes is enormous. It is also possible to conclude that the only reason the lake has not become eutrophic is that, because of its shallowness, it is subject to constant flushing.

Mr. Bill Sinclair in his study of Lakelse Lake has predicted that recreational usage will double in the next six years. In my estimation, the amount of sewage produced by this number of people will destroy the lake in both a fish producing and a recreational sense if that sewage is handled in the same manner as at present. This reality should be recognized and steps taken almost immediately to gain control of the domestic wastes being released into the lake. There are very few alternatives open, I believe, for handling the problem whose solution lies in the control of nutrient releases. Tertiary treatment is the only known method for removing nutrients from domestic sewage, but tertiary treatment facilities require stable influent flows. The domestic sewage releases here are seasonal and flows are without doubt not constant.

.../2

1090 West Pender Street
Vancouver 1, B.C.

1090 rue West Pender
Vancouver 1, (C.-B.)

The only alternatives available involve the diversion of sewage away from the lake. This could be accomplished by pumping the sewage into the nearest large river following partial treatment or collecting the sewage in holding tanks and trucking it to the nearest large treatment plant. A prerequisite for both alternatives is controlled access for picknicking and camping so that domestic waste sources would be concentrated.

Should you have any questions concerning this report and our interpretation of the implications, I will be only too pleased to discuss them with you when I come to Terrace on May 8, 1974.

Yours very truly,

W.J. Schouwenburg, Chief,
Habitat Protection Unit,
Northern Operations Branch.

Encl.

Environment Canada Environment Canada

MEMORANDUM NOTE DE SERVICE

DATE April 10, 1974

FROM: R. A. McIndoe,
Technician.
DE: W. Knapp,
Technician.

Our file Notre référence
31-2-L2

TO: W. Sinclair,
À: Chief,
Economics and Sociology Unit.

Your file Votre référence

SUBJECT: Re: Lakelse Lake Trophic Level.
SUJET:

Dear Bill:

Please find enclosed our final submission on the water quality nutrient study. Since the data is incomplete, we have decided to report it in memo form. We trust it will be sufficient in order for you to complete your socio-economic survey of the area.

R. A. McIndoe,
Technician,
Habitat Protection Unit,
Northern Operations Branch. and

W. Knapp,
Technician,
Habitat Protection Unit,
Northern Operations Branch.

cc: W. J. Schouwenburg
T. R. Cleugh

F-2013 (REV. 6/72)

INTRODUCTION

An investigation of the limnology of Lakelse Lake, in the Skeena River drainages basin, was undertaken by the Fisheries & Marine Service (Habitat Protection Unit of Northern Operations Branch) during 1972 - 73 to deduce and document the possible degree of eutrophication.(1) Limnology, for the purpose of this investigation, was considered in the broadest terms to include nutrient studies as related to lake primary production, lake morphometry, and temperature regime only as it was not financially possible to investigate the total chemical and physical limnology. The form this memo will take is to examine the (1) lake morphometry, (2) Fishery, (3) Nutrients, (4) temperatures, (5) pollution, (6) logging and ending with a brief discussion of the (7) lake trophic level.

1. LAKE MORPHOMETY

Morphometric parameters are of fundamental importance in all aquatic situations. They influence the productivity of the lake and are basic parameters of all limnological problems. The depth contours (1949) are plotted on the outline map figure II. Mean and maximum depth are 7.9 m. and 31 m. respectively. The lake has an area of 14.17 sq. km. and a volume of 108×10^6 cubic meters.

The maximum length and width are 8.7 km. and 2.4 km. respectively. Shoreline development (relation of shore length to the circumference of a circle equal in area to that of the lake) is not great at 1.83. The flushing period, or that time required for an amount of water equal to the lake volume to pass through its outlet, is a significant limnological parameter in this study. The exchange rate is computed at:

$$\frac{\text{Lake volume}}{\text{Flow}} = \frac{87{,}555 \text{ Acre feet}}{554{,}800 \text{ Acre feet/yr.}} = 0.157 \text{ yrs. or } 58 \text{ days}$$

(1) The eutrophication of waters means their enrichment in nutrients and the ensuing deterioration of their quality due to the luxuriant growth of plants with its total effect on the overall metabolism of the waters involved. Euthrophic is very rich in nutrients, oligotrophic is very sparce in nutrients, mesotrophic is mid point between eutrophic and oligotrphic.

Continued . . . ./2

2. FISHERY

Five salmonid species utilize the Lakelse River Watershed to some extent. The ten year average adult escapement (1961 - 70 inclusive) is as follows: Pinks - 625,000; Coho - 30,000; Sockeye - 13,600. Chinook and chum data is incomplete but each average escapement would be in the order of 100 - 300 fish. The bulk of the sockeye escapement spawn in Schulbuckhand, Williams, and Sockeye Creeks. Hatchery Creek was an important tributary (in the past) but through flood control modifications, now has very limited numbers of fish in the creek. Evidence of beach spawning on Lakelse Lake itself has not been observed at any time. Other small streams on the watershed are minimal in importance as spawning grounds.

3. NUTRIENTS

Nutrient sampling was carried out twice during September and November 1972 and seven times from March to October 1973. Lake and stream water samples were collected from 23 stations, (see Figure 1). The number of samples taken per station varied with the depth at each site. At inshore shallow stations only one surface sample was taken, at intermediate depths surface and bottom samples were taken, and at the lake's deepest station (STATION 5, 30 meters) six samples were taken. One litre water samples were collected with a Nansen bottle, preserved with 5 ml/l. of chloroform and frozen or immediately frozen, and sent to the Cypress Creek Laboratory in Vancouver for analysis.. The nutrients measured were ammonia, nitrate-nitrate, and phosphates. Analytical results are recorded in Appendix I.

The period of highest average lake nitrate-nitrate concentration was on June 5, 1973 at 0.029 mg/l per sample. The period of highest nitrogen input from the Hot Springs Canal was on September 3, 1973, with a high of 0.76 mg/l, low of 0.09 mg/l, and an average of 0.45 mg/l for all four Hot Spring sample stations.

The period of highest average lake concentrations of phosphorus was on September 3, 1973 at 0.056 mg/l per sample. The highest input from the Hot Springs Canal was on August 13, 1973, with a high of 0.50 mg/l, a low of 0.03 mg/l and an average of 0.30 mg/l per sample site. Concentration levels at the Williams Creek outlets also were relatively higher on September 3, 1973.

Continued . . . ./3

Collections of nitrogen as ammonia were analyzed on a complete sample circuit twice, in August and September 1973. The period of highest average lake concentrations of ammonia was August 13, 1973, at 0.044 mg/l. The Hot Springs Canal also was highest during this period with a high of 2.200 mg/l, a low of 0.080 mg/l, and an average of 1.455 mg/l throughout the canal.

4. TEMPERATURES

Detailed temperature profiles from each visit are presented in Appendix II. Maps of vertical temperature gradients are shown in Figure III. Lake temperatures were taken at three sample sites (1, 4 and 5) using a telethermometer and recorded at every meter. The lake was generally isothermal during the sampling periods. Maximum observed stratification was 5°C on August 13, 1973. The lack of well defined stratification in Lakelse Lake is probably due to the shallow depth and the strong southwesterly winds.

5. POLLUTION

Pollution from the various residential and tourist components are unknown at this time. When proper sewage system design and installations are adhered to, adverse effects on water quality should be minimal. Some design criteria of the recent past are in need of major revision. Control parameters such as, area drainage size, loading concentration, soil permeability and slop have not been fully considered. With facilities situated in such close proximity to the lake shore some form of rigid inspection should be undertaken. The use of dyes flushed down toilets could aid in indicating any possible leakage of the present facilities now in use. Public education of the effects of phosphate soaps, fertilizers, etc., on their local environment should be undertaken.

Mention has been made of the remains of a fish counting fence on the upper Lakelse River which has reduced velocities on the river and caused to some degree an impoundment of the lake. Some residents feel that removal of the fence would facilitate a more rapid drainage of the lake resulting in less flooding of their properties. However, such removal could possibly commence a scouring action of the river bed upstream to Lakelse Lake itself, one end result being a quagmire for waterfrontage on the lake.

Continued . . . .

. . . ./4

6. LOGGING

In the past years, extensive logging operations have been undertaken in the Lakelse area. Immediately after such forest harvesting certain factors can result. The decay of slash materials may increase nutrient loads to a certain degree. As the lake is in a partial west coastal climatic zone of heavy precipitation, deforestation may result in temperature increases in the stream during periods of low summer flow and freezing of spawning grounds during the winter. The loss of cover can adversely affect timing and quantity of the watershed runoff to the lake, increasing erosion and thereby inducing stream turbidity and sedimentation. The snowpack itself may melt at an accelerated rate when the forest canopy is removed, increasing the chances of uncontrolled spring runoff flows and a loss of watershed storage for later months.

The annual rate of cut of the Lakelse Lake watershed is presently reduced from previous years. This decrease in deforestation will lessen the nitrogen nutrient input into Lakelse Lake and help to decrease the trophic level of the lake.

7. TROPHIC LEVEL

Nutrient loading into Lakelse Lake could only be measured at two sources, the inflowing streams and the hot springs canal. Nutrient leaching from the shoreline could not be estimated. Nutrient loading from the streams is computed at 0.019 grams of phosphorus per square meter of lake. The hot springs canal loading is computed at 0.02 grams of phosphorus per square meter of lake, which is as much as all the streams combined. However, these figures are based on the entire summer. According to the Environment Directorate (1971) loading should be computed for spring nutrient imput when nutrient loading should be at a peak. If we considered only spring values the nutrient imput would be much lower indicating, therefore, that the peak nutrient imput comes during the summer.

The nutrient imput of the streams (0.019 gms. P/m^2) indicates low enrichment from the watershed as a result of deforestation and natural soil leaching. If only spring values are considered, the nutrient imput is only slightly higher at 0.022 gms. P/m^2. Phosphorus imput at this level (0.019 -

Continued . . . .

. . . ./5

0.022 gms. P/m^2) would likely produce an oligotrophic lake.

The Lakelse Lake hot springs canal had the greatest detected nutrient imput during the sampling period. The nutrient imput into the lake from the canal increased during mid-summer, when the greatest recreational use of the area occurs.

The combined total loading of the streams and the hot springs is 0.039 grams of phosphorus per square meter, which is also a low enrichment level. Therefore the majority of nutrient imput must come from another source. The only other reasonable source is from shoreline leaching. Estimates of the amount of imput from this source is impossible to measure due to the constant mixing in the lake and the rapid exchange rate. If it were not for these two factors the trophic level of the lake would be much higher, possibly eutrophic.

The source of nutrients from the shoreline appears to increase in mid-summer in conjunction with the influx of recreational activities. Estimates (from W. Sinclair) of the human population at Lakelse Lake are 43 permanent residences and 100 seasonal residences (each with an average of 4 people), 176,220 overnight visitors, and 243,710 day visitors. Estimating phosphorus imput for only the overnight visits at 10 ppm. total phosphorus and 25 gallons of water per person per day would equal a total summer loading of 2.2×10^3 Kgms. If the total nutrient imput from all the above sources are estimated the total impact on the trophic level of the lake can be appreciated. The problem would be compounded if the lake did not totally exchange its entire water mass 1 2/3 times during this period.

8. CONCLUSION

Lakelse Lake is a relatively small, warm water lake. It is utilized by substantial numbers of all five salmonid species, and since it is the only warm water lake in the area, has a relatively large recreation potential.

Current evidence does not indicate the exact source of nutrient loading, but shows that the streams have a low nutrient imput and that the hot springs canal has a summer loading greater than all the streams combined. However, these two sources still do not have a substantial nutrient imput,

Continued . . . ./6

therefore a third source (shoreline leaching) must be considered. Extrapolating the human population and nutrient imput indicates that an appreciable amount of nutrients could come from this source.

In conclusion, although absolute evidence is not present, the recreational activities on the lake or lake shore must be considered as having the major influence on the lake trophic level. If the water exchange rate were less it is very likely that the lake would have a luxuriant growth of plants with its repercussions on the lake metabolism. Therefore unless some adequate measures are taken to regulate present development, the trophic level will increase and eventually cause severe eutrophication within the lake.

Province of British Columbia

Ministry of Recreation and Conservation

FISH AND WILDLIFE BRANCH

MEMORANDUM

To: Al Edie

Date: June 8, 1980.

RE: Cleugh vs. Ableson

I. DATA

-in comparing the data the only significant difference was in the spring overturn values for total phosphorous

CLEUGH from table 12, p.30 DATE: May 28, 1975			ABLESON from table 8, p.25 May 8, 1974	
Station	TOTAL PHOS.	STATION DESCRIPTION	STATION	TOTAL PHOS. (mg/l)
II	0.044	open water, near Mailbox point	#5	Sfc. 0.007 Bot. 0.007
* III	0.066	open water, deeper, north end of lake...STNS. III & #3 locations correspond closely	#3	Sfc. 0.008 Int. 0.007 Bot. 0.022
		open water off Muller Bay	#2	Sfc. 0.007 Int. 0.008 Bot. 0.009
		open water, mid lake	#4	0.007 all depths
IV	0.044	hot springs outflow	#6	0.007 (NOT AS CLOSE TO OUTFLOW AS CLEUGH'S STN) SEE A7
V	0.017	MO. Skully Cr.	-	

-the above are listed for your convenience, as sample stations with closely corresponding locations....

Comments

-the most striking discrepancy is in the open water stations as listed above....
-- Ablesons bottom value of 0.022 at Stn #3 would indicate that the lake had not yet turned over.....Nitrogen data (p. 24) does not support this idea however....as the N concentations over depth are quite homogeneous..... ABLESON ALSO HAD HIGH (0.031)
[P] BOTTOM READING AT SOUTH END...?
-both authors had high values for Phos. in Nov. & Dec. ← NUTRIENT SETTLING

II. Authors' Interpretations

n.b. SAMPLE SITE LOC. · CLEUGH p.17 FIG. 3 (MAPS) ABLESON p 7 FIG 2

A) Ableson

-bases his conclusions(i.e. that the lake isolig trophic, poor in nutrients etc.) On the classifications of two Authors.....

i) "Sawyer (1945) suggested" (from Ableson p.22)

if total inorganic Phos. > 0.015 mg/1 , algal blooms could be expected.

Ableson contradicts himself here, as the last paragraph on p.22 indicates that Ablesons figures are ≥ this theoretical minimum.....!.....

ii) he also uses Sakamoto's (1966) :

if N:P > 12:1 then Phos. is generally the limiting factor, ie the system is lacking in Phos. (see p26 - Abkson's ratios ~~ARE~~ practically ALL >12)

if N:P < 12:1 phosphorous is less important and other factors are of increased significance...ie, there is lots of phosphorous and something else (I assume Nitrogen) is more significant.....

iii) Uses low values of Chl. a and carbon to justify low trophic status....p 47 and poor amounts of phyto plankton

Comment RE: 0.015 mg/1

i) Ableson obviously contradicts himself here.....his data indicates that P levels are high enough to cause algal blooms, according to Sawyer (1945)

Cleugh uses Vollenweider (1971) which classified levels from 0.01 -0.03 mg/1 Phos. as being indicative of meso eutrophic conditions..... (p. 64)

ii) Re; N:P ratios

First off, Ableson uses the low May turnover values for calculation of these ratios (the ratios are tabularized on p 26)..these ~~WEEK~~ ratios would be much less if we used Cleughs May turnover data for Phos.....

Second,pleade note attached paper by Rhee(1978)

Rhee states that: Natural phytoplankto contains N/P in a ratio of about 15:1 butj that this may vary .....he found the ratio in Scenedesmus sp. to be 30:1.....

iii) RE: chl. A

Cleugh acknowledges low Chl. A but cites Haser and Jones (1949) , and Vollenweider (1961) who indicate that macrophytes can absorb large quantities of nutrients which would impoverish the phytoplankton community.....(p64-65) .....Cleugh states that there has beena rapid expansion inthe macrophyte and benthic communties Ab;eson did not investigate these communities.....

To: Dr. Rick Nordin
Aquatic Studies
Assessment & Planning Division

Date: July 23, 1980

File: 0316533-c-6
d-2

Fr: Ben Kangasniemi
Special Projects Subsection
Aquatic Plant Management Section
Inventory & Engineering Branch

Re: Review of Cleugh et al. (1978) and Ableson (1976)

Nutrients

Cleugh et al. (1978) state (page 38) that "the analysis is based on two lake stations, and complete mixing of the lake waters was assumed". All the other stations were considered as representing the quality of the runoff, and not the lake. However, in the discussion (page 64), only data from Station III is used to assess the trophic status of the lake in general. According to the map on page 17 it appears Stations II and III represent lake quality away from the direct affect of runoff. The following table is based on total P data for all sampling dates from Cleugh et al. (1978).

Station	n	$\bar{x}$ mg/L total P
II	4	0.021
III	7	0.023
overall	11	0.022

Cleugh et al. (1978) state that 0.026 mg/L is the mean total P for Station III (page 64).

Stations 2, 3, 4 and 7 used in the Ableson (1976) study appear to be located away from the influence of runoff according to the map on page 7. The following table is based on Ableson (1976) data for all sampling dates.

Station	n	$\bar{x}$ mg/L total P
2	20*	0.014
3	21	0.013
4	21	0.016
7	14	0.012
overall	76	0.014

* one anomalous value rejected

BKB 2-IX-80

According to the above manipulation of the more extensive Ableson (1976) data, an overall total P of 0.014 mg/L puts Lakelse Lake in the middle of the range proposed by Wetzel (1975) for an oligo-mesotrophic condition.

The conclusion based on total N: total P ratios and theoretical chlorophyll a carried out by Ableson (1976) should be treated with more caution. Based on the low inorganic N values and the moderate total P levels, N may be limiting phytoplankton production.

Macrophytes

The macrophytes documented by Cleugh et al.(1978) can utilize both lake water nutrients and sediment nutrients, and therefore may be either a source or sink of lake nutrients. The documentation of species present and their relative abundance is not detailed enough to estimate the overall impact of the macrophyte community on the nutrient budget of the lake.

Conclusion

The data of both Ableson (1976) and Cleugh et al.(1978) can be interpreted to support the conclusions of Ableson (1976).

Ben Kangasniemi

cc: Dr. P.R. Newroth

Province of British Columbia — Ministry of Environment

MEMORANDUM

To: R. J. Buchanan
Director, Aquatic Studies Branch
Assessment & Planning Division

Date: August 12, 1980

File: 0328526-Gen.

Fr: R. N. Nordin
Assessment & Planning Division
Aquatic Studies Branch

Re: Lakelse Lake

Dennis Abelson of the Waste Management Branch, Prince George made a request 10 July 1980, asking for comments on two reports on Lakelse Lake. The two reports, one done by Abelson (1976), the other done by Cleugh et al. (1978), were felt by Abelson to differ in their interpretation of the tropic status of the lake.

Ben Kangasniemi has made some comments on the two reports (attached) and the following are a summary of my comments on the two reports.

Abelson's main point of contention is the claim in the federal report that the trophic status of Lakelse should be described as eutrophic. Abelson it appears, is justified on this point. All the parameters which the Federal report cite (nitrogen, phytoplankton biomass, zooplankton numbers, water exchange rate) except phosphorus indicate oligotrophy or mesotrophy in trophic status. The phosphorus value which is cited (66µg/L) as being spring overturn value, is poorly chosen and not representative of either spring overturn or a representative value of this period. The value was taken in May and the corresponding ortho phosphorus concentration is less than 5 µg/L, indicating that the phosphorus in that sample was largely suspended, non available material and likely a consequence of freshet inflow. A more representative mean total phosphorus value would be obtained using the March 3, 1975, data which would be 17.5 µg/L (all stations). By most trophic rating schemes (i.e. Wetzel 1975) this would indicate a mesotrophic condition. However, there are a number of problems with using the total phosphorus values especially in the case of Lakelse.

If the ortho phosphorus data from the federal report are examined, it is evident that the biologically available phosphorus is very low. Only 15 of the 45 samples taken had concentrations above the laboratory detection limits (5 µg/L). The mean concentration is likely to be less than 5 µg/L over the sampling period. Clearly this would be difficult to represent as eutrophic status.

To arrive at what might be more reasonable figures for total phosphorus at overturn, data for station 3, May 8, 1974, of Abelsons data, indicates a mean of 12.3 µg/L. Station 3 of Cleugh et al. for March 3, 1975, indicates a value of 20 µg/L and something in between the two probably would be the best approximation of overturn phosphorus. As such, mesotrophy would be indicated. Overall, the federal phosphorus data are higher than the provincial data and this

RJB 2-IX-80

reflects either the difference between years or difference in analytical methods. Certainly the minimum detection limits are different. An indication of these differences are apparent for data collected December 10, 1974, (province) and December 11, 1974 (federal) at equivalent stations (#3). Provincial data for total P (surface is 18 µg/L the federal data is 26 µg/L. The inorganic nitrogen is more divergent, the provincial result being 58 µg/L (surface) and the federal data being 30 µg/L. \ Dennis -- would this seem to justify a need for replicate sampling.

Of some consideration also to trophic status is the role played by aquatic macrophytes. They play a major role in the nutrient cycle, however whether they are sources of nutrients or trap nutrients in the lake is uncertain since no investigation in this regard was done at Lakelse. It is evident however that the concentration of nutrients differs if the open water stations are compared to these stations near or adjacent to weed beds. In the federal report the only phosphorus values above the minimum detection limit for both ortho and total, were at stations II, III and IV (open water stations) whereas all the other stations had concentrations below detection limits. The implication from this is that the macrophytes are sinks of nutrients although this is very speculative on such flimsy evidence.

The weed beds also enter into any consideration of production of the lake. If the macrophytes are included in the productivity of the lake, they would certainly increase the estimation of lake production since the phytoplankton production is so low. Since production is one of the categories which would be used to consider trophic level, the macrophyte production would certainly change the assessment were it included. Certainly the open water by itself appears to be oligo-mesotrophic, the addition of macrophyte production might conceivably change that evaluation of the lake.

Another point from the data is the very low N:P ratios of the lake. This was pointed out by Cleugh et al. and needs emphasizing here. If nitrogen is limiting production (N:P appears to be 5-6: 1) this must be taken into account in any watershed planning consideration.

In summary, it appears that the federal government report made a poor choice in the representative sample for total phosphorus. The value of 66 µg/L should not have been used. It appears from their data set that a value of 17-20 µg/L would be more representative. Abelson's data tends to indicate a lower spring phosphorus concentration (12 µg/L) but all of the other parameters (biological and chemical) from both reports, indicate the open water areas of the lake should be more properly represented as oligo-mesotrophic.

Both reports do not address the question of the role of macrophytes, either in nutrient cycles or more importantly in the overall productivity of the lake.

R. N. Nordin

Attach.

Province of British Columbia
Ministry of Environment
FISH AND WILDLIFE BRANCH

MEMORANDUM

To: Allan Edie
Habitat Biologist
Fish & Wildlife Branch
Smither, British Columbia

Date: September 25, 1980

Site#0341

SC736

Dear Sir:

Further to recent telephone conversation and as a result of questions raised by your office regarding conflicting interpretations of study results on Lakelse Lake. I have enclosed correspondence for Dr. R.J. Buchanan, Director Aquatic Studies Branch, in which his staff reviewed the respective reports on Lakelse Lake.

Understandedly I am somewhat gratified to find that the conclusions advanced in my report, Ableson (1976) have been verified. Clearly the water quality studies done to date indicate a very low level of nutrient enrichment, with correspondingly low levels of primary productivity. As such, the trophic classification of Lakelse Lake is oligo trophic - mesotrophic, and not eutrophic, as had been indicated by the Federal study.

The interpretation of this conclusion should not lead one to project a lack of concern for lakeshore development around the foreshore of Lakelse Lake. On the contrary, although nutrient levels in the lake are presently low and will probably continue to remain so (primarily due to a very high flushing rate), the possibility of localized nutrient enrichment leading to undesireable weed growth in certain areas of the lake, cannot be ignored. Considering the very limited lake recreational potential in the area, as well as the very high fisheries significance of Lakelse Lake, every effort must be made to ensure the preservation of the existing water quality. In taking this position it is imperitive that the government stand is based on correctly interpretated data. Hopefully the enclosed reviews have rectified the confusion which had existed over the reports of Ableson (1976) and Cleugh, et. all (1978).

If there are any further questions, please do not hesitate to contact this office. In the meantime, thank you for drawing this matter to my attention.

Sincerely,

D.H.G. Ableson
Regional Fisheries Biologist
Omineca Peace Region

DHG/dl

cc: T. Roberts
Waste Management Branch
Smithers

Province of British Columbia

Ministry of Environment
ASSESSMENT AND PLANNING DIVISION

MEMORANDUM

To: Mr. D. Ableson
Regional Biologist
Waste Management Branch
Ministry of Environment
1011 Fourth Avenue
Prince George, B.C.
V2L 3H9

Date: September 12, 1980
0328526 - Gen

Re: Review of reports on Lakelse Lake

In response to your request dated 10 July 1980 for a review of your 1976 report and that of Cleugh et al. (1978), I have secured comments from Dr. R. N. Nordin in my Branch and Mr. B. J. Kangasniemi in the Inventory and Engineering Branch. I am forwarding herewith their comments for your information.

I look forward to another opportunity to assist you or others in your Regional office.

R. J. Buchanan, Ph.D.
Director
Aquatic Studies Branch

13)

Province of
British Columbia

Ministry of
Environment

Fish and Wildlife Branch
4825 Keith Avenue
Terrace, B. C. V8G 1K7

638-0212

YOUR FILE Lakeshore Planning

OUR FILE 0359/0859

February 5, 1982.

Al Edie,
Regional Habitat Protection Biologist,
Fish and Wildlife Branch,
Bag 5,000
Smithers, B. C. V0J 2N0

Al:

Re: Lakelse Lakeshore Development Planning

I was at a meeting as per our discussion on the phone this P.M. with Hermann Delyea, Conrad Skaalrud, John Hipp and Randy Nelson regarding the status of Lakelse Lake with respect to development and environmental input.

Brought up at the meeting were the following points.

1. Development pressure on the lake is high currently.
2. Fish and Wildlife and Recreational values are enormous.
3. The carrying capacity of the lake is limited and we don't know what that limit is. It is limited for effluent loading and by inference, human days of useage. It also has an upper limit on location and number of different types of developments to protect Public Access etc.
4. The Fraser Fort George Regional District has developed guidelines to handle such contigencies, we haven't (in sufficient detail).
5. We lack sufficient data to approve further development because of these high values and areas of ignorance.
6. Protection of the billion dollar/century fishery etc. demands that a carrying capacity/development type study be done to provide a rational data based method of arriving at development approvals by those agencies entrusted with the care of this resource. The Fraser Fort George Guidelines might serve as a preliminary model.

To properly address these questions, it was agreed by the participants that Regional District should be approached with these concerns and that the successful solution of these questions was essential to ~~approval of~~ proper input for future developments in the Lakelse Lake Area.

This has been done and Bob Marcellin and Earl Hamilton, both with the Regional District, are to address the matter further at a T.P.C. meeting on the 10th of February.

Yours truly,

Jorman Jyrkkanen,
Habitat Protection Technician.

/2

Water Research Vol. 14, pp. 841 to 852
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0043-1[illegible]0/0701-0841502.00/0

CHANGES IN PHOSPHORUS CONCENTRATIONS DUE TO MIXING BY MOTORBOATS IN SHALLOW LAKES

YOUSEF A. YOUSEF,* WALDRON M. MCLELLON* and HERBERT H. ZEBUTH†

University of Central Florida, Engineering and Industrial Experiment Station, College of Engineering, P.O. Box 25000, Orlando, FL 32816 U.S.A.

(*Received November* 1979)

Abstract—Recreational motorboats equipped with engines varying from 28 to 165 horsepower were operated at three selected Central Florida lakes. Also, a pair of isolation chambers representing aquatic habitats were placed in each lake for control and mixing studies. Mixing in isolation chambers was performed by small electrical motors connected to two blade propellers.

Agitation of the water column in the lake mixing stations and inside the isolation chambers increased water turbidities and phosphorus concentrations. The increase in turbidity and phosphorus content occurred at a much higher rate than the rate of decline after cessation of mixing. The increase in phosphorus content could result in an increase in lake productivity as noticed from the increase of chlorophyll *a* concentrations in lake mixing stations.

INTRODUCTION

Phosphorus has usually been considered the limiting nutrient in most aquatic systems (Fitzgerald, 1970; Syers, 1973, and USEPA, 1976). The amount of phosphorus present in most aquatic organisms has been found to be only a small percentage of their total weight. However, phytoplankton can absorb more than ten times their normal content of phosphorus and store it for future use. Zooplankton and littoral macrophytes also absorb and store orthophosphate directly from the water column. In environments rich in phosphorus, the luxury phosphorus is usually stored in the form of polyphosphates which have been found to comprise up to 20% of the cell dry weight (Hooper, 1973).

The suspended plankton in a water column settle and become part of the sediment. Sediment phosphorus content has been observed to be generally highest near the sediment–water interface and decreasing with depth as illustrated by sediment phosphorus profiles in several Florida lakes (Stewart, 1976). Phosphorus in the sediment is present in both the soluble and insoluble states (Syers *et al.*, 1973; Williams & Mayer, 1972; Williams *et al.*, 1971).

Mixing of the sediments and the overlying water occurs due to natural and man-made processes. Principal processes of natural mixing have been found to result from thermal gradients, wind and pressure waves, mobility of organisms, such as insect larvae and worms, and the formation of gas bubbles and pockets, either methane, carbon dioxide, or oxygen. Man-made mixing results from recreational activities such as boating and artificial mixing of the lake. Mixing of the sediments and the overlying water would have a number of effects on the phosphorus concentrations and forms present in the sediment. Interstitial water, containing up to fifty times the concentration of soluble ortho-PO_4, would be mixed with the overlying water. After resettling, phosphorus contained in lower sediments and interstitial waters could diffuse upward, replacing the supply of orthophosphate lost to the water column. It has been reported that 19–65% of the inorganic phosphorus absorbed by bottom sediments is exchangeable (Li *et al.*, 1973). Continued mixing would increase the rate of phosphate exchanged (Kuo & Lotse, 1974). Also, contact with aerobic lake water would cause some ortho-PO_4 to be lost to the water column with the conversion of ferrous hydroxide associated with sediments to ferric oxyhydroxide and the resultant decrease in its adsorptive capacity. In addition, bacteria on the now aerobic particles would exhibit a rapid uptake of inorganic phosphorus. Soluble organic phosphorus is released from both phytoplankton and bacteria (Lean, 1973; Hays, 1958). The rapid conversion of sediment orthophosphate to organic phosphorus in a water column is supported by Carter *et al.* (1974) studies.

Little work has been done to determine what role, if any, the increased use of outboard motors has played in the increased rate of eutrophication of many lake systems. Casey *et al.* (1974) and Neilson (1974) were interested in the rate of transfer of oxygen from

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Presented to 1979 North American Lake Management Conference, Kellogg Center for Continuing Education, Michigan State University, East Lansing, Michigan, April 16–18, 1979.

* Professors of Engineering, Civil Engineering and Environmental Sciences Department, University of Central Florida, Orlando, Florida.

† Environmental Specialist, Florida Department of Transportation, Deland, Florida.

Province of British Columbia

Ministry of Environment

...sh and Wildlife Branch
1011 Fourth Avenue
Prince George
British Columbia
V2L 3H9
Phone: ~~562-8331 Local 238~~
563-1181

YOUR FILE

OUR FILE 40.8508

1982-02-10

Allison
Letter.

Jorma Jyrkkannen
4825 Keith Avenue
Terrace, British Columbia
V8G IK7

Dear Sir:

Re: Lakeshore Guidelines and Developmental Capacity

Further to your recent telephone inquiry I have taken the liberty of photostating portions of the manual used by the Province of Ontario for assessing lakeshore development. Your attention is respectfully directed towards pages 15-30, where the theory for each step of the management scheme for southern Ontario Lakes is outlined. With specific regard to the calculation of phosphorus leading to the lake, I would stress the following points from Dillon:

1) If a development significantly alters the amount of cleared land in a watershed then an appropriate change in the export value must be made.

2) The total amount of phosphorus supplied to the lake from the land is calculated as the sum of the area of each drainage basin times its phosphorus export co-efficient.

3) A complicating factor arises if any tributaries in the watershed have additional lakes in its course; these lakes will act as nutrient traps, decreasing the actual amount of phosphorus transported from the drainage area to the lake.

../2

I would stress that the detailed Ontario calculations remain untested in B.C.; many of the variables such as the phosphorus export co-efficient, and the phosphorus retention co-efficient for lake sediments are probably different.

I would also stress, as you have realized, the overwhelming significance of the high flushing rate of Lakelse Lake.

Please contact me if I can be of further assistance. I would also suggest R. Nordien of Aquatic Studies in Victoria as a knowledgeable resource person.

Yours truly,

D.H.G. Ableson
Fisheries Biologist
Omineca Peace Region

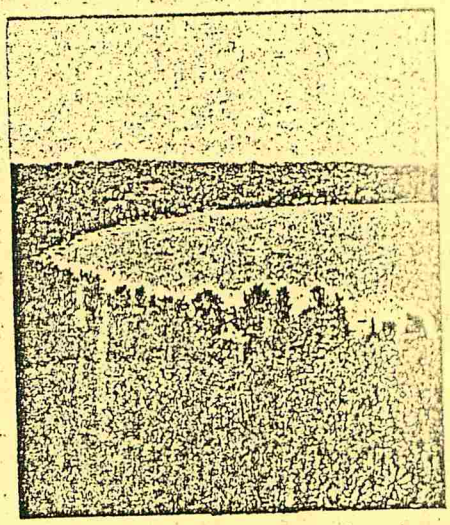
DHA/mh

attachments

Contents

Process Research

Process Design



Cover: At Crystal Lake, Mich., a specially designed survey used a recently developed septic leachate detector, groundwater monitoring, and mathematical models to analyze the performance of shoreline treatment systems. See p. 1717. Photo by William B. Kerfoot.

Province of British Columbia
Ministry of Environment

MEMORANDUM

To: T. Roberts
Regional Manager
Waste Management Branch
Smithers, B.C.

Date: March 9, 1982

File: 50.6003

Re: Additional Studies at Lakelse Lake

Studies of Lakelse Lake by Ableson (1976) and Cleugh (1978) developed a reasonably good first cut evaluation of the trophic status of the lake. The studies were not directed at developing lake capacity guidelines or management prescriptions in order to protect or enhance the very major fisheries and recreational resources in the lake and system.

It has been six years since the lake was studied, during which time there has been some minor recreational development. However, the issue of the new Mailbox point strata title subdivision (27 lots) plus the attempt to resurrect the Hotsprings Hotel, raises new and important questions of lake capacity.

The subdivision is worrisome in several respects. First, will it cause additional nutrient loading to the lake? Second, are there other land owners awaiting the outcome of this proposal before jumping in with their own? Third, is there a habitat loss situation when cottage owners clear their waterfront of weeds for aesthetic purposes. Fourth, is there nutrient enrichment from boat activity in shallow waters (Yousef, et al 1980)?

It is therefore suggested that additional studies get underway which are more management oriented and ask the ultimate carrying capacity question.

Suggested components of the investigations include:

Item	Reason
1. nutrients in groundwater	changes in the watershed will vary natural & anthropogenic loadings of nutrient
2. nutrient in inlet streams	changes in the watershed will vary natural & anthropogenic loadings of nutrient
3. role of rooted macrophytes as a source or sink of nutrients	to evaluate the impact of macrophyte loss as a result of mechanical removal by cottagers

...../2

Freshwater and Sportfish in Lakelse Lake and Tributaries (Cleugh, et. al. 1978)

Steelhead	Summer Run	200
	Winter Run	700

Cutthroat trout
Rainbow trout
Dolly varden char
Squafish
Whitefish
Peamouth chub
Large-scale suckers
Redside shiners
Threespine sticklebacks
Prickly sculpin
River lamprey eels

Habitat Use

Habitat use by the above species is complex with respect to time of year and types being used.

Potential Impacts of Developments Changing Trophic Regimes

Changes in species abundance relative to each other would be the most likely impact. Predatory anadromous fish would show a numerical response to any changes in prey species abundance. This would have implications to the commercial fishery. It might be possible to model the dynamics of the possible changes to project the general direction of the impact, and possibly crudely approximate its magnitude.

Avian predators like Mergansers and Red necked grebes, would also be affected by any changes in the relative abundance of certain prey species.

Cleugh et. al. reports in his abstract that " ...Relative to a 1946 report the benthic community increased threefold per square meter of substrate in a limnetic zone of nearly twice the depth...". Is this finding indicative of a trend towards a higher trophic status? If so, is the trend (a) Continuing? (b) Caused by effluent leachates or other watershed developments? (c) Likely to cause a change in fishery population dynamics of a Socio-economic nature?

J. Jyrkkanen
Habitat Protection Technician
Fish and Wildlife Branch
Terrace.

Province of
British Columbia

Ministry of
Environment

Fish and Wildlife Branch
4825 Keith, Terrace, B.C.
V8G 1K7 ph: 638-0212

YOUR FILE Lakelse Lake
OUR FILE 0959

22 March, 1982

Nancy
Doulton
Jorma

Bob Marcellin
Regional District of Kitimat Stikine
#9-4644 Lazelle Ave.
Terrace, B.C.
V8G 1S6

Bob:

RE: Mailbox Point STP

Total development in the Lakelse Lake system needs some pre-established upper bound to protect fish and fish habitat.

I am not expert enough to determine what criteria could determine that upper bound so I am being asked to comment on a referral outside my area of general knowledge.

Thus, until I receive further direction from my superiors on this complex matter I will have to defer comment. A site inspection with the developer has been tentatively scheduled for this spring and futher clarification of our Branch's position should result.

In short, I suggest putting the Lakelse Lake Mailbox Point Proposal on hold until further Ministry discussions crystalize into firm objectives and policies for their implimentation.

A multi-agency discussion after the site inspection should be fruitful. My Regional Manager has indicated interest in such a meeting. Perhaps the 30th of April, 1300 hours, at the Regional District Office would be a good time, following a morning site inspection.

Would that be acceptable to all?

Yours truly,

JJ
f the reg mgr

CC: AE, RG, JH, BW, BB, HD, Mr. Inselberg-129-9th St.-Prince Rupert, B.C.

For addresses - see over.

Province of British Columbia
Ministry of Environment
Fish and Wildlife Branch
4825 Keith, Terrace, B.C.
V8G 1K7 ph: 638-0212

SC737

23 February, 1982.

YOUR FILE .....

OUR FILE .....

SC737

LAKELSE LAKE DEVELOPMENT CAPACITY

J. JYRKKANEN
HABITAT PROTECTION TECHNICIAN
TERRACE

BACKGROUND

Sinclair (June, 1974) mentions in his summary on the Socioeconomic study of Lakelse Lake that ".....The planning and development of Lakelse Lake must be based on the concept that it has a limited, and identifiable, capacity to accomodate shoreline and water-oriented activities."

Historically, there is a point in the life of developed lakes where pollution, alteration and alienation significantly affect the capability of those lakes to provide quality resource utilization. The sequential changes are often subtle but the net effect is gross.

Pollution isn't just phosphorous. It can be chemical leachates, accidental spills, temperature changes, flow timing alterations, debris influx, changed plant communities or introduction of a predatory species more pollution tolerant. In Canada, the Ontario government recognized that lakes are a finite resource after the collapse of the Great Lakes Fishery, rehabilitation of which may never be complete even with great capital outlay, much to the detriment of all Canadians. They subsequently implimented lake development guidelines to control maximum lake development (MNR Report, March, 1975).

Lakelse Lake and its associated Lakelse River have sufficiently high fisheries values to warrent some form of limiting process to protect these same values. Currently, it has only zoning which is arbitrary and only vaguely based on ecological values. There is no mandatory minimum lot size, established ratio of public access to private waterfront or boat limit.

LAKELSE LAKE CAPACITY

LAKELSE CARRYING CAPACITY ANALYSIS

The Ontario report cites a number of ways to assess the capacity of a lake for development. These methods indirectly consider the effects of total watershed development on water quality and on the ability of the resource to supply certain socioeconomic opportunities. The method is collectively called the 'Lake Alert Study'(Hough, Stansbury and Associates Ltd., 1972). I make a crude application of its methods below.

Boat Limit Method (BLM)

The BLM method recognizes that boats are a reflection of human pressure on a lake. The rule of thumb that is suggested is that there be 3.3 Acres of useable lake surface per motor boat and by inference, per cottage.

Lakelse Lake has 3501.4 Acres of surface area and 250 property owners according to Sinclair in 1974. Assume that (2/3) are useable surface area and additional pressure has added another 50 boats. This yields an A/B ratio of 7.78, still over 2 times as high as the 3.3 A/B limit suggested, possibly indicating an increased capacity for development. This value needs periodic reassessment.

Shoreline Development Method (SDM)

Another check on the safety of the Lake is to compare existing shoreline development with levels suggested to protect total shoreline from intensive development (Regional District of Fraser-Fort George, Lakeshore Guidelines, 1980).

The suggested allowable shoreline development for a lake like Lakelse is 50% (pg.16) with an absolute maximum of 75%. Lakelse currently has 67% in private lands and 27% tied up in Parks. Thus without adding Parks to the shoreline developed, this index is close to the maximum. With Parks, the limit has been exceeded significantly and no additional room exists for development

LAKELSE LAKE CAPACITY

It is of course reasonable to consider Parks as developments. Thus, according to the SDM, 94% is committed and no more development should be allowed. There exists a 19% over-run.

Chlorophyll-a Limiting Method (CLAM)

Maximum permissable chlorophyll-a values for protection of cold water fisheries are in the range $2 \leq$ Chlor-a ≤ 5 (Dillon and Rigler, 1975). However, chlorophyll-a levels are related to phosphorous so this method (CLAM) is not independent of another method described below which uses just a few more parameters.

Actual summer average chlor-a was 2.4 micrograms/L which translates to 2.4 mg/m^{-3}, ex: (microg/L x 10^{3} L/m^{3} x 10^{-3} mg/microg.)= mg/m^{-3}.).

This value is within the maximum permissable level and could even be doubled and still conform. Thus, the CLAM supports more development capacity.

The key question about using this index seems to be...How much additional phosphorous is needed to bring this index over the permissable? It could be computed from a regression curve relating the two variables and this should be done.

Morpheodaphic and Other Parameters Method (MOPM)

This more sophisticated method was developed in Ontario, adapted to suit the Fraser-Fort George Lakeshore Planning Guidelines, but has never been used in British Columbia. The reason, according to Abelson (Abelson, Dennis, 1982, Personal communication), is that the cost of getting parameters is too prohibitive. However, most of the parameters are available for Lakelse Lake since so many studies exist on the system.

LAKELSE LAKE CAPACITY

(1) After selecting 2.06 mg/m^{-3} for a permissable chlorophyll-a concentration, permissable spring phosphorous (2) is computed from P = log ((clor-a + 1.14)/1.45) =.3411. The lake surface area (3) is determined (very crudely) as A_o = 14.2 x 10^6 m^2. (4) Mean depth is Z = 7.9 m. (5) Lake volume V= 1.08 x 10^8 m^3. (6) Total watershed area A_d = 2.447223 x 10^8 m^2. (7) Since A_d is greater than 10 A_o, total outflow volume is computed (8) as Q = 6.7932 x 10^8 m^3/yr. (9) Flush rate is p = Q/V = 6.29 Times /yr while (10) Aerial water load is q_s = 47.84. The retention coefficient (11) is computed from:

$$R = 0.426 (\exp(-0.271 q_s)) + .574 \exp (-0.00949 q_s))= 0.36454.$$

(12) Response time of the lake to an influx of P loading is:

$t_{1/2}$ = 0.69/ (P + 10/Z) = 0.429392. The permissable P loading to the (13) lake or L_{perm} = PZp/(1-R) = 26.7112 mg/m^2/yr. . The permissable P supply (14) to the lake is only J_{perm} =((L_{perm})(A_o))/10^6 = 379.3 kg/yr. (15) The total sypply of P from the land to the lake is the drainage area times the P export coefficient. I chose 10.2 for the export coefficient since it represents igneous bedrock with a forest and farm scenario. Thus, J_E = A_d x k_d = 2496.2 kg/yr.

Even without adding the P from precipitation, the total supply from the land to the lake exceeds the permissable by 6.6 times!

Now, adding the load from precipitation (16) gives J_r = 75(A_o)/ 10^6 = 1065 kg/yr. Thus, the total natural supply to Lakelse Lake is (15) + (16) = 3561.2 kg/yr or 9.4 times the permissable value chosen.

One needs to go no farther to compute the allowable development. There is none according to the computations with the parameters chosen.

But, caution in interpretation is strongly indicated.

LAKELSE LAKE CAPACITY

Why hasn't this high apparant P value manifested itself in the Lake? There are a number of possible reasons including the choice of basic paramters. Sources of elimination of P from the actually observed may be:

a) Interception by beaver ponds with a low P export coefficient in the same.

b) Alpine retention in snow longer through the season.

c) Rapid uptake by aquatic macrophytes and plankton.

d) Strong adhesion to Lakelse Lake subsrtates.

e) A converse low Lakelse Lake retention coefficient.

The preliminary conclusion from MOPM is that the precise mechanism should be elucidated prior to any further development. The reason is that if it is either 'c' or 'd', then there are potentially significant ramifications on the lake's fisheries habitat values. This would come about by the alteration of the proportions of various species of plankton and macrophytes with a resulting effect on the anadromous fish food chain and rearing habitat cover values.

Physical Limiting Factors on Biological Systems (PLFBS)

Aquatic plant species have very special ranges of tolerances to concentrations of various nutrients. Some are intolerant to levels where other species thrive. Change of levels of key limiting nutrients can result in a change to undesirable species. Local pockets of nutrient enrichment may produce communities of undesirable plants. This needs study. Aquatic succession and its impact on fish escape habitat is a topic worth looking at in Lakelse Lake. Whether or not the macrophytes function as nutrient buffers (sinks and sources) or serve to create toxic levels in the annual cycle of decay needs to be looked at. If mechanical damage eliminates these plants, it may have far reaching impacts on the fish survival.

BIOLOGICAL CONSIDERATIONS

R. N. Nordin (August 12, 1980) states in a letter to R.J. Buchanen, Director of the Provincial Aquatic Studies Branch, that if the macrophytes enter into any consideration of the lake production, ..." they would certainly increase the estimation of lake production since the phytoplankton is so low." This comment uniquely changes the values in Lakelse Lake if found to be true. Therefore, it should be studied.

When aquatic plants enter the winter, the summers growth dies back. This decomposes with the help of bacterial action and forms detritus. Detritus in turn forms the basis of a whole food chain for invertbrate production and eventually fish production since they feed on these same invertebrates.

If such a detritus based food chain is present, then fish rearing habitat will hinge on the health of these reed and other macrophyte beds. This should be looked at by a Fisheries Ecologist.

If the beaver swamps are trapping large amounts of drainage P, then when these decline over the roation of the forest as they invariably due because of loss of browse species, then perhaps this phosphorous will damage Lakelse Lake.

CONCLUSION

Various methods of assessing the lake's carrying capacity yield the following summary findings. The BLM=.5(CAPY), SDM = 1.253(CAPY), CLAM = .48(CAPY), MOPM = 9.4(CAPY)(these are read as Method = we are at x% ~~of the~~ times true carrying capacity). If one multiplies all of the factors together, then one finds out the overall prediction of how we rate with carrying capacity. It is briefly, .5(1.235)(.48)(9.4)= 2.78 times the carrying capacity currently, exclusive of biotic factors.

Averaging them yilds a similar conclusion.

MANAGEMENT IMPLICATIONS FOR LAKELSE LAKE

1. Any potentially impacting development should include an impact study of the proposal on water quality, macrophyte community and fish rearing habitat- by all potential impact pathways.

2. Single cottage units and developed foreshore already appear in excess by a number of criteria and thus backfilling should be considered with land disposal systems.

3. In lieu of studies of the values of macrophytes, the areas currently undeveloped should have closures to further dock construction.

4. Studies of the value of macrophyte communities as a nutrient source and sink are needed.

5. Fry and other fish survival in and out of the reed beds are needed to determine the relative values of these to the fishery.

6. Mechanical impacts on macrophytes and total production studies are needed.

7. The analytical methods used in this article need further testing and refinement.

8. A maximum acres/boat and maximum percent shoreline allowable development should be chosen by the Regional District and then strictly adhered to.

9. Sewage removal by trucking ~~and cottage development by backfilling should be studied as methods of increasing the areas future carrying capacity.~~

Province of British Columbia

Ministry of Environment

Fish and Wildlife Branch
4825 Keith Avenue
Terrace, B. C. V8G 1K7

638-0212

YOUR FILE Khyex to Tyee Hwy. Re-alignment
OUR FILE 0458

April 21, 1982.

Al Edie,
REgional Habitat Protection Bio.,
Fish and Wildlife Branch,
Bag 5,000,
Smithers, B. C.

Al:

Re: Khyex to Tyee Hwys. Meeting to discuss Proposed Re-alignment

I attended a meeting from 1000 - 1200 hours on the 7th April, at the highway's office here in Terrace. The purpose of the meeting was to hear multi-agency concerns for this section. In attendance were a number of representatives of Highways including David Moore, Art Beaumont and Michael Kent, who is their Environmental Coordinator. Also present were Catherine Fry sitting in for Don Tretheway of the CWS, Tim Panco of the Fisheries and Oceans, Brian Dane and myself.

CONCERNS IDENTIFIED

1. Loss of fish rearing habitat and Oulachon spawning habitat.

2. Replacement of rearing and spawning habitat with fill and a sloping rip rap bank.

3. Loss of roost trees for raptors and migrating passerines.

4. Loss of vegetation zone providing visual screening for near shore feeding waterfowl.

5. Siltation during Oulachon run covering spawn.

6. Loss of near shore sedge communities impacting Geese, Shorebirds, Mallards, Teal, Mergansers. Geese and dabblers feed on the sedge. The impact is mainly on spring and fall migrants.

7. Loss of gently sloping silt bars near shore.

8. Reduction of feeding habitat for migrant Laridae. (Gulls)

/2..

ACTION OUTLINED

1. Fisheries and Oceans indicated that their policy would be 'NO NET LOSS OF HABITAT'. To this end, area lost would be determined from air photos and mitigation measures implemented to recover lost habitat.

2. I suggest minimal disturbance of existing roosting and visual screening vegetation and revegetation on the embankments.

3. Where possible, with groins or recreational pushouts, re-create bars for natural re-vegetation.

4. Timing constraints during the Oulachon run and spawning period.

5. Where mitigation is indicated, but not possible, might I suggest a transfer of the amount of money that would provide that habitat in another location, be made to the newly created Provincial Habitat Fund (with earmarking for similar habitat development or acquisition)?

DISCUSSION

I feel that the development can be carried out in a relatively non-impacting manner if proper attention is given to timing and replacement habitat. The Branch has concerns with practically every aspect of the proposal due to the diversity of species using the area and the unique availability of the habitats at critical times of the year ie. early spring and late fall. However, during the construction, migrant waterfowl will lose the use of the site to some degree. Severe weather may aggravate this impact resulting in reduced survivorship. We can probably accept this if a firm committment is made regarding the replacement aspect. Alternately, we might monitor the quantity and quality of other local habitats regarding vegetation availability during the critical periods and alter construction timing only if a definite period of need is shown to exist. This would be difficult from a construction logistics point of view however. Another loss will be the loss, during construction, of the fish rearing and Oulachon spawning habitat. This is unavoidable unless pre-development alternate habitat is created (not very likely).

CONCLUSION

The concerns of the Fish and Wildlife Branch should be adequately addressed if we:

(a) Support the NO NET LOSS policy.
(b) Obtain a post-construction RECLAMATION AGREEMENT.
(c) Support Fisheries and Oceans SPRING TIMING CONSTRAINTS.
(d) Provide expertise on TERRESTRIAL and AQUATIC INTERTIDAL REVEGETATION.
(e) Carry out periodic field inspections.

Yours truly,

J. Jyrkkanen,
Habitat Protection Technician.

For the Regional Manager.

JJ/rgw
c.c. Cathy Stuart, Habitat Protection Division, 810 Blanshard Street, Victoria, B. C. V8V 1X5

Dr. R. J. Buchanen, Director, Aquatic Studies Branch, 765 and 777 Broughton Street, Victoria, B. C. V8V 1X5

Province of British Columbia

Ministry of Environment

FISH AND WILDLIFE BRANCH
4825 Keith Avenue
Terrace, B. C.

YOUR FILE CIPA 5 Year Development Plan/Scotia River
OUR FILE CIPA

April 26, 1982.

Al Edie,
Regional Habitat Protection Biologist,
Fish and Wildlife Branch,
Bag 5,000,
Smithers, B. C.

Al:

Re: CIPA's Modified 5 Year Plan

I attended a meeting to review CIPA's new Five Year Development Plan It was held in the Forestry Conference room in Rupert and in attendence were: John Hipp, Randy Nelson(Federal Fisheries), Tony Wideski, Paavo Pirtikoski, Ray Kabool, Al Murdoch (BCFS) and myself (J. Jyrkkanen). We discussed the Development Plan in Principle only at this point in time.

Al Murdoch asked if I would agree to abide by Fisheries and Oceans concerns and suggestions. At the time I thought this would protect our interests but it occurs to me that perhaps I was hasty in replying. The reason is that we do have trout using tributary streams which salmon do not use. Craig reported cutthroats in the system. This means that we will have concerns for water quality in the fish bearing streams.

This system should stay fairly clean through development since road material is very clean and acts as a good uphill filter. Timber is also generally windfirm. Thus, filter strips should do their job. However, the gradient is steep and thus run-off is flashy meaning that we should perhaps concern ourself with total amount of cut, particularily to protect stream bed integrity during storms. This could perhaps be accomplished in part by breaking up the harvest of one large block on the east side of the river, into two cuts separated by several years.

I would like to inspect two settings along the river which are potential brush sites, and perhaps we could discuss follow-up treatment. No herbicides are anticipated in this drainage and Al indicates that Hot planting will be done.

The Development Plan seems acceptable if these concerns are addressed. I don't think that we will be requesting many constraints on top of the Fisheries and Oceans, but it seems wise to continue joint site inspections.

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Yours truly,

J. Jyrkkanen,
Habitat Protection Technician.

For the Regional Manager.

JJ/rgw
c.c. Al Murdoch, Asst. Timber Sup., North Coast Forest District, 125 Market Place, Prince Rupert, B. C. V8J 1B9

John Hipp, Federal Fisheries and Oceans, 4721 B. Lazelle Avenue, Terrace, B. C.

Lakelse Community Association

RR#4, Site 9, Comp. 10,
Terrace, British Colombia,V8G 4V2
Tel. (250) 798 2524
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January 29, 2001

Honourable Ian Waddell
Minister of Environment, Lands and Parks
PO Box 9047 STN PROV GOVT
Victoria BC V8W 9E2

Dear Mr. Minister:

The Lakelse Lake and watershed of Northwestern British Columbia is one of the fairest and most productive fresh water salmonid systems in the Skeena area and is renowned in Canada. In the past, salmon eggs from the area have been used to restock the famous Adams River system after the devastating slide which blocked the Fraser River. We are proud and protective of this jewel in the ecosystem and, as such, wish to draw your attention to an invasive, non indigenous weed of concern which has been quickly establishing itself in this lake.

As a Community Association, we are concerned not only about the damage to the recreational aspects of the lake, but also the fisheries habitat which, if not being destroyed, is being dramatically altered.

We would like you to have your officials look into this on behalf of all Canadians.

Sincerely,

Shirley Kimery
Secretary - Director
Lakelse Community Association

BRITISH COLUMBIA

March 2, 2001 Our File: 34560-25/Lakelse Lk.

Shirley Kimery
Secretary/Director
Lakelse Community Association
RR#4, Site 9, Comp. 10
Terrace, BC V8G 4V2

Dear Shirley Kimery :

The Honourable Ian Waddell, Minister of Environment, Lands and Parks, has asked me to respond to your letter of January 29, 2001, regarding an invasive weed in Lakelse Lake.

I agree that Lakelse Lake is a very important area for fish, as well as wildlife. Introduced weeds can threaten the conservation and recreational values of lakes. Alternatively, native weeds are responsible for much of the insect production that fish in Lakelse Lake depend on. Lakes gradually increase the abundance of weeds through the process of eutrophication (enrichment). Human caused introduction of nutrients and other factors can enhance this process.

Experts identified the samples collected by BC Parks in the summer 2000 as a native aquatic plant, Elodea canadensis. They checked distribution records and while Lakelse Lake is within the accepted known distribution, there has been no recorded collection from Lakelse Lake until fall 1999 when residents collected some from the boat launch. We are uncertain whether humans or wildlife transported it there. This is most likely the plant that you refer to in your letter.

The Regional District of Kitimat Stikine is coordinating a process to address water quality. BC Parks will work with the community to understand concerns relating to aquatic plants and to determine appropriate management options for the park and the rest of the lake residents.

Expansion of aquatic plant growth in lakes is a complex problem that has no simple solution. This ministry will not undertake aquatic plant control because of the expense and the limited chances of success. Temporary measures such as the annual mechanical harvesting of aquatic plants from Lake Kathlyn can offer some improvement from a recreational perspective, however, this would only be permitted after careful consideration by government agencies. If you require further information, please contact Brian Fuhr, Regional Habitat Section Head, at 847-7288 or the BC Parks at 798-2277.

Sincerely,

Jim R. Yardley
Regional Director

cc: Hugh Markides, District Manager, BC Parks
Brian Fuhr, Regional Habitat Section Head, BC Environment

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